



NYSERDA

**Department of
Transportation**

Advancing Smart Card and NFC Technologies at the Buffalo Niagara Medical Campus

Final Report



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Abstract

Buffalo Niagara Medical Campus, Inc. was awarded a cost-shared research agreement to conduct a Feasibility Study and Pilot Program aiming to create a transportation system that utilizes existing smart card and near field communications (NFC) technology to integrate access to bus, rail, carsharing, bikesharing, secure bicycle parking, shuttles and vehicular parking. In doing so, the Project Team aimed to streamline the alternative commuting process, therefore increasing alternative transportation use and decreasing campus parking demand, traffic congestion, and associated greenhouse gas emissions. The Feasibility Study identified existing technology that could be utilized to create one ID card and associated account management system that allowed a cardholder to gain access to and in some instances pay for various transportation services. The Project Team is currently implementing the program with expected completion by the end of 2017.

Keywords

Account Based System
Contactless Smart Card
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Single-Sign-On
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Table of Contents

Notice	ii
NYSDOT Disclaimer	ii
Abstract	iv
Keywords	iv
List of Figures	vi
Acronyms and Abbreviations	vii
Executive Summary	ES-1
1 Introduction	1
1.1 Project Background.....	2
1.2 Project Tasks Overview.....	4
1.2.1 Task 1: Project Management.....	4
1.2.2 Task 2: Exploration and Planning.....	5
1.2.3 Task 3: Development and Implementation.....	5
1.2.4 Task 4: Evaluation.....	5
2 Research Method	6
2.1 Exploration and Planning.....	6
2.2 Consultant Selection and Subcontracts.....	7
2.3 Feasibility Study Scope of Work Overview.....	8
3 Feasibility Study Findings and Conclusions	10
3.1 Summary of Analysis and Recommendations.....	10
3.2 Transportation Services Analysis and Recommendations.....	13
3.2.1 NFTA Metro Rail and Bus.....	13
3.2.1.1 Analysis.....	14
3.2.1.2 Recommendations.....	14
3.2.2 University at Buffalo Shuttle System.....	15
3.2.2.1 Analysis.....	16
3.2.2.2 Recommendations.....	16
3.2.3 Buffalo CarShare.....	16
3.2.3.1 Analysis.....	17
3.2.3.2 Recommendations.....	17
3.2.4 REDDY BikeShare/Social Bicycles.....	18
3.2.4.1 Analysis.....	19
3.2.4.2 Recommendations.....	19

3.2.5	Secure Bicycle Parking	19
3.2.5.1	Analysis	20
3.2.5.2	Recommendations	20
3.2.6	BNMC Vehicular Parking	20
3.2.6.1	Analysis	21
3.2.6.2	Recommendations	21
3.2.7	511NY RideShare	21
3.2.7.1	Analysis	22
3.2.7.2	Recommendations	23
3.3	Management and Backend Operation System	23
4	Statement on Implementation	25
4.1	BNMC and UB Partnership Scope of Work	25
4.1.1	Scope of Work.....	26
5	Conclusion	34
Appendix A: BNMC Smart Card Request for Information		A-1
Appendix B: BNMC Smart Card Study Request for Proposals.....		B-1
Appendix C BNMC Smart Card Feasibility Study		C-1
Appendix D: Description of Relevant CBORD Systems		D-1

List of Figures

Figure 1. System compatibility with proposed GO CARD.	11
Figure 2. Backend system diagram.....	13
Figure 3. NFTA Metro Rail Station on the Medical Campus.	13
Figure 4. The UB Blue Line Shuttle.....	15
Figure 5. Buffalo CarShare on the Medical Campus.....	17
Figure 6. A REDDY hub at BNMC.....	18
Figure 7. BNMC secure bicycle parking example.	20
Figure 8. 511NY RideShare user interface example.	22
Figure 9. Overview of backend system in relation to UB's existing system.....	27

Acronyms and Abbreviations

ABS – Account Based System

BNMC – Buffalo Niagara Medical Campus, Inc.

DOT – New York State Department of Transportation

GHG – Greenhouse Gas Emissions

NFC – Near Field Communications

NYSERDA – New York State Energy Research and Development Authority

RPCI – Roswell Park Cancer Institute

UB – University at Buffalo

Executive Summary

In 2013, Buffalo Niagara Medical Campus in Buffalo, NY (BNMC) was awarded a cost-shared research agreement (30901) from NYSERDA and the DOT to conduct a Feasibility Study and Pilot Program aimed at creating an integrated transportation system for an employee to access and pay for a multitude of transportation options available to them on the BNMC. The timing of the project came at a critical juncture as many local transportation service providers were in the process of exploring the feasibility of upgrading the hardware and software technology, presenting a proactive opportunity to set the stage for widespread integration. By creating an integrated system, project partners hoped to streamline the commuting process and encourage employees to utilize alternative transportation options, therefore helping reduce parking demand, traffic congestion, and associated greenhouse gas emissions.

S.1 Research Findings and Conclusions

The BNMC TMA, comprised of BNMC member institutions and several transportation agencies located in Western New York, released a Request for Proposals to perform a Feasibility Study on opportunities and limitations of created an integrated system. Together with the Project Management Team and selected Feasibility Study consultants, the team gathered pertinent data from the stakeholders and came up with a set of recommendations on the best path forward for creating an integrated system:

- Create a new multiuse transportation card compatible with transportation service provider systems. Ensure that service providers upgrade to fare collection and access control systems compatible with this card. This GO CARD is intended for interested employees who utilize alternative transportation services. The GO CARD would need to be ISO 14443 compatible and include MIFARE DESFire EV1 technology. A complementary mobile ID could also be created using this technology.
- Utilize the University at Buffalo's (UB) existing campus cash program as the GO CARD's account management system. The GO CARD would have an account based system to manage access permissions and payments. CBORD – the system utilized by UB – was identified as an ABS that can meet the projects goals. CBORD acts as a user profile with a prepaid debit account that allows a user to put money into this account for use at participating vendors. CBORD also has single sign-on integration capabilities, which would allow this central account to link to service provider accounts so funds for these services are stored in one account, and these services can be accessed from one location, or “portal.” The portal would be located on www.gobnmc.org and allow a user to:
 - Request a GO CARD / Add funds to GO CARD account.
 - Activate card for access to NFTA services / pay for NFTA services.
 - Activate card for access to UB Shuttle services.

- Activate card for access to CarShare / access CarShare account / pay for CarShare usage.
- Activate card for access to REDDY BikeShare / access BikeShare account / pay for BikeShare usage.
- Activate card for access to secure bike parking / pay for secure bike parking.
- Sign up for 511NY RideShare / access 511NY RideShare account
- Sign up for additional BNMC TDM programs.

S.2 Implementation

Following the completion of the Feasibility Study, BNMC, and UB entered into agreement to create the integrated transportation system. The majority of the system is expected to be completed by the end of 2017. Upon completion of the project, UB and BNMC's ID card and account management systems will allow students, faculty, staff and BNMC employees to use their ID card and affiliated account to gain access to, and in some instances pay for:

- Vehicular parking on the Buffalo Niagara Medical Campus.
- Secure bicycle parking on the Buffalo Niagara Medical Campus.
- UB shuttles.
- Social Bicycles/REDDY BikeShare.
- NFTA Metro Rail & Bus.
- 511NY RideShare Matching services (online).
- UBER.

1 Introduction

In 2013, Buffalo Niagara Medical Campus in Buffalo, NY (BNMC) was awarded a cost-shared research agreement (30901) from NYSERDA and the DOT to conduct a Feasibility Study and Pilot Program that aimed to create an integrated transportation system in which an employee can access and pay for a multitude of transportation options available to them on the. At the beginning of the project, these transportation options included:

- Vehicular parking on the BNMC.
- Secure & indoor bicycle parking on the Buffalo Niagara Medical Campus.
- University at Buffalo's student and employee shuttle system.
- Social Bicycles' bikesharing system (now called REDDY BikeShare).
- Buffalo CarShare vehicles.
- NFTA Metro Rail and Bus services.
- 511NY Rideshare Matching services (online).

An additional objective of the project was to determine if and how such an integrated transportation system could incentivize the use of alternative transportation options through the streamlining of associated services and the development of an incentive/reward program based on alternative transportation usage in partnership with local vendors. Expected benefits of this integrated program included:

- An increase in employee use of alternative transportation options and associated reductions in GHG emissions, traffic congestion, and the Campus' parking demand.
- Greater coordination and collaboration between the public sector, private sector, and transportation service providers.

Furthermore, the research project aimed to identify how ID cards and access control systems for the major buildings located on the BNMC could integrate with transportation services. This would allow a student or employee to utilize their campus ID cards to access transportation services – creating an all-inclusive product that streamlines services and reduces unnecessary duplication of efforts.

1.1 Project Background

BNMC is a consortium of nine healthcare, research and educational institutions located on 120 acres in Downtown Buffalo. BNMC member institutions currently employ approximately 12,000 people on the Campus with over 1 million annual patient visits. Members include:

- Buffalo Hearing & Speech Center
- Buffalo Medical Group
- Hauptman-Woodward Medical Research Institute
- Center for Hospice and Palliative Care
- Kaleida Health
- Roswell Park Cancer Institute
- Olmsted Center for Sight
- University at Buffalo
- Upstate New York Transplant Services

The BNMC is a major urban employment center that is rapidly developing. By the end of 2017, approximately 17,000 employees will be located on the Campus due to current capital projects, and there are numerous additional projects moving out of the planning stage that will bring more employees.

In 2010, BNMC representatives with consultants Howard/Stein-Hudson conducted the *BNMC Comprehensive Transportation Study*, which yielded a series of recommendations regarding the development of Travel Demand Management (TDM) strategies on the Campus. The Study made clear that in order to absorb the amount of planned development on the Campus without serious traffic congestion and parking issues (as well as significant increases in GHG emissions), the BNMC must implement a system of effective strategies to promote transit, alternative modes, and ride sharing among employees.

In 2011, BNMC formed a Transportation Management Association (BNMC TMA) which works to advance TDM strategies on the Campus and demonstrate the effectiveness of TDM strategies in reducing the number of vehicles traveled, enhancing alternative transportation options, and increasing the mobility of employees and neighborhood residents. The TMA is comprised of representatives from:

- BNMC and its member institutions
- NFTA
- Greater Buffalo Niagara Regional Transportation Council
- NYSEERDA
- DOT
- GObike Buffalo
- Shared Mobility, Inc. (including Buffalo CarShare and REDDY BikeShare)
- City of Buffalo.

While the BNMC TMA implemented several TDM programs over the years, and with a significant decrease in single-occupant-vehicle (SOV) commuting, there remains a need to make alternative transportation options more accessible and desirable to employees. Currently, different methods of payment and access controls are often required for various modes of transportation, such as varying financial accounts, key fobs, and swipe cards. Consequently, it was desired to streamline the commuter process for employees to a single card or mobile application, which would improve ease of use and provide greater access to and flexibility among a multitude of transportation and parking options and programs available on and surrounding the Campus.

Mass transit agencies worldwide have stored value prepaid cards for electronic ticketing since the 1970s. Through the 1990s, this market steadily began transitioning from magnetic stripe technology to contactless smart cards. Today, major deployments of contactless smart cards as the primary ticket medium for transit are already operational in cities around the world. In 2011, the Pittsburgh Port Authority moved to smart cards, introducing the Connect Card, with the University of Pittsburgh as its first group of users.

Through a fully collaborative effort, the BNMC TMA aimed to further advance this existing technology – which is currently underutilized in New York State – towards the integration of transit with other access and mobility services in the City of Buffalo.

The timing of the project came at a critical juncture as new transportation services and new accompanying payment and access control systems were designed and implemented in Buffalo. Because of this, the BNMC TMA found it necessary for stakeholders to begin considering, exploring, planning and testing interoperable systems now in order to develop an integrated, multi-modal transportation network for the future. This proactive approach was aimed at developing systems that will work within a larger framework and remain compatible with one another.

Examples of partner initiatives taking place at the beginning of the project regarding fare collection and access controls included:

- Campus Shared Corridor Planning: BNMC member institutions are developing pedestrian connections between Campus buildings and the new NFTA Metro Rail Station located on the Campus. These pedestrian bridges and tunnels require an upgrade of access control systems or ID card technology used by BNMC member institutions.
- NFTA Fare Collection System Replacement: NFTA is replacing the fare collection system for all bus and rail operations with an account based cashless system utilizing smart cards and mobile applications. Full system replacement is expected by the end of 2017.
- University at Buffalo Shuttle Access Controls: UB is upgrading their student and employee ID card technology to a smart card and mobile application: This work includes replacing their shuttle system's access control technology with updated hardware and software as well.
- Buffalo CarShare Fleet Expansion: BCS (now Shared Mobility Inc.) looked to expand their fleet to include electric vehicles and considered an alternative to their current software and access controls.
- Social Bicycles in Buffalo: Shared Mobility also worked with Social Bicycles out of Brooklyn, NY to launch an innovative bicycle sharing program in Buffalo, with the BNMC as a major sponsor. Social Bicycles was in the process of upgrading their hardware and software to include compatibility with smart card and mobile application technology.
- New Secure Bike Parking Facilities: BNMC and GOBike Buffalo continue to provide secure bike parking facilities on the Campus, which utilize smart cards to control user access.

1.2 Project Tasks Overview

The cost-shared research agreement included BNMC as the contractor performing the following tasks to achieve the project's objectives.

1.2.1 Task 1: Project Management

- Submission of quarterly progress reports to NYSERDA Project Manager.
- Submission of SPR Quarterly Status Reports to DOT Project.
- Hold a project kick-off meeting with all stakeholders as well as periodic meetings as necessary.
- Identify contractor personnel involved in project.
- Enter into subcontracts for technical consulting services to conduct a Feasibility Study and Implementation Plan and implement a Pilot Project.
- Create a Stakeholder Advisory Group to review progress and provide guidance throughout the course of the project.

1.2.2 Task 2: Exploration and Planning

- Establish a Project Management Team through the existing organizational structure of the TMA, including stakeholder representatives and technical subcontractors.
- Designate a Project Manager to oversee the program and organize activities of the Project Management Team.
- Conduct a Feasibility Study and Implementation Plan to examine existing options as well as current and planned uses of technology to identify the desired outcomes of each stakeholder, to identify the challenges of system integration and interoperability, and to help develop solutions to overcome potential barriers.

1.2.3 Task 3: Development and Implementation

- Work with technical consultants and stakeholders to develop a Pilot Program based on the findings of the Feasibility Study and Implementation Plan.
- Implement and monitor the Pilot Program.

1.2.4 Task 4: Evaluation

- Develop performance criteria to help examine the program's performance and effectiveness.
- Conduct evaluations by weighing the collected data and actual outcomes of the project against the performance criteria.

2 Research Method

2.1 Exploration and Planning

Upon award of this cost-shared research agreement, BNMC established a Project Management Team as a subgroup to the BNMC TMA. The Project Management Team acted as the Stakeholder Advisory Group and included representatives from:

- Buffalo Niagara Medical Campus, Inc. (project management; integration with BNMC buildings and ID cards)
William Smith, Director of Campus Access
Jamie Hamann-Burney, Project Manager
- Kaleida Health (integration with KH buildings and ID cards)
Rob Bragg, Vice President Campus Development
Paul Drabinski, Manager of Safety and Security
- Roswell Park Cancer Institute (integration with RPCI buildings and ID cards)
Harvey Strassberg, Director of Public Safety, Parking and Transportation
- University at Buffalo (integration with shuttles, UB buildings and ID cards)
Maria Wallace, Director of Parking & Transportation Services
Chris Austin, Assistant Director of Parking & Transportation Services
Sean Brodfuehrer, Architectural Planner
- GObike Buffalo (integration with secure bike parking)
Justin Booth, Executive Director
- Shared Mobility, Inc. (integration with Buffalo CarShare and REDDY BikeShare)
Michael Galligano, Executive Director
- Social Bicycles (integration with Social Bicycles)
Ryan Rzepecki, CEO
- NYSDOT 511NY Rideshare (integration with 511 NY Rideshare)
Ellwood Hanrahan, Project Manager
- NFTA (integration with Metro Rail and Bus)
Tom George, Director of Surface Transportation
Dennis Lupp, Project Manager

The Project Management Team began meeting on a consistent basis to provide guidance for the project and gather preliminary data respective to each organization's existing systems and future plans. The Team also reached out early on to the Smart Card Alliance to establish additional partnerships and gather more information on smart card technology as well as learn more about similar initiatives. The Smart Card Alliance is a not-for-profit, multi-industry association working to stimulate the understanding, adoption,

use, and widespread application of smart card technology. The Alliance is comprised of over 200 members worldwide, including participants from financial, government, enterprise, transportation, healthcare, and retail industries. The Alliance has a Transportation Council that is focused on promoting the adoption of interoperable contactless smart card payment systems for transit and other transportation services. The Council is managed by a steering committee that includes a broad spectrum of leaders from transportation and smart card industries.

Members of the Project Management Team also began meeting with various local and international providers of fare collections systems and access controls to learn more about the various systems and receive expert feedback and advisement. This initial explorative phase was crucial in getting team members familiar with the various opportunities and case studies available to them, and helping to understand the technical feasibility of system integration.

2.2 Consultant Selection and Subcontracts

On October 10, 2013, the Project Management Team issued a Request for Information (RFI) for the BNMC Smart Card study as the first major step in the consultant selection process. The goals of the RFI were:

- To gather feedback on the proposed project and gain awareness of potential costs, benefits, and risks of the project.
- To identify existing access control and fare media technologies to achieve the project objectives.
- To better understand operating opportunities and needs.
- To better understand existing system and equipment capabilities.
- To gauge the capabilities of potential consultants.
- To gather other market information for planning purposes.
- To create a shortlist of qualified candidates who would receive future Request for Proposals (RFP).

The RFI was advertised through various channels by the BNMC Project Management Team, and the Smart Card Alliance distributed the RFI to its Transportation Council members. The RFI can be viewed in **Appendix A**.

Seven organizations responded to the RFI. These organizations were:

- Cubic Transportation Systems, Inc.
- M/E Engineering, P.C.
- Johnson Controls, Inc.
- SPX Genfare
- MDU Network Installation Services, LLC
- U&S Services
- Social Bicycles

Aided by the information gathered through the responses to the RFI, the BNMC Project Management Team then crafted an actual RFP and sent it to the organizations that responded on December 4, 2013.

The RFP included a Draft Scope of Work that featured three main tasks: Stakeholder outreach and engagement; conducting a feasibility study; and developing a draft implementation plan and demonstration program. The RFP is located in Appendix B.

The Project Management Team received three responses to the RFP, and each respondent met with the Team to discuss the RFP. The Project Management Team was asked to review and rate each proposal based on a RFP selection criteria sheet created by BNMC.

Based on the ratings and the overall quality of the response, BNMC entered into contract with M/E Engineering and U&S Services – who partnered together on the response – to conduct the Feasibility Study.

2.3 Feasibility Study Scope of Work Overview

The Scope of work for the Feasibility Study included:

- Task 1. Project Initiation Meeting and Stakeholder Engagement Meetings
- Task 2. Feasibility Study Report, including:
 - Descriptions of existing systems for each stakeholder.
 - Narrative of design parameters and vision for existing, planned and future systems.
 - Analysis and evaluation of existing and future access control and fare vending systems.
 - Analysis and evaluation of preferred management backend operation and accounts management system for users.

- Identify loyalty program opportunities.
- Overview of system requirements with consideration for future growth.
- Recommendations of design concepts with appropriate implementation options.
- Engineer's opinion on probable construction costs.

The BNMC TMA held a consultant kick-off meeting with M/E and U&S and all project stakeholders on February 26, 2014. The agenda for the meeting was as follows:

1. Stakeholder and Consultant Introductions.
2. Review Project Goals and Objectives
3. Review Project Scope of Work.
4. Review Project Schedule.
5. Discussion/Next Steps.

Following the kick-off meeting, the Project Managers and the consultant team met with each stakeholder organization individually to gather the data necessary to conduct the Feasibility Study. The Project Managers and consultant team created a preliminary online survey that was sent to stakeholders prior to the meetings to begin gathering this data. Additionally, the consultant team collected existing access cards or key fobs from each stakeholder organization so they could begin identifying the ability of these existing cards/fobs to meet the project's goals. The agendas for each stakeholder meeting included:

1. Survey Follow-Up Questions.
2. Stakeholder's Existing and Future Plans for their Access Control System.
3. Stakeholder's Vision/Needs for the BNMC Smart Card Project.
4. Feasibility Study Next Steps.

3 Feasibility Study Findings and Conclusions

The intent of the Feasibility Study was to identify if and how an integrated access control and fare vending system can be created on the Buffalo Niagara Medical Campus in which a single smart card could access a wide array of transportation services and secured Campus facilities. This smart card would access NFTA Metro Rail and Bus Services, UB Shuttle services, Buffalo CarShare vehicles, Social Bicycles bikes, secure bike parking facilities, vehicular parking, and shared public corridors that create indoor connections between Campus buildings. The Study also looked into a loyalty/rewards program for smart card users, but did not seek to replace the existing access control systems of the Campus Member Institutions.

3.1 Summary of Analysis and Recommendations

The study first analyzed existing cards and access systems for the stakeholder institutions (BNMC, Kaleida Health, RPCI, and UB) to see if the existing systems were compatible with one another and with the transportation service provider systems. The study found that these systems were NOT compatible, therefore, the institutions would have to replace their entire access control systems with a new system. Other key findings included:

- Card technology and associated hardware varied between each service provider and were not compatible with one another. The service providers would need to move toward a mutual card technology and upgrade their hardware accordingly.
- The service providers had varying payment collection systems and policies that limited integration potential. Many providers require their own account management systems to track member usage and conduct transactions. However, a new centralized account management system could be created that links to each individual account management system through single-sign-on (SSO) functions, therefore providing a user with the option to access various services through one central account system with one username and password. However, there was not a common compatible SSO technology across the different systems, meaning it may require significant back-end upgrades to connect to the many account systems.
- UB currently uses an account based system (ABS) for their campus cash program that could be utilized for the purposes of this project instead of developing a new and costly alternative.

Therefore, the study recommended:

- **Creating a new multi-use transportation card compatible with the transportation service provider systems.** This would allow the institutions to keep their existing access systems, which would be too expensive to replace. However, the institutions could replace their systems with a system that is compatible over time. This secondary GO CARD would be given to interested employees who utilize these transportation services. The GO CARD could have multiple technologies present, require ISO 14443 compatibility, and have the following components:
 - MIFARE DESFire EV1/EV2 (required): This technology would make the card compatible with the proposed NFTA, UB ABS and UB Shuttles, CarShare, BikeShare, and bike parking facility systems.
 - Magnetic Stripe (optional): This technology would make the card compatible with loyalty/reward programs – although UB operates a campus cash program that will switch to MIFARE DESFire EV1 cards that associated vendors can accept.
 - 125 kHz Proximity (optional): This technology would make the card compatible with BNMC, Inc. and Kaleida Health’s existing access control systems. Therefore, these two organizations could replace their existing cards with the proposed GO CARD so that employees only need one card to access these services and facilities.

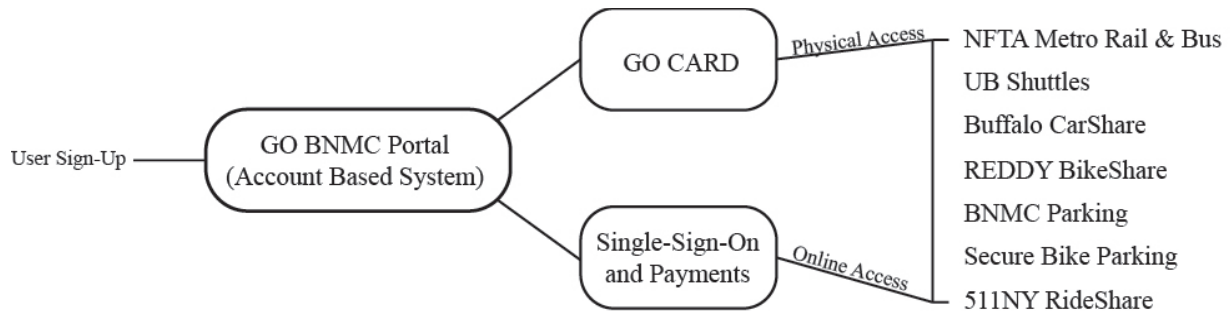
UB is also in the process of upgrading their ID cards to MIFARE DESFire EV1, creating the opportunity for a partnership between UB and BNMC.

Figure 1. System compatibility with proposed GO CARD.

		Stakeholder Cards				
		Proposed GO CARD	BNMC Facility Card	RPCI Facility Card	Kaleida Facility Card	Proposed UB Card
Stakeholder Access Readers/Fare Collection Systems	BNMC Facility Access Readers	✓	✓			
	RPCI Facility Access Readers			✓		
	Kaleida Facility Access Readers	✓			✓	
	UB Facility Access Readers	✓				✓
	Proposed Shared Corridor Access Readers	✓	✓	✓	✓	✓
	Proposed NFTA Fare Collection System	✓				✓
	Proposed CarShare Access System	✓				✓
	Proposed BikeShare Access System	✓				✓
	Proposed UB Shuttle Access System	✓				✓
	Proposed Bike Storage Facility Access Readers	✓	✓	✓	✓	✓

- **Utilize UB’s campus cash system as the GO CARD’s account management system.** The GO CARD would need an account based system to manage access permissions and payments. This ABS would manage transactions and access permissions between BNMC, the GO CARD user, and the transportation service provider. UB’s campus cash system – provided by CBORD – was identified as an ABS that meets the project’s goals, and the technology is currently used by many colleges to manage student and employee card accounts. The campus cash system acts as a user profile with a prepaid debit account that allows a user to put money in this account to use at participating vendors. The system also has SSO and integration capabilities that allows this account to link to service provider accounts so funds for these services are stored in one location, and services are accessed from one location, or online “portal.” While there would be a centralized portal, each service provider could still control their own separate user account management systems. The portal could be located on BNMC’s TDM website www.gobnmc.org and would allow the user to:
 - Request a GO CARD / Add funds to GO CARD account.
 - Activate card for access to NFTA services / pay for NFTA services.
 - Activate card for access to UB Shuttle services.
 - Activate card for access to CarShare / access CarShare account / pay for CarShare usage.
 - Activate card for access to REDDY BikeShare / access BikeShare account / pay for BikeShare usage.
 - Activate card for access to secure bike parking / pay for secure bike parking.
 - Sign up for 511NY RideShare / access 511NY RideShare account
 - Sign up for additional BNMC TDM programs.
- **Utilize the proposed account management system for a rewards/loyalty program.** UB’s campus cash program allows students and faculty to purchase goods and services, at a discounted rate, from participating vendors using their UB ID card and associated financial account. This could act as a rewards program for alternative transportation users.
- **Install multi-format card readers in shared corridors and secure bike parking facilities.** Because each stakeholder has a unique access control system for their facilities, and it would be cost-prohibitive or infeasible due to security measures to replace all controls with a unified system, it was recommended that all stakeholders replace existing card readers or provide new card readers at all shared corridor entrance points. These updated card readers would be multi-technology and multi-format so that they are compatible with all existing cards, as well as the proposed GO CARD. The card readers would output serial communications in Wiegand or RS-485 format protocol in order to interface with most of the existing stakeholder access control systems. The backend system for the shared corridors would enable multiple stakeholders to have the ability to verify permission of the user and unlock doors. The local control system would communicate out to the appropriate stakeholder database, validate the user access permission, respond back to the local panel, and unlock the entrance. Each stakeholder would control their own employee access database, and BNMC would control access to the secure bicycle parking facilities.

Figure 2. Backend system diagram.



3.2 Transportation Services Analysis and Recommendations

3.2.1 NFTA Metro Rail and Bus

The NFTA will be upgrading their fare collection system in the near future. The Feasibility Study looked to see how third-party cards will be compatible with this system so that an integrated transportation system can allow a user to have one card to gain access to and pay for various transportation services.

Figure 3. NFTA Metro Rail Station on the Medical Campus.



3.2.1.1 Analysis

The NFTA's new fare collection system will be compatible with cards issued by the NFTA and other stakeholders. The third-party cards will require registration and set up on an account based system with validation in real time.

The new card readers will be smart card compatible and able to accept:

- MIFARE DESFire EV1
- HID iClass Prox
- Magnetic Stripe
- Cash
- Coins/Tokens

Third-party cards will also need ISO 14443 compliancy. Any card that meets these requirements can be used with the new NFTA system.

The new NFTA system is an account based system; which is pay-per-use as long as the card has a stored value account in the NFTA database and linked to an auto-load. Third-party cards cannot be used as a "credit" token, whereby the money is sent to the agency post travel by the user.

Third-party cards would need backend registration and then placed on a list given to the NFTA by the third party so the user can ride any form of NFTA transportation that the account is authorized.

3.2.1.2 Recommendations

The new GO CARD with MIFARE DESFire EV1 technology would be compatible with the new NFTA fare vending system.

A BNMC user would create a GO CARD account via www.gobnmc.org. Once the account is created, the user would request a GO CARD, which can then be activated for use on NFTA Metro Rail and Bus services. If accepted, BNMC would provide NFTA with the GO CARD's ID number so the NFTA can white list the card for access to their services. The user (or the user's employer via pre-tax payroll deduction) would deposit funds into the GO CARD account. As a third-party provider, BNMC would have to bill the user based on usage on a recurring basis, and transfer those funds to NFTA on behalf of

the user. The NFTA would invoice BNMC on a recurring basis the charges incurred by individuals participating in the GO CARD program. The NFTA backend system will not allow the user to transfer funds directly to the NFTA – funds have to be given to the NFTA by BNMC. BNMC would white list users based on their ability to make monthly payments to BNMC.

BNMC and NFTA would work together to:

- Develop white list for card acceptance on board NFTA Metro Rail and Bus.
- Develop payment collection system from GO CARD users and invoicing system to transfer funds from BNMC to NFTA based on usage.

3.2.2 University at Buffalo Shuttle System

The University at Buffalo currently operates three different shuttle services: The UB Stampede is a series of buses connect the University's North Campus to its South Campus. The UB Blue Line is a series of shuttles that connect its South Campus to the BNMC. The Wave Shuttle is a circulator that takes employees and visitors to various locations on the BNMC. The Stampede currently has access readers installed on their buses, while the Blue Line and Wave do not. The Feasibility Study looked to see if Stampede Shuttle access readers are, or can be, compatible with the proposed GO CARD and what access control system should be installed on the UB Blue Line and Wave Shuttles so the GO CARDS can use them.

Figure 4. The UB Blue Line Shuttle.



3.2.2.1 Analysis

The Stampede Shuttles use the Pasio Smart Track System to authenticate ID cards. This system is not a “real time/on-line” system and credit cards are not accepted. The Blue and Wave Shuttles do not have access systems at this time.

Each Stampede shuttle bus is equipped with an on-board database that verifies if an ID card is a valid rider. This database is upgraded nightly via a download.

The current Pasio system can accept two technologies:

- Magnetic Stripe
- Proximity Card

3.2.2.2 Recommendations

Provide new card readers on Blue and Wave Lines that are multi-technology, multi-format type that would be able to read MIFARE and magnetic stripe cards meeting standards ISO 14443. The UB Stampede access controls should also be upgraded in anticipation of UB switching to MIFARE DESFire EV1 cards.

BNMC shall create, via a backend operation, a link with the UB Shuttle database that validates and registers GO CARD users. These valid users would be downloaded to the local databases. A GO CARD user would create a GO CARD account via www.gobnmc.org and ask for permission to ride UB Shuttles. If permission was granted, BNMC would provide the user’s ID card number to UB who would allow that number to access the shuttles.

BNMC and UB would work together to:

- Develop white list system for card acceptance onboard UB Shuttles.

3.2.3 Buffalo CarShare

Buffalo CarShare’s access system was not compatible with third-party cards, and therefore, not compatible with an integrated transportation system that allows a user to have one card for access to various transportation services. The Feasibility Study looked into hardware and software upgrades for CarShare’s fleet to become compatible with third-party cards and account systems.

Figure 5. Buffalo CarShare on the Medical Campus.



3.2.3.1 Analysis

At the time of the study, CarShare used a proximity card (AWID 37-bit Key FOB) for access to and use of vehicles. The system was 10 years old. The associated account management system was web based and mobile friendly, but with no app – with the server located in Toronto, Canada. Credit cards were an accepted form of payment and therefore, theoretically, CarShare could be tied into the UB and GO BNMC account system.

While the system was out of date, Buffalo CarShare was exploring several systems to upgrade to including INVERS, but no time table or system was identified. INVERS software with the right reader would be compatible with the GO CARD. However, AWID FOB's used by CarShare are not directly compatible with any stakeholder's system. There are no known multi-technology cards offered by HID, AWID, or Allegion that merge AWID technology with other card technologies. The only way it appeared possible was with a multi-technology reader.

3.2.3.2 Recommendations

Option 1 – Hardware Upgrade: Until a new system would be implemented, CarShare could replace existing card readers in the dash with a multi-technology and multi-format card reader that connects to the Stakeholder's access cards. The multi-technology, multi-format card reader would read the MIFARE cards. The design make of the card reader could be: Metavera CBox Microbox on Convadis Platform.

Option 2 – Software Upgrade: Replace existing 10-year old system with the new system that is compatible with both UB and GO CARD technologies. The vending system could be upgraded to accept MIFARE DESFire EV1 third-party cards, and software could upgrade to the current version of Metavera Autovera.

A GO CARD user would create a GO CARD account and then sign up for Buffalo CarShare. If accepted, the GO CARD would be activated to allow access to CarShare vehicles. Through an SSO, the user would be able to access their CarShare account by logging into their GO BNMC account. The user would also pay for CarShare usage with their GO CARD account.

BNMC and Buffalo CarShare would work together to:

- Develop GO CARD activation system.
- Develop SSO between GO CARD account and CarShare Account.
- Develop payment transaction method between GO CARD account and CarShare payment collection system.

3.2.4 REDDY BikeShare/Social Bicycles

Social Bicycles, REDDY BikeShare’s vendor, was at the time of the study in the process of upgrading their access control system to allow MIFARE cards to be used as access keys. The Feasibility Study looked to see if third-party cards, including the proposed GO CARD, were or could be, made compatible with this proposed upgrade.

Figure 6. A REDDY hub at BNMC.



3.2.4.1 Analysis

Social Bicycles was considering upgrading their fare vending system to a MIFARE Family system. This would be a proximity card technology based system that was ISO 14443 compliant. This would also make the bicycles compatible with the proposed GO CARD.

Social Bicycles also has an online account based system and mobile application requiring customers to create a user account and pay for use through a credit card. However, third-party accounts cannot replace this Social Bicycles account.

3.2.4.2 Recommendations

The proposed GO CARD would be compatible with Social Bicycle's system upgrade because of its MIFARE technology. This would allow the GO CARD to be used as an access key for the bicycles.

A GO CARD user would create an account and then sign up for Social Bicycles. If accepted, the GO CARD user would be able to access their Social Bicycles account through an SSO by logging into their account. The user could also pay for usage through their account instead of a credit card. BNMC and Social Bicycles would work together to:

- Develop GO CARD activation system.
- Develop SSO between GO CARD account and Social Bicycles Account.
- Develop payment transaction method between GO CARD account and Social Bicycles payment collection system.

3.2.5 Secure Bicycle Parking

BNMC offers secure bicycle parking to employees on the Campus. The Feasibility Study looked at identifying the access control systems for secure bike parking complexes based on their ability to be compatible with existing institution cards and the proposed GO CARD.

Figure 7. BNMC secure bicycle parking example.



3.2.5.1 Analysis

BNMC, in partnership with GObike Buffalo, charges a nominal fee for the use of the bicycle complexes. All fees go toward supporting GObike Buffalo. BNMC would like GO CARD users to have access to the secure bike parking, and to use the account system as a form of payment.

3.2.5.2 Recommendations

BNMC could install the same access readers as proposed for the shared-corridors so as to become compatible with existing cards and the proposed GO CARD. BNMC could also deduct monthly payments from the GO CARD user's account.

3.2.6 BNMC Vehicular Parking

BNMC currently controls numerous parking lots and garages on the Campus. The Feasibility Study looked to see if the proposed GO Card could allow access to parking lots and if the account could pay for parking as well as other transportation services. BNMC also currently has an incentive program in which a registered alternative commuter is put on a parking list allowing them to park for free twice per month when they cannot utilize an alternative transportation option. The Study looked into how to conduct this program through the use of the GO CARD instead of a parking list.

3.2.6.1 Analysis

BNMC's current parking hardware and software was not compatible with any existing card or the proposed GO CARD and would need upgrading to accept these forms of access keys. Today, the parking system uses a paper magnetic stripe ticket for transient visitors and a RFID hangtag for parkers.

UB's existing campus cash account system has parking gate access functionality. However, BNMC's current vendor – Amano McGann – was not integrated into UB's campus cash system. Integration would have to occur and BNMC would have to upgrade their gate controls to become compatible with the proposed GO CARD and associated account system. The upgraded system would also allow for a set amount of free parking to take place as part of the TDM program.

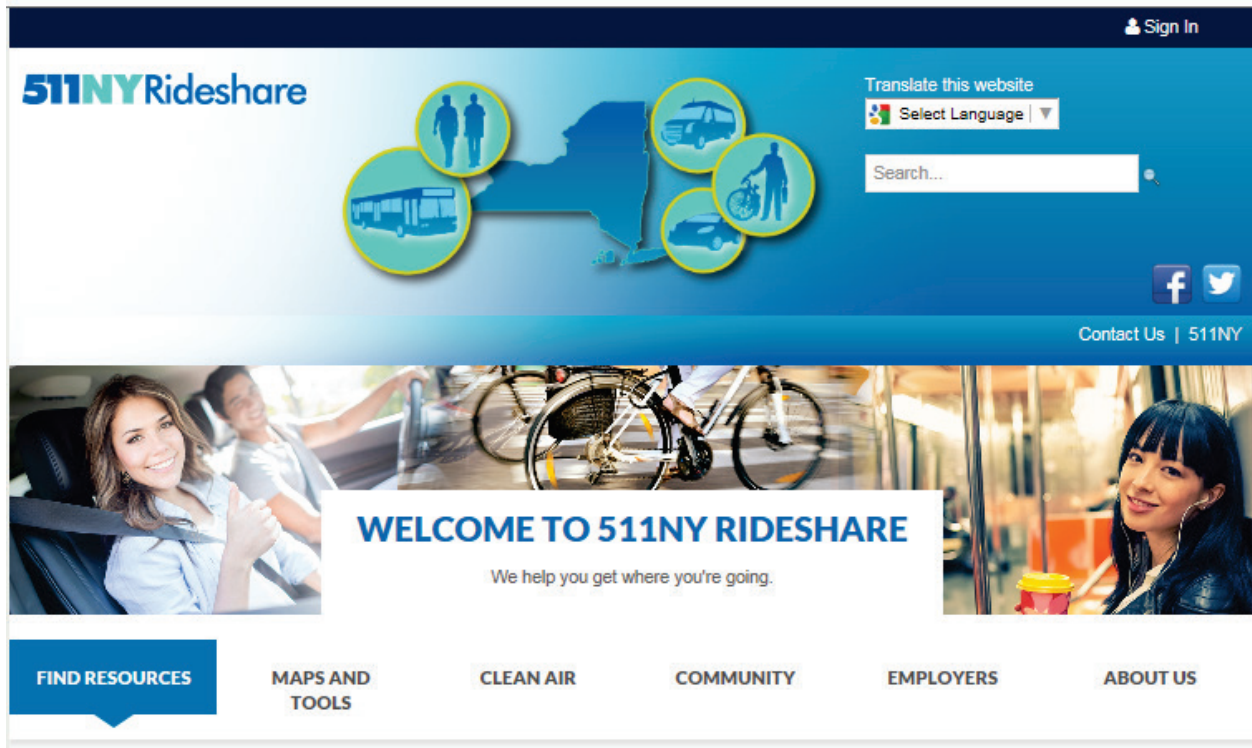
3.2.6.2 Recommendations

Amano McGann could work with CBORD on backend system integration to allow a GO CARD to be the access card and the account used to pay for parking. BNMC would also have to upgrade their gate controls to accept MIFARE DESFire EV1 cards. Furthermore, BNMC could ensure that all future RFP's for parking control systems include language stating mandatory compatibility with the proposed system.

3.2.7 511NY RideShare

BNMC currently partners with DOT to offer carpool matching services to employees through www.gobnmc.org. The Feasibility Study looked at how to better integrate the separate 511NY RideShare software into the GO BNMC website and into the proposed GO CARD account management system.

Figure 8. 511NY RideShare user interface example.



3.2.7.1 Analysis

511NY RideShare requires a user to create a separate rideshare account with its own username and password. The service is free to the user, and DOT has created SSOs in the past allowing users to log in to their account with Facebook and similar programs. However, 511NY is not integrated with CBORD, and therefore a GO CARD user would need a separate 511NY account and GO BNMC account. CBORD and 511NY both accept OAuth as a form of SSO.

The sign-up process for 511NY includes a preliminary registration where the user provides a username and password and then gets emailed with additional registration information. Developing an SSO could allow the user to skip the preliminary registration process.

3.2.7.2 Recommendations

BNMC, CBORD and 511NY should work together to create an SSO using OAuth to allow a GO CARD user access to their 511NY RideShare account using log-in information from their account. The program could be set up so when the user creates a GO CARD account, it automatically pre-registers the user for 511NY. From that point, the user could then sign in to their 511NY account without having to go through the preliminary registration process.

3.3 Management and Backend Operation System

It was desired to have a management and operating system for the smart cards, which would allow each stakeholder the ability to maintain their individual access controls, and allow users to activate an account for fare vending system platforms. The hardware and software would integrate with multiple databases and individual operating platforms of various entities to allow for flexibility and easily adjust for future changes in users, technologies, security policies, and credentialing processes.

A preferred BNMC ABS would need to be identified for the smart card services that require a fee. The BNMC ABS would allow the BNMC to manage monetary transactions between employees, employers, transportation and parking service providers, and any other potential reward program vendors.

UB currently uses a prepaid debit account, known as campus cash, that is accessible to UB students and employees with a UB ID card. The UB ID card and associated account can make purchases such as food, supplies, and gifts from numerous locations both on and off campus. Some participating companies offer additional discounts to the students through the card. The UB system is run through the IT department via the UB Faculty Student Association (FSA).

It was determined that the UB campus cash website can be duplicated and tailored for GO BNMC and incorporate transportation and parking vendors. The system is powered by CBORD with varying authentication software compatibilities. The actual server resides on UB North Campus, and has adequate capacity on the existing servers for a BNMC program to reside on. Advantages to mirroring UB's existing system include:

- Pre-populating the card database with faculty and students for testing.
- Easily tying into other Campus systems like UB Shuttles.
- UB system already has integrated numerous vendors successfully.
- UB has already developed a mobile version.
- CBORD is already integrated with additional national transportation service providers, including UBER.

The existing system would need to be expanded and integrated for fare vending services, using CBORD. The accounts management system would provide a web based system that can link to the GO BNMC site. Users could access the account system to activate and purchase fare and transportation options, activate their GO CARDS, and access separate accounts through a single username and password via SSO functionality.

4 Statement on Implementation

The Feasibility Study identified potential ways to create a comprehensive integrated transportation system while still maintaining each vendor's ability to control their own access controls and user accounts. While the steps toward integration vary between each vendor and the proposed backend system that piggybacks off of UB's campus cash program, there are three overarching elements that need to take place to create an integrated system:

- Each vendor needs the ability to accept MIFARE DESFire EV1 card technology as an access key. This would allow a user to have one ID card for all participating vendors.
- For vendors who need to maintain their own separate user account system and want to be part of the integrated system, an SSO would need to be created between the proposed GO CARD account system and the vendor account system. This would allow a user to log in to both their GO CARD account and individual vendor accounts from a single portal using a single username and password. The recommended SSO that is most compatible with UB's existing campus cash system is OAuth.
- For vendors who collect payments for the use of their transportation services and want to be part of the integrated system, the GO CARD account would need to be an accepted form of payment by the vendor. This would allow the GO CARD user to have a single transportation financial account that they can use to pay for various transportation services – including the option of having an employer deposit funds into the account on behalf of the employee as transportation benefits.

4.1 BNMC and UB Partnership Scope of Work

In January of 2015, UB and BNMC leadership agreed to partner on the development of the backend system that would allow for integration between various transportation service providers and 1) UB's existing campus cash system and 2) a similar system specifically for employees located on the Buffalo Niagara Medical Campus. Following the development of the backend system, the two organizations would then work together with the transportation service providers to integrate their services into the backend systems, and expand UB's campus cash program to the Medical Campus – including creating a rewards program through local vendor participation that aims to encourage the use of alternative transportation modes.

Upon completion of the project, UB and BNMC's ID card and account management systems will allow students, faculty, staff and BNMC employees to use their ID card and affiliated account to gain access to, and in some instances pay for:

- Vehicular parking on the Buffalo Niagara Medical Campus
- Secure bicycle parking on the Buffalo Niagara Medical Campus
- UB shuttles
- Social Bicycles/REDDY BikeShare
- NFTA Metro Rail & Bus
- 511NY RideShare Matching services (online)
- UBER

An agreed upon Scope of Work was established between UB and BNMC, and for the past two years the two organizations have worked together along with the service providers to develop the integrated system. A summary of the Scope of Work, work performed to date, and work that is still pending is provided in the next section.

4.1.1 Scope of Work

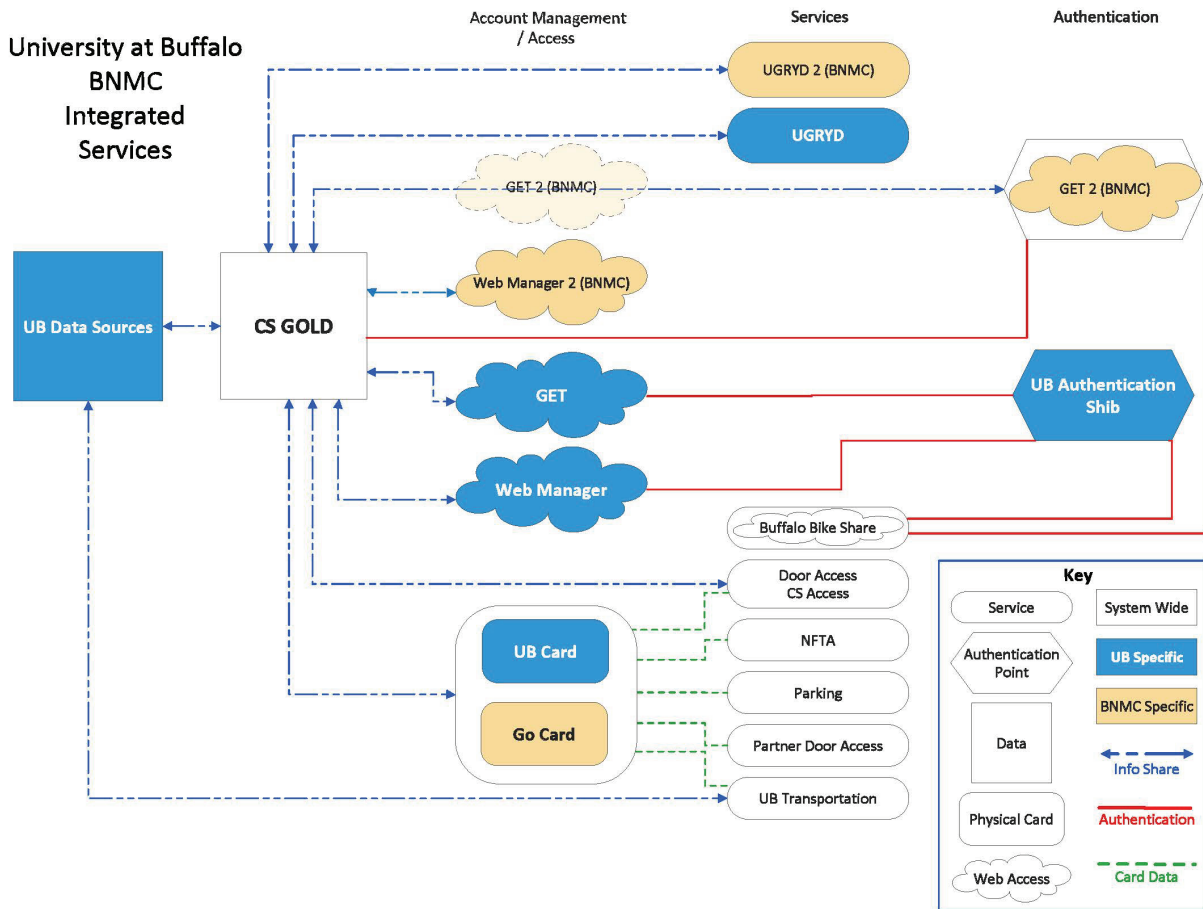
1. Develop GO CARD account management system as part of GO BNMC and update UB's account management system.

UB's campus cash program currently utilizes CBORD's CS GOLD Platform. There are three primary components of the CS GOLD Platform that make up the campus cash system:

1. CS GOLD Webmanager: the primary user interface that allows the user to manage their account, and the primary administrator tool to manage user accounts. The concept is to utilize Webmanager as the portal that allows a GO CARD user to create an account, with an assigned username and password, and access their primary account. Their primary account – through a Webmanager user interface – will allow the user to request a GO CARD, sign up for various services, and access other vendor accounts through SSO's for which they are already signed up. The Project Team worked with CBORD to customize Webmanager so it can act as a user identifier – which it previously could not, but was critical to the development of the backend system.
2. GET: the financial account based system where users deposit funds associated with an ID Card. These funds can pay for goods and services at participating vendors. GET allows a user to attach a credit/debit card to the account, perform auto load functions, and create sub-accounts when necessary where specific funding sources need separation from a general fund. For instance, a general fund can pay for goods from merchants and services like REDDY BikeShare, and a sub-account can be created for direct deposit through an NFTA pre-tax payroll deduction program.

3. **UGRYD**: the transaction system that allows funds from a GET account to transfer in real-time to a vendor. This is essential for reward programs and for when a transportation service provider can bill the user directly instead of billing the third party (BNMC or UB).

Figure 9. Overview of backend system in relation to UB's existing system



Next Steps

While these components theoretically allow for an integrated system, a great deal of customization still would have to take place. The Project Team worked with CBORD on this since UB and BNMC agreed to partner on the project. The development of the backend system – which needs to take place before any transportation service providers can integrate into the system.

Estimated Completion Date: Q1 2017

2. Identify the card technology to be used for the GO CARD.

MIFARE DESFire EV1 technology was identified as the common ID card that was most compatible with existing and future systems. Because of this project, UB has expedited their plans to replace their existing magnetic stripe ID cards with MIFARE DESFire EV1 cards, which include a mobile application version. UB has agreed to provide BNMC with MIFARE DESFire EV1 cards for use in a pilot program. These cards will also be in 125 kHz technology so they are compatible with BNMC's Innovation Center access control system.

Next Steps

Following the development of the backend system and integration with a few transportation service providers, BNMC will pilot the program out of the Innovation Center and provide Innovation Center tenants with the new ID cards.

Estimated Completion Date: Q2 2017

3. Integrate 511NY RideShare with UB and BNMC account management systems.

- Create single-sign-on functions between UB and BNMC account management systems and the 511NY RideShare program account management system.
- Update the UB and BNMC account portals to include the option to sign up for and access 511NY RideShare.

The Project Team views integration with 511NY as “low hanging fruit” to demonstrate how SSO's could work between the BNMC and UB systems and a separate vendor account system. During the development of the backend system, UB and CBORD will create the SSO using OAuth. When a user completes the registration process for a GO CARD account, they will automatically be pre-registered for 511NY. From there, a user would log in to their GO CARD account and then access their separate 511NY account without having to log in again.

Next Steps

UB, BNMC, and DOT plan to develop the SSO during the development of the backend system.

Estimated Completion Date: Q1 2017

4. Integrate secure bicycle parking facilities with UB and BNMC access card and account management systems.

- Upgrade secure bicycle parking access readers so that they accept GO CARD technology.
- Develop a payment transfer system between UB and BNMC account management systems and GOBike Buffalo’s payment collection system.
- Update the UB and BNMC account portals to include the option to sign up for secure bicycle parking.

Secure bicycle parking on the Campus can be accessed through the GO CARD and paid for through the users GET account. To date, secure bicycle parking is outfitted with access readers that accept the GO CARD as well as other card technologies. The Project Team sees payment of the service as “low hanging fruit” to demonstrate how GET works with service providers.

Next Steps

As part of the development of the backend system, the Project Team will link GOBike’s payment collection system to GET accounts to demonstrate the payment transaction technique.

Estimated Completion Date: Q1 2017

5. Integrate UB Shuttle system with UB and BNMC access card and account management systems.

- Upgrade access readers on board UB shuttles so they are compatible with proposed GO CARDS.
- Develop a white list system that allows BNMC employees to request access to UB Shuttles.
- Update the BNMC account portal to include the option to sign up for access to UB Shuttles.

The Project Team has worked with Pasio – UB’s shuttle access system vendor - to identify the type and cost of access readers needed for compatibility with UB’s new ID cards and the proposed GO CARD. UB plans to replace the access readers when UB begins the phase out of their existing magnetic stripe cards. UB has indicated they are willing to install upgraded access readers in shuttles that service the Medical Campus as part of a pilot program. BNMC would provide UB with a white list of card ID’s based on which participants should be given access to the shuttles.

Next Steps

Once the backend system is developed, UB and BNMC will partner together to integrate UB Shuttles into the system. This will include installing new access readers on downtown shuttles and developing a white list system that BNMC will provide to UB that details which BNMC employees have access to the shuttles.

Estimated Completion Date: Q2 2017

6. Integrate REDDY BikeShare/Social Bicycles with UB and BNMC access card and account management systems.

- Integrate UB and proposed GO CARDS with Social Bicycles access readers so they can be used to unlock the bicycles.
- Create single-sign-on functions between UB and BNMC account management systems and the REDDY BikeShare account management system.
- Develop a payment transfer system between UB and BNMC account management systems and BikeShare's payment collection system.
- Update the UB and BNMC account portals to include the option to sign up for and access Social Bicycles accounts.

The Project Team continues to work with REDDY BikeShare and Social Bicycles on integration. Social Bicycles has provided REDDY BikeShare in Buffalo with a new bicycle fleet that has hardware and access readers compatible with MIFARE DESFire EV1 cards. The cards were tested on the bicycles and no problems were identified. The Project Team is also currently working with Social Bicycles on creating an SSO that would allow a GO CARD user to log in to their REDDY BikeShare account through their GO CARD account, and on adding GET accounts as an accepted payment option.

Next Steps

As part of the development of the backend system, UB and Social Bicycles will work together on finalizing the creation of an SSO and allowing GET to be an accepted payment option.

Estimated Completion Date: Q1 2017

7. Integrate BNMC parking system with the UB and BNMC access card and account management systems.

- Integrate Amano McGann's account management system with CBORD to allow GO CARD's and GET accounts to access and pay for parking.
- Upgrade gate control technology to accept MIFARE DESFire EV1 technology.
- Update the UB and BNMC account portals to include the option to sign up for parking programs.

At the beginning of the project, Amano McGann technology was not compatible with CBORD. The Project Team worked with Amano McGann to update their system so that it became compatible with CBORD. Amano McGann now offers integration as a plug-in to CBORD for a one-time fee. The Project Team also identified access readers that accept MIFARE DESFire EV1 technology.

Next Steps

Upon completion of the development of the backend system, the Project Team intends to purchase the Amano McGann plug-in and install new access readers at one BNMC-controlled lot as part of a pilot program.

Estimated Completion Date: Q2 2017

8. Integrate Buffalo CarShare with the UB and BNMC access card and account management systems.

- Determine the type and cost of hardware and software needed for installation to accept UB and BNMC access cards and install hardware and software.
- Create single-sign-on functions between the UB and BNMC account management systems and the Buffalo CarShare account management system.
- Develop a payment transfer system between the UB and BNMC account management systems and CarShare's payment collection system.
- Update UB and BNMC account portals to include the option to sign up and access Buffalo CarShare accounts.

Unfortunately, following the completion of the Feasibility Study, Buffalo CarShare lost its insurance carrier and was forced to cease operations. Buffalo CarShare sold its assets to Zipcar, which already had a presence at UB's North and South Campus. Zipcar expanded into the City of Buffalo, including partnering with BNMC to establish a carshare hub in the center of the Medical Campus. However, Zipcar has not expressed interest in participating in an integration pilot program. The findings from the Feasibility Study are relevant to Zipcar if they at some point decide to participate.

9. Integrate NFTA Metro Rail and Bus with the UB and BNMC access card and account management systems.

- Proceed with NFTA's upgrading of their fare collection system.
- Develop a white list system that allows BNMC employees to gain access to NFTA Metro Rail and Bus through their GO CARD.
- Develop a payment transaction system that allows BNMC to pay for employee use of NFTA Metro Rail and Bus.
- Update UB and BNMC account portals to include the option to sign up and pay for NFTA Metro Rail and Bus.

Because of the NFTA's involvement in the BNMC TMA and in this research project, the NFTA's RFP for selection of a fare collection system upgrade vendor include stipulations that the new system needs to be compatible with the proposed BNMC system. NFTA selected Scheidt & Bachmann as their vendor and the Project Team met with them on several occasions to discuss the project. The installed system will be compatible with the proposed BNMC system. The access readers will accept MIFARE DESFire EV1 technology and BNMC will be able to transfer funds from GO CARD users to the NFTA based on usage. The NFTA is expecting to complete their upgrade by the end of 2017. Once the upgrade is completed, BNMC and NFTA will enter into an agreement on how a pass program will operate with BNMC as a third party, collecting funds from BNMC users, and paying the NFTA for that use.

Next Steps

Once the NFTA completes the fare collection system upgrade, BNMC and NFTA will create a white list system that provides GO CARD users with access to NFTA Metro Rail and Bus.

Expected Completion Date: Q1 2018

10. Integrate UBER with the UB and BNMC account management systems.

In 2016, CBORD entered into agreement with UBER to develop a system that allows GET account holders to pay for UBER with funds from the GET account. If UBER is allowed to operate in Buffalo, NY, the Project Team plans on making this an option for GO CARD users as well.

11. Develop a Rewards Program based on the use of alternative transportation options.

Because of the numerous parties involved and the need to maintain individual accounts for specific service provider systems, it was deemed infeasible to develop a streamlined point-based system where BNMC could track the usage of alternative transportation options and reward an employee based on that usage. However, the Project Team believes that partnering with local vendors to offer free items or discounts to employees who have a GO CARD can also work as rewards program. The Project Team already has numerous local vendors that participate in similar award programs through individual service providers, and many of these vendors have expressed interest in participating in a more comprehensive program. Through a partnership with BNMC, UB intends to expand their campus cash program to downtown vendors. This would set up a vendor's ability to accept payment through the proposed GO CARD. BNMC would then work with the vendor on potential rewards programs for people participating in the GO CARD program. UGRYD already allows vendors, if interested, to automatically assign a percentage discount if a customer uses a UB ID card. The rewards program concept is to apply these discounts to GO CARD users as well.

Next Steps

Following the development of the backend system, UB and BNMC will expand the campus cash program to downtown and develop the rewards program with interested local vendors.

Estimated Completion Date: Q3 2017

5 Conclusion

Through this cost-shared research agreement, the BNMC TMA was successful at organizing a proactive approach toward developing an integrated transportation system for the BNMC in which a single smart card or mobile ID can gain access to, and in some instances pay for, a variety of transportation options available in the Buffalo area. The Feasibility Study performed by the Project Management Team and the consultants, M/E Engineering and U&S Services, identified limitations and opportunities associated with creating an integrated transportation system. Overall, the Feasibility Study outlined a path forward and made it clear that integration would require a significant amount of work on both BNMC and on the ends of the many transportation service providers that were part of the project.

It was decided the most direct path forward was to not create a completely new system, but to expand and customize an existing technology that is currently utilized by campuses across the United States. By piggybacking off of the University at Buffalo's existing campus cash system – which utilized CBORD technology – by upgrading hardware and software belonging to the various transportation service providers – the Project Team could create a system where one card can gain access to transportation services, one central financial account would pay for these transportation services, and one central portal could allow the user to access numerous individual transportation accounts all from one location and with one username and password through SSO functions.

Following the completion of the Feasibility Study, the Project Management Team began working on an implementation plan. Creating the integrated system would not be easy – it would require customization and expansion of existing technology and a great deal of staff time from all parties involved. However, the Project Management Team is still committed to developing the system in a phased approach as more technology comes online and transportation service providers are able to upgrade their systems to something compatible with the proposed GO CARD system. The majority of the system, including integration with NFTA services, has an expected completion date toward the end of 2017.

Appendix A: BNMC Smart Card Request for Information

REQUEST FOR INFORMATION (RFI)

For

BNMC Smart Card Pilot Project



**Buffalo Niagara
Medical Campus**

640 Ellicott Street

Buffalo, NY 14203

October 9th, 2013

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Table of Contents

BNMC CONTACT INFORMATION.....	5
CONFIDENTIALITY NOTICE	5
ABOUT THE BNMC	5
PURPOSE OF RFI.....	6
PROJECT BACKGROUND.....	6
INTEGRATING EXISTING TECHNOLOGIES.....	7
PROJECT OBJECTIVES	10
GOALS OF THIS RFI.....	10
RFI RESPONSE INFORMATION.....	11
Company/Organization Information Table.....	11
Industry / Smart Card Information Questionnaire	11
RFI SCHEDULE AND SUBMISSION DETAILS	12

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BNMC CONTACT INFORMATION

Direct all inquiries to:

William Smith
Director of Campus Access
640 Ellicott Street
Buffalo, NY 14203
716.218.7155
wsmith@bnmc.org

CONFIDENTIALITY NOTICE

This is a publically advertised RFI and information included in this RFI document or in discussions connected to it may be disclosed publicly unless the information is clearly marked (i.e., “proprietary” or “confidential”). Each page containing proprietary or confidential information must be marked.

ABOUT THE BNMC

The **Buffalo Niagara Medical Campus** is a consortium of nine research, healthcare and educational institutions and over 50 smaller companies all located on 120 acres just north of the City of Buffalo’s Central Business District.

BNMC, Inc. is non-profit umbrella organization created in 2001 by the institutions to foster conversation and collaboration among companies on the Campus, their 12,000 employees, and the community; to coordinate activities related to sustainable planning, development and enhancement of the 120 acre Campus; and to create a distinct, innovative environment that provides opportunities for entrepreneurship and economic development.

BNMC, Inc. formed a **Transportation Management Association (TMA)** in 2012 to help develop an efficient and sustainable transportation system for the Campus. The BNMC TMA is comprised of representatives from:

- BNMC, Inc.
- Campus Member Institutions, including Roswell Park Cancer Institute, Kaleida Health and University at Buffalo
- Niagara Frontier Transportation Authority (NFTA)
- NYS Department of Transportation (NYSDOT)
- NYS Energy and Research Development Authority (NYSERDA)
- City of Buffalo
- GObike Buffalo
- Buffalo CarShare

PURPOSE OF RFI

BNMC, Inc. was recently awarded funding from NYSERDA and NYSDOT to create a Smart Card Pilot Program that aims to provide BNMC commuters with a single Smart Card that can be used to access various alternative transportation services and secured facilities on and around the Medical Campus. The project team is also looking to explore the opportunity of creating a complementary mobile application that provides users with real-time data for different transportation services (transit arrival times, carshare/bikeshare hub locations, etc.), as well as access, reservation and account management services.

The purpose of the Program is to create a more efficient and user-friendly multi-modal transportation network that will encourage employees to utilize alternative transportation options. Partners in the Pilot Program include: BNMC, Inc., NFTA, NYSERDA, NYSDOT, University at Buffalo, GObike Buffalo and Buffalo CarShare.

The purpose of this RFI is to gauge the capabilities of potential consultants, identify existing access control and fare collection/media technologies that can be utilized to achieve the projects objectives, obtain information on system and equipment capabilities, and to gather other market information for planning purposes. The RFI is solely for informational and planning research purposes and does not constitute a Request for Proposals (RFP) or a Request for Qualifications (RFQ).

Respondents to this RFI will not be notified of the results of the submission review process. The information collected may be used in the creation of a future RFP for the pilot project. The RFP will be sent to a short-list of qualified candidates based on the results of this RFI. BNMC, Inc. reserves the right to contact any or all respondents on an individual basis to seek clarification on the information submitted in response to this RFI.

PROJECT BACKGROUND

The Buffalo Niagara Medical Campus is currently home to approximately 12,000 employees. However, this population is expected to rise to over 17,000 by the end of 2016 due to the growth of existing companies, the development of new companies and the relocation of several major institutional facilities to the Campus.

In 2010, a comprehensive transportation study was conducted to identify the issues that would arise from this population growth. The study showed that transit and other alternative commuting modes were significantly underutilized by employees, with approximately 88% of the current 12,000 employees driving alone to work. If the Campus was to successfully absorb the amount of planned development without serious traffic congestion and parking issues (as well as significant increases in GHG emissions and other negative impacts on surrounding communities), it was determined that the BNMC must implement a system of effective strategies that shift mode-shares away from single-occupancy-vehicles and towards carpooling, public transit, bicycling and walking.

A BNMC Transportation Management Association (TMA) was created in 2012 to oversee Campus-wide efforts to reduce parking demand through the implementation of transportation demand management strategies (TDM). These TDM strategies have focused on increasing awareness of, encouraging the use of, and improving alternative transportation services, and as of this date, the Campus has seen a drop in the drive alone mode share by approximately 4-5%.

While the Campus' TDM strategies have been successful, there still remains a need to make alternative transportation options more accessible and desirable to employees. A major barrier to this is that these various modes of transportation all have different methods of payment and access controls, which make the transportation system less efficient and more challenging to use.

The goal of the proposed Program will be to streamline the commuter process by creating a single Smart Card that will provide access to a multitude of alternative transportation options, as well as access to secured facilities on the Campus. The Smart Card would provide access to the following, but is not limited to the following: NFTA Metro Rail and Bus, University at Buffalo shuttles, Buffalo CarShare vehicles, Buffalo BikeShare bikes, secure bike storage facilities and secured buildings. While the Smart Card would have the ability to provide access to all of these services, the Smart Card holder would only be able to use the card to access services and facilities that he or she has signed up for or has been granted access to.

The project team is also looking to explore the opportunity of creating a complementary mobile application that provides users with real-time data for different transportation services (transit arrival times, carshare/bikeshare hub locations, etc.), as well as access, reservation and account management services.

Additionally, the project team is exploring the possibility of creating an incentives and rewards program for employees based on the utilization of alternative transportation services through the Smart Card. For instance, using the Smart Card to access public transit would allow you to accrue points that would be redeemable as discounts on goods and services from local restaurants and shops.

INTEGRATING EXISTING TECHNOLOGIES

The timing of this project comes at a critical juncture as new transportation services and new accompanying payment and access control systems are being designed and implemented in the City of Buffalo. Because of this, it is critical that stakeholders begin to plan and test interoperable systems now in order to develop an integrated, multi-modal transportation network for the future.

Examples of ongoing and upcoming partner initiatives regarding fare collection and access controls include:

NFTA Fare Collection System Replacement: The NFTA is currently planning to upgrade their fare collection system for both Metro Rail and Bus. The scope encompasses 307 buses, 74 PAL vehicles, fare vending at 14 Rail Stations and 4 transit centers as well as cash vaulting equipment at three garages.

The NFTA envisions an account-based fare system that uses a variety of contactless fare media. The system will not initially process contactless bank cards for direct fare payment on buses and at turnstiles, and as such may not rely upon robust high-speed account validation processing at the central system. Rather, fare media may be validated locally with transactions transmitted to the central system on a periodic basis based on business rules for applicable communications. Media lists will be updated as needed, including potentially in near or real-time to reflect account status changes such as a customer reload.

Key new Fare Media system components include:

- Long-term use Smart Cards that are account based, with only minimal NFTA-specific data encoded onto the Card for security purposes;
- Limited use Smart Cards with a pass product encoded on the Card; and
- Barcode-printed paper media as single ride tickets for the light rail system.

Key new Bus system components include:

- NFTA buses will be equipped with new validating fareboxes that accept and properly process bills, coins, bar code fare media and Smart Cards. The new farebox will not need to issue paper transfers.
- The bus farebox vaulting/probing system will be replaced at the same time as implementation of the new fareboxes. Centralized computer and software for the farebox/vaulting system is expected to interface with the new fare collection central computer system.
- The new fare collection system will utilize a common operator interface with the CAD/AVL system for driver convenience. GPS information required for the fare system will be obtained from the CAD/AVL system.
- The current bus fleet uses Fleetlynx and OrbStar CAD/AVL systems, and as the NFTA replaces its bus fleet, new vehicles are supplied with OrbStar systems and a prerequisite to the new fare system will be a system-wide deployment of OrbStar. The new farebox may also interface with other planned on-board systems, such as those to support GPS and cellular data communications.

Key new Rail system components include:

- Turnstiles and ADA faregates will be installed at all underground rail stations which are currently barrier-free.
- Fare Vending Machines (FVM) will be located on either side of the turnstiles and ADA faregates in the underground stations. FVM's will vend barcode media and allow customers to purchase stored value and passes for their Smart Card accounts. FVM's will accept cash and credit/debit Cards as payment.
- Rail equipment will have wired communications to the fare collection central system.

University at Buffalo Shuttle Access Controls: University at Buffalo's Parking and Transportation Department is in the process of utilizing Smart Card technology and proximity readers for their UB

Stampede and Blue Line shuttle services which run between UB North Campus in Amherst, UB South Campus in North Buffalo, and the Medical Campus downtown. UB is interested in exploring the interoperability of their UB Card system with transit and added mobility services in order to provide an efficient and seamless transportation system for their students, faculty and staff.

Buffalo CarShare Fleet Expansion: Buffalo CarShare is expanding their fleet and now has five vehicles, including two electric vehicles, located on the Medical Campus. The company is currently exploring alternatives to their current software and access controls (which utilize key fobs and AWID proximity readers) that can be more easily integrated with transit services and electric charging infrastructure. Hardware options (and vendors) being considered include:

- RideLink (Just Share It)
- Invers
- Convadis
- Local Motion

CarShare plans to select between these vendors in early 2014.

Social Bicycles in Buffalo: Buffalo CarShare is also working with the Social Bicycles system on a bike sharing program that would service the Medical Campus as well as other campuses and neighborhoods in the region. The bicycles are equipped with GPS and currently can be reserved online or on a mobile device, and require users to enter their member information through a touch pad system mounted on the bike. The Social Bicycles team is planning to add long-range RFID technology to their bikes in the next version of the system hardware in 2014.

New Secure Bike Storage Facilities: The BNMC, in partnership with GObike Buffalo, is constructing secure bike storage facilities on the Medical Campus and at Metro Rail Stations (to act as bike n rides), which will utilize Smart Card technology to control user access.

GO BNMC Online TDM Toolkit: The BNMC TMA is creating a responsive TDM website that will provide employees on the Medical Campus with access to information about the alternative transportation options and programs available to them, as well as the ability to partake in these programs. The website is intended to be a single location where employees can sign up for alternative transportation programs, including the ability to purchase Metro passes, reserve CarShare and BikeShare vehicles, and sign up for access to secure bike storage facilities. The TMA would like to explore possibilities of how this responsive website and the Smart Card Program could interact with one another to improve project efficiency.

New Building Access Controls and Interconnected Facilities: The BNMC Public Safety Project Management Group has been planning an integrated security and access controls system throughout a semi-public corridor from a NFTA Metro Rail Station and throughout three new buildings: the UB School of Medicine, Conventus Medical Office Building, and Children's Hospital of Buffalo. The proposed Smart Card should also be compatible with the hardware and software being utilized in these internal, semi-public, pedestrian corridors.

PROJECT OBJECTIVES

The following are major objectives of this Project, as agreed upon by the BNMC TMA:

- To create a single Smart Card and mobile application that can be utilized by employees to gain access to a multitude of alternative transportation services and secured facilities;
- To improve the efficiency and ease of use of these services, therefore making these services more appealing choices; and
- To create an incentive and rewards program for employees based on an employee's utilization of the Smart Card.

GOALS OF THIS RFI

By issuing this RFI, the BNMC TMA seeks to achieve the following goals:

- To gather feedback on the proposed project and gain awareness of potential costs, benefits and risks of the project;
- To identify existing access control and fare collection/media technologies that can be utilized to achieve the project objectives;
- To better understand operating opportunities and needs;
- To better understand existing system and equipment capabilities;
- To gauge the capabilities of potential consultants;
- To gather other market information for planning purposes; and
- To create a short-list of qualified candidates that a later RFP will be sent to.

RFI RESPONSE INFORMATION

BNMC, Inc. is requesting that firms with expertise and experience related to the proposed project provide the following information (please answer all questions):

1. Responses to the Company/Organization Information Table
2. Responses to the Industry/Smart Card Information Questionnaire

Company/Organization Information Table

Company Name	
Company Location (main and satellite)	
Company Website	
Main Products/Services	
Main Market/Customers	
Number of Employees	
Contact Person Name	
Contact Person Title	
Contact Person Phone	
Contact Person Email	

Industry / Smart Card Information Questionnaire

Please provide answers to the following questions in a concise and coherent manner.

The vision for this project is to create a Smart Card that provides employees on the Buffalo Niagara Medical Campus with access to a multitude of alternative transportation services and secured Campus facilities. The current approach is to create a Smart Card that has multiple “access slots” that can be activated based on what the Card holder has been given permission to use the Smart Card for. For instance, SUNY at Buffalo may decide that only faculty, staff and students can utilize their existing shuttle services, and therefore the Smart Card would only provide access to the shuttle services to Card holders that are faculty, staff or students. Smart Card holders that are not affiliated with the university would not be able to use the Smart Card to access shuttles. CarShare is another example: while the Smart Card has a “slot” that can provide its holder with access to Buffalo CarShare vehicles, the slot would only be activated and the Smart Card would only allow access to these vehicles if Buffalo CarShare has given the holder permission to use the vehicles.

The project team is also looking to explore the opportunity of creating a complementary mobile application that provides users with real-time data for different transportation services (transit arrival times, carshare/bikeshare hub locations, etc.), as well as access, reservation and account management services.

1. Please discuss the potential benefits and drawbacks associated with this approach. Is there a more desirable approach, and if so, what is it?
2. Please discuss standard industry practices, and highlight any best practices associated with this type of program.
3. Please discuss the potential costs associated with this project, based on previous experiences and expert knowledge of the industry.
4. Please discuss the hardware and software components that would be necessary for this type of project.
5. In addition to new hardware (such as access control systems for bicycle facilities), the Smart Card would have to be compatible with existing access control systems. Please discuss examples of where this has been implemented before, including potential challenges and opportunities.
6. What are typical operating and management structures for Smart Cards that have various uses and stakeholders? What roles and responsibilities do the stakeholders usually have?
7. What experience does your organization have with this type of project? Please describe those experiences and indicate the outcome. Please discuss the challenges/issues you faced with these experiences and provide feedback on how this project could avoid those challenges.
8. Please discuss any issues the project managers should consider when developing an RFP for this program. Discuss any factors that would make competing for this contract desirable or undesirable for your firm.
9. What do you believe is the ideal contract type for procuring services to develop and pilot this project?
10. Please discuss any additional comments or concerns.

RFI SCHEDULE AND SUBMISSION DETAILS

10/9/13: RFI is advertised through various channels

10/25/13: Deadline for questions or requests for changes regarding RFI

11/1/13: Due date for submission

RFI responses will be accepted until 5:00 PM of the due date listed on the schedule above. Responses will only be accepted electronically. Paper responses will not be accepted.

Please submit your response in PDF format no larger than 10 MB to:

William Smith
Director of Campus Access
wsmith@bnmc.org

and:

Jamie Hamann-Burney
Project Associate
jhamann-burney@bnmc.org

If your file is larger than 10 MB, you are allowed to send more than one file.

The file names should adhere to the following convention:

BNMC Smart Card RFI *_company name_#_of_#.pdf*

For instance, if you have more than 1 file, the file name should be:

BNMC Smart Card RFI *_company name_1_of_2.pdf*

Appendix B: BNMC Smart Card Study Request for Proposals

REQUEST FOR PROPOSALS (RFP)
for
**BNMC Smart Card Feasibility Study and
Demonstration Project**



Buffalo Niagara
Medical Campus

640 Ellicott Street

Buffalo, NY 14203

December 4th, 2013

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Table of Contents

1. STAKEHOLDER PROJECT TEAM	5
Lead Agency	5
BNMC Contact Information	5
Additional Stakeholder Project Team Members.....	5
2. PROJECT LOCATION.....	6
3. PROJECT OVERVIEW.....	6
4. DRAFT SCOPE OF WORK.....	7
Task 1. Stakeholder Outreach and Engagement.....	7
Task 2. Conduct Feasibility Study.....	8
Task 3. Develop Implementation Plan and Demonstration Program	13
5. ESTIMATED PROJECT SCHEDULE.....	14
6. RFP RESPONSE REQUIREMENTS	15
7. RESPONSE SUBMITTAL PROCESS	16
8. SELECTION PROCESS	16
APPENDIX A: BNMC Public Safety Management Group Report on the Semi-Public Pedestrian Corridor	17

1. STAKEHOLDER PROJECT TEAM

The Stakeholder Project Team consists of a wide array of transportation service providers, advocates, and healthcare/educational institutions. Please click the links below for more information about each partner.

Lead Agency

[Buffalo Niagara Medical Campus, Inc. \(BNMC, Inc.\)](#)

BNMC, Inc. is the lead agency for the project and will control all contracts with future consultants/vendors. BNMC, Inc. is a non-profit umbrella organization created in 2001 to foster conversation and collaboration among companies on the Campus, their 12,000 existing employees, and the community; to coordinate activities related to sustainable planning, development and enhancement of the 120 acre Campus; and to create a distinct, innovative environment that provides opportunities for entrepreneurship and economic development.

BNMC Contact Information

William Smith
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wsmith@bnmc.org

Jamie Hamann-Burney
Project Manager
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[Jhamann-burney@bnmc.org](mailto:jhamann-burney@bnmc.org)

Additional Stakeholder Project Team Members

[SUNY at Buffalo \(UB\)](#)

[Roswell Park Cancer Institute \(RPCI\)](#)

[Kaleida Health \(Kaleida\)](#)

[Niagara Frontier Transportation Authority \(NFTA\)](#)

[GObike Buffalo \(GObike\)](#)

[Buffalo CarShare \(BCS\)](#)

[Social Bicycles \(SoBi\)](#)

[New York State Department of Transportation \(NYSDOT\)](#)

[New York State Energy and Research Development Authority \(NYSERDA\)](#)

2. PROJECT LOCATION

The project will take place on the Buffalo Niagara Medical Campus in Buffalo, NY. The Buffalo Niagara Medical Campus is a consortium of nine research, healthcare and educational institutions and over 50 smaller companies all located on 120 acres just north of the City of Buffalo's Central Business District. The Campus is roughly bounded by Michigan Avenue to the east, North Street to the North, Main Street to the west, and Goodell Street to the south.

3. PROJECT OVERVIEW

BNMC, Inc. was recently awarded funding from NYSERDA and NYSDOT to conduct a feasibility study and small scale demonstration program on the Buffalo Niagara Medical Campus focusing on the development of an integrated access control and fare vending system in which a single Smart Card could be used by an employee to access a wide array of transportation services and secured facilities on the Campus. The project is not seeking to replace existing access control systems. Instead, the Smart Card is envisioned to be compatible with several existing access control systems, as well as being compatible with future/planned systems (discussed in Section 4). The project is also looking to develop a loyalty program for the Smart Card users.

The Stakeholder Project Team is seeking a consultant (or Firm/Consultant Project Team) to help conduct a feasibility study and help implement a small-scale demonstration program on the Campus. The feasibility study would address, but is not limited to:

- Determining compatibility solutions for existing access control systems;
- Determining compatibility solutions for future/planned access control and fare vending systems;
- Determining the preferred management and backend operation system for the proposed Smart Card;
- Determining the preferred accounts management system for the user; and
- Identifying loyalty program opportunities.

An implementation plan and small-scale demonstration program will take place upon completion of the feasibility study. The actual size and scope of the demonstration program will be determined based on the findings of the feasibility study.

The purpose of the project is to create a more efficient and user-friendly access and transportation system for the Buffalo Niagara Medical Campus, and to create a model that can be replicated at a larger scale within the City of Buffalo and throughout New York State.

The overall vision is to create a Smart Card that has multiple “slots” (i.e. a menu of options) that can be activated based on the transportation modes and permitted levels of access of the Card holder. For instance, an NFTA Metro Rail commuter that works at Buffalo General Medical Center and has a Buffalo CarShare membership could (1) use their Card to access the light-rail for getting to work (2) use the same Card for accessing the building where they work (3) use the same Card to access a CarShare vehicle for getting to a lunch meeting across town.

The timing of this project comes at a critical juncture as new transportation services and new accompanying payment systems and access control systems are being designed and implemented in the City of Buffalo; therefore, it is critical to begin to plan and test interoperable systems now in order to develop a large-scale integrated network for the near future.

4. DRAFT SCOPE OF WORK

Task 1. Stakeholder Outreach and Engagement

The consultant is expected to work closely with the Stakeholder Project Team and BNMC Project Manager to develop the feasibility study and small-scale demonstration program. The consultant is expected to utilize the Stakeholder Project Team to help gather data for the feasibility study to lower consultant project costs.

Subtask 1.1 Project Initiation

The consultant, in coordination with the BNMC Project Manager, will hold a kick-off meeting with representatives from the Stakeholder Project Team to discuss the scope of work, schedule and deliverables, and to begin to collect data necessary to complete the feasibility study.

Subtask 1.2 Stakeholder Engagement

The consultant will also, if necessary and in coordination with the BNMC Project Manager, prepare and hold one (1) separate initial meeting with representatives from each organization that makes up the Stakeholder Project Team.

The consultant is also expected to regularly work with and communicate with the BNMC Project Manager, and to attend/prepare additional meetings with the Stakeholder Project Team or individual representatives if necessary.

Task 2. Conduct Feasibility Study

Subtask 2.1 Determine compatibility solutions and costs for existing access control and fare vending systems

The Stakeholder Project Team does not desire to replace existing access control and fare vending systems with a new system. The Smart Card is envisioned to be compatible with multiple database systems and security platforms across various organizations. The feasibility study will identify whether/how the proposed Smart Card could be developed to be compatible with these existing systems, and the estimated cost of this. These existing systems include:

- UB Stampede Shuttle Access Control System: UB operates a shuttle service for those affiliated with the University that runs between its North and South Campuses. UB recently installed access control readers onboard its Stampede shuttles that require swiping a UB identification card in order to gain entry. The specifications for this existing system are below:

Existing Operating Platform: Passio SmartTrack System

Typical ID Cards: Magnetic Stripe; cr80 card with a hico magnetic stripe

Typical Access Control Readers: not yet identified

- Innovation Center Access Control System: BNMC, Inc. owns and operates the Innovation Center at 640 Ellicott Street. Tenants at 640 Ellicott Street are given personalized proximity Identification Cards that provide them with access to the secured building and secured sections within the building. The specifications for this existing system are below:

Existing Operating Platform: Johnson Controls, Inc. JCI P2000

Typical ID Cards: JCI HD

Typical Access Control Readers: CardKey Proximity 4000

- UB Access Control System: The University at Buffalo owns several buildings on the Campus. Employees are given personalized magnetic stripe Identification Cards that provide them with access to these secured buildings and secured sections within these buildings. The specifications for this existing system are below:

Existing Operating Platform: Stanley/Best BASIS system, BASIS ET692 server software w/RHEL Server release 5.7 and a dedicated Oracle instance

Typical ID Cards: Magnetic Stripe; cr80 card with a hico magnetic stripe

Typical Access Control Readers: Controller models BAS-3300, BAS-2220, BAS-2000, BAS-1000, and BAS-500. Readers LNL-2005W (typical)

- *Kaleida Access Control System*: Kaleida Health owns and operates several facilities on the Campus. Employees are given personalized proximity Identification Cards that provide them with access to these secured buildings and secured sections within these buildings. The specifications for this existing system are below:

Existing Operating Platform: Pro-Watch Security Management Suite 4.0

Typical ID Cards: HID's Corporate 1000

Typical Access Control Readers: HID 125 MHz proximity readers

- *RPCI Access Control System*: Roswell Park owns and operates several facilities on the Campus. Employees are given personalized proximity Identification Cards that provide them with access to these secured buildings and secured sections within these buildings. The specifications for this existing system are below:

Existing Operating Platform: Lenel (OnGuard)

Typical ID Cards: HID iClass Card 210CGGNN (Configured only)

Typical Access Control Readers: (HID Proximity Readers)

Subtask 2.2 Determine compatibility solutions and costs for future/planned access control and fare vending systems

In addition to existing access control and fare vending systems, many of the project partners are in the process of upgrading their systems, planning to upgrade their systems, or need to install new systems in the near future. The feasibility study will identify whether the proposed Smart Card could be developed to be compatible with these future/planned systems, and the estimated cost of this. These future/planned systems include:

- *BNMC Mobility Hub Access Control System*: BNMC, Inc. is currently constructing an *Integrated Mobility Hub* at 927 Washington Street that will feature office and retail space as well as a bicycle parking complex. An access control system for the *Mobility Hub* has not yet been determined. The feasibility study will identify the preferred system for the *Mobility Hub* based on its compatibility with the proposed Smart Card. NOTE: Construction of the *Mobility Hub* is expected to be completed by March of 2014. Therefore, the selection and installation of the *Hub's* access control system is expected to take place during the early stages of the feasibility study, and the cost of the system is to be included in this project. 1-2 access readers will be required.

- *BNMC Bicycle Parking Facility Access Control System:* BNMC, Inc. recently constructed a secure bicycle parking facility on the corner of Ellicott and Virginia Streets. An access control system for the facility has not yet been determined. The feasibility study will identify the preferred system for the Mobility Hub based on its compatibility with the proposed Smart Card. NOTE: BNMC, Inc. intends to begin operating the facility in March of 2014. Therefore, the selection and installation of the facility's access control system is expected to take place during the early stages of the feasibility study, and the cost of the system is to be included in the project. 1 access reader will be required.
- *UB Blue Line and Wave Shuttle Access Control System:* UB operates a shuttle service for those affiliated with the University that runs between its South Campus and the Medical Campus known as the *Blue Line*. UB also operates *The Wave*, a shuttle that circulates through the Medical Campus. These shuttles do not currently have access control systems, but UB plans to install systems in the near future. The feasibility study will help identify a preferred system for the shuttles based on its compatibility with the proposed Smart Card. The cost for the additional access control readers may or may not be included in this project. If it is included, up to 4 access readers will be required.
- *NFTA Metro Rail and Bus Fare Vending and Access Control System:* NFTA is currently creating a separate RFP for a new fare vending and access control system for their Metro Rail and Bus services. The feasibility study will determine whether/how the proposed Smart Card can be compatible with the new fare vending and access control system that the NFTA plans to implement.

The NFTA anticipates implementing an Account Based System (ABS) for their customers where customers can receive a personalized ISO 14443 contactless card that gives them access to Metro services. The NFTA ABS is expected to have third party extensions that allow non-NFTA cards, such as the BNMC Smart Card, to be used to gain access to Metro Rail and Bus services. Therefore, the proposed Smart Card must work with ISO 14443 standards.

- *Buffalo CarShare Access Control System:* BCS is currently exploring alternatives to their current software and access control system, which utilize key fobs and AWID proximity readers. The feasibility study will determine whether/how the new access control system that BCS installs can be compatible with a new Smart Card, or if there is a separate solution.

Hardware options and vendors being considered by BCS include:

- RideLink (Just Share It)
- Invers
- Convadis
- Local Motion

BCS is expected to make their decision by Spring of 2014.

- *Buffalo BikeShare Access Control System:* BCS and SoBi are currently beta testing a bike sharing system on the Medical Campus as well as other campuses and neighborhoods within the region. Currently, the bicycles are equipped with GPS and can be reserved online or on a mobile device, and require users to enter their member information through a touch pad system mounted on the bike. The Social Bicycles team is planning to add long-range RFID technology to their bikes in the next version of the system hardware in 2014. The feasibility study would determine whether/how a new Smart Card could be compatible with the planned RFID access control hardware, or if there is a separate solution.
- *BNMC Shared Semi-Public Corridor Access Control System:* BNMC, Inc. and member institutions are currently planning an integrated security and access control system throughout a semi-public corridor from a NFTA Metro Rail Station and throughout three under-construction buildings: The UB School of Medicine, the Conventus Medical Office Building, and Oishei Children's Hospital of Buffalo. The Rail Station, three new buildings and several existing buildings are planned to be linked via skywalks and underground tunnels. The feasibility study will determine whether/how the proposed Smart Card could be compatible with the to-be-determined access control system for the semi-public corridor. The corridor is expected to be operational by Fall of 2016, when the UB School of Medicine is completed. An overview of this project can be seen in more detail in **Appendix A**.

Subtask 2.3 Determine the preferred management and backend operation system for the proposed Smart Card

The feasibility study will identify a preferred operating and management system for the proposed Smart Card. It is assumed that the system will allow each organization to continue to maintain their individual access and fare vending system platforms. It is also assumed that the system will allow for both autonomy and integration (the hardware and software system will be integrated with multiple databases and individual operating platforms of various entities), and would allow for flexibility (the system should be able to be easily adjusted for future changes in users, technologies, security policies or credentialing processes).

The feasibility study will also help identify a preferred BNMC Account Based System (ABS) for the Smart Card for services that require a fee, such as NFTA Metro services and Buffalo CarShare. For instance, the BNMC ABS would allow the BNMC to manage monetary transactions between employees, employers and the NFTA. Employees/employers could transfer funds to the BNMC to pay for access to NFTA Metro services (as a third party), and the BNMC would then transfer these funds to the NFTA along with the identification numbers of Smart Card holders who should be given access to these services.

The feasibility study will help identify how this management system would operate, and the preferred access/fare media options that would be available to BNMC employees. The ideas below include, but are not limited to, fare options that the BNMC would like to explore through the feasibility study:

- *NFTA Monthly Unlimited Pass*: A Smart Card holder could purchase monthly unlimited passes through the BNMC. The BNMC would provide the NFTA with the employee’s Smart Card identification number and transfer the fee to the NFTA, and the employee would then be able to access NFTA Metro services unlimitedly during that month.
- *NFTA Pre-Tax Monthly Unlimited Pass*: A Smart Card holder could purchase monthly unlimited passes via pre-tax paycheck deductions through their employer. These monetary deductions would be sent to the BNMC, who would then provide the NFTA with the participating employee’s Smart Card identification number and transfer the deduction to the NFTA. The employee would then be able to access NFTA Metro services unlimitedly during that month.
- *NFTA Allotted Time Unlimited Pass*: Smart Card holders could purchase one-week, two-week, etc. passes through the BNMC that provide them with unlimited access to NFTA Metro services during the allotted time period. The BNMC would provide the NFTA with the participating employee’s Smart Card identification number and transfer the funds to the NFTA.
- *NFTA Pay as you Go*: Smart Card holders could choose an option in which money that is put into their account is deducted per use.
- *Buffalo CarShare and BikeShare Accounts*: A Smart Card holder’s account could be loaded with money that could be used to pay for CarShare and BikeShare services. Each use would deduct money from this account, which could be reloaded by the holder or by the holder’s employer.
- *General Fund Account*: A Smart Card holder’s account could have a “general transportation” pot of money that could be used for single-trip NFTA services as well as other transportation services like Buffalo CarShare and BikeShare. Each use would deduct money from this account, which could be reloaded by the holder or the holder’s employer.

Subtask 2.4 Determine preferred accounts management system for user

The feasibility study would address the user’s interaction with their Smart Card account. It is assumed that www.gobnmc.org (the Medical Campus’ member-based transportation website) will be utilized for accounts management where needed, such as paying for NFTA and CarShare services.

www.gobnmc.org is a responsive TDM website (currently under construction) that will provide employees on the Medical Campus with access to information about the Smart Card and alternative transportation options and programs available to them, as well as the ability to sign up for these programs. The website is intended to be a single location where employees can sign up for alternative transportation programs, including the ability to purchase NFTA services (reload the Card account, etc.), reserve CarShare and BikeShare vehicles, and sign up for access to the Mobility Hub and other bicycle facilities.

Subtask 2.5 Identify loyalty program opportunities

The feasibility study will determine the software opportunities for a preferred loyalty program for Smart Card users. The loyalty program is envisioned to provide users with “points” every time they utilize an associated transportation service. These points would be redeemable for discounts at local participating restaurants and shops. The Stakeholder Project Team would create the plan for the loyalty program based off of the Smart Cards capabilities.

Task 3. Develop Implementation Plan and Demonstration Program

The consultant will work with the Stakeholder Project Team to develop an implementation plan and small-scale demonstration program upon completion of the feasibility study. The actual size and scope of the demonstration program will be determined based on the findings of the feasibility study. The demonstration program is envisioned to include:

- The development of a management and backend operation system.
- The development of an accounts management system for the user.
- The development of loyalty program software.
- The installation of future/planned fare vending/access control systems necessary for the demonstration program to take place. NOTE: Some installation will occur during the early stages of the feasibility study due to schedule overlaps.

The Stakeholder Project Team will primarily be responsible for managing the demonstration program, including recruitment and user management.

5. ESTIMATED PROJECT SCHEDULE

Interview/Meet With Potential Consultants: December 16, 2013 – December 20, 2013

RFP Responses Due: January 15, 2014

Consultant Contract Execution: February 7, 2014

Conduct Feasibility Study: February 10, 2014 – April 30, 2014

- NOTE: If you believe the feasibility study can be completed sooner than the date above, please indicate in your response submittal.

Develop Implementation Plan and Demonstration Program: May 1, 2014 – July 31, 2014

- NOTE: If the development of the implementation plan and demonstration program can be completed sooner than the date above, please indicate in your response submittal.

Implement and Monitor Demonstration Program: August 1, 2014 – May 31, 2015

- NOTE: The consultant is expected to have minimal involvement in this process.

Project Closeout and Evaluation: June 1, 2015 – June 31, 2015

- NOTE: The consultant is expected to have minimal involvement in this process.

6. RFP RESPONSE REQUIREMENTS

1. **Experience of Firm/Consultant Project Team:** Responses to this RFP should include a description of similar projects your Firm/Consultant Project Team have been a part of, and the specific role your organization played in these projects. Please also include an organizational chart, identifying the project manager and team members, with their titles and a brief description of their experience and qualifications for taking on this project. All proposed sub-consultants must also be identified, along with their project managers and key personnel.
2. **Approach and Methodology:** Responses should include a brief description of your Firm's/Consultant Project Team's approach to and methodology for the Scope of Work found in Section 4. Please also discuss how you plan to utilize the Stakeholder Project Team and BNMC Project Manager to reduce consultant costs.
3. **Project Schedule:** Responses should include a proposed project schedule for the Scope of Work found in Section 4. If your project schedule differs from the estimated schedule found in Section 6, please indicate the reasoning.
4. **Cost and Budget:** Responses should include your Firm's/Consultant Project Team's estimated hours, costs and budget, broken down by task and subtask, for **Scope of Work Tasks 1 and 2 (Outreach and Engagement, and Conduct Feasibility Study)**. Because the size and scope of *Task 3: Develop an Implementation Plan and Demonstration Program*, is dependent upon the findings of the feasibility study, a budget for these Tasks cannot be estimated at this time, and is not required.

Upon completion of the feasibility study, the Stakeholder Project Team will work with the consultant to create a budget for the implementation plan and demonstration program.

7. RESPONSE SUBMITTAL PROCESS

There is no restriction on the length of your Response to this RFP, but respondents are encouraged to be as concise as possible.

RFP responses will be accepted until 5:00 PM on Wednesday, January 15th, 2014. Responses will only be accepted electronically. Paper responses will not be accepted.

Please submit your response in PDF format no larger than 10 MB to:

William Smith
Director of Campus Access
wsmith@bnmc.org

And:

Jamie Hamann-Burney
Project Manager
Jhamann-burney@bnmc.org

The file name should adhere to the following convention:

BNMC Smart Card RFP _ *company name*.pdf

8. SELECTION PROCESS

This RFP is being sent to a short-list of organizations that responded to the initial BNMC Smart Card Request for Information (RFI).

The initial meeting with your Firm/Consultant Project Team with the Stakeholder Project Team and the Firm/Consultant Project Team's response to the RFP will guide the selection process.

The Stakeholder Project Team will create a short list from the responses, and subsequent interviews may be required as well as changes to the proposed project scope and budget.

Contract execution is expected to be made around February 7th, 2014.

APPENDIX A: BNMC Public Safety Management Group
Report on the Semi-Public Pedestrian Corridor

BNMC Public Safety Project Management Group
Report on the Semi-Public Pedestrian Corridor

June 6, 2013

DRAFT

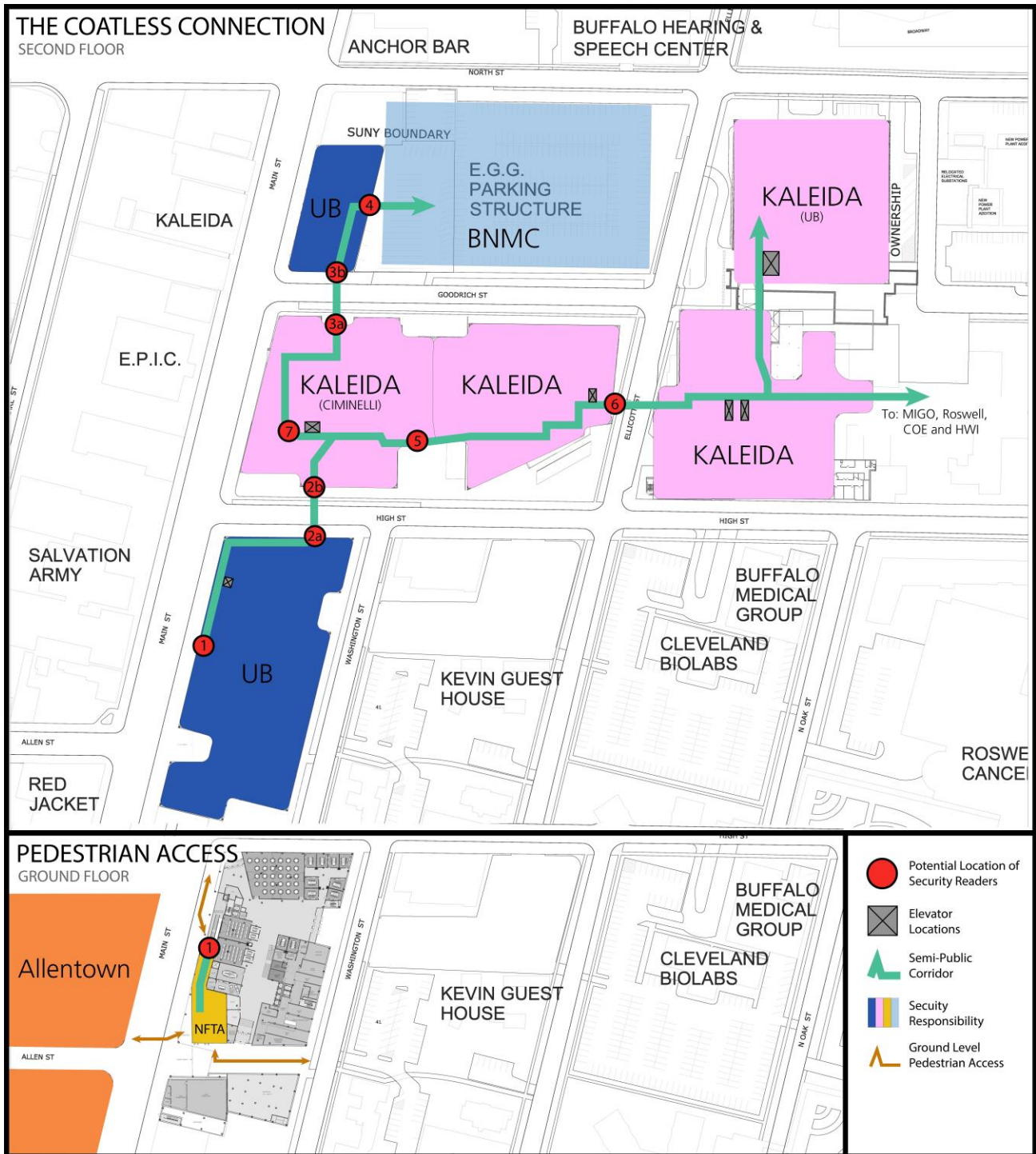
Table of Contents

1. Defining the Pedestrian Corridor 3
2. The Planning Process 4
3. Proposed Access Control System 5
4. Operational Assumptions 8

- Attachment A.** Current Security Technology Table
- Attachment B.** Cut Sheets for Multi-Class Card Readers
- Attachment C.** Case Study from Arizona State University

1. Defining the Pedestrian Corridor

As shown in blue in the below diagram, a semi-public corridor is being proposed that connects the soon to be constructed UB School of Medicine, Conventus Medical Office Building, and the John R Oishei Children’s Hospital with the existing UB Research Institute on Addictions, Buffalo General Medical Center, Ellicott Goodrich Parking Garage, and the NFTA Metro Station.



The following provides a description of each link and checkpoint of the semi-public corridor corresponding with the numbers in the above labeled diagram:

1. Connects the underground NFTA Metro Station with the first floor lobby of the SMBS, and then continues upward to the second floor. Access controls will be located at the 2nd floor location and begins the semi-public corridor.
2. Connects the 2nd floor of SMBS with the 2nd floor of Conventus via pedestrian bridge over High Street (occupied by the Kaleida Ambulatory Care Center). Access controls located at 2a and 2b (each end of the bridge).
3. Connects the 2nd floor Conventus with the 3rd floor of the UB RIA via pedestrian bridge over Goodrich Street. Access controls located at 3a and 3b (each end of the bridge).
4. Connects a new or expanded Ellicott Goodrich Garage with the 2nd floor of the UB RIA via pedestrian bridge. Access controls will be located at the entrance to the RIA building.
5. The corridor extends through the complex connecting the 2nd floor of Conventus with the 2nd floor of Children's Hospital. Access controls will be located between the two facilities.
6. Connects the 2nd floor of Children's Hospital with the 2nd floor of the BGMC (A-Tower) via pedestrian bridge over Ellicott Street. Access controls will be located at the entrance to Children's Hospital.

2. The Planning Process

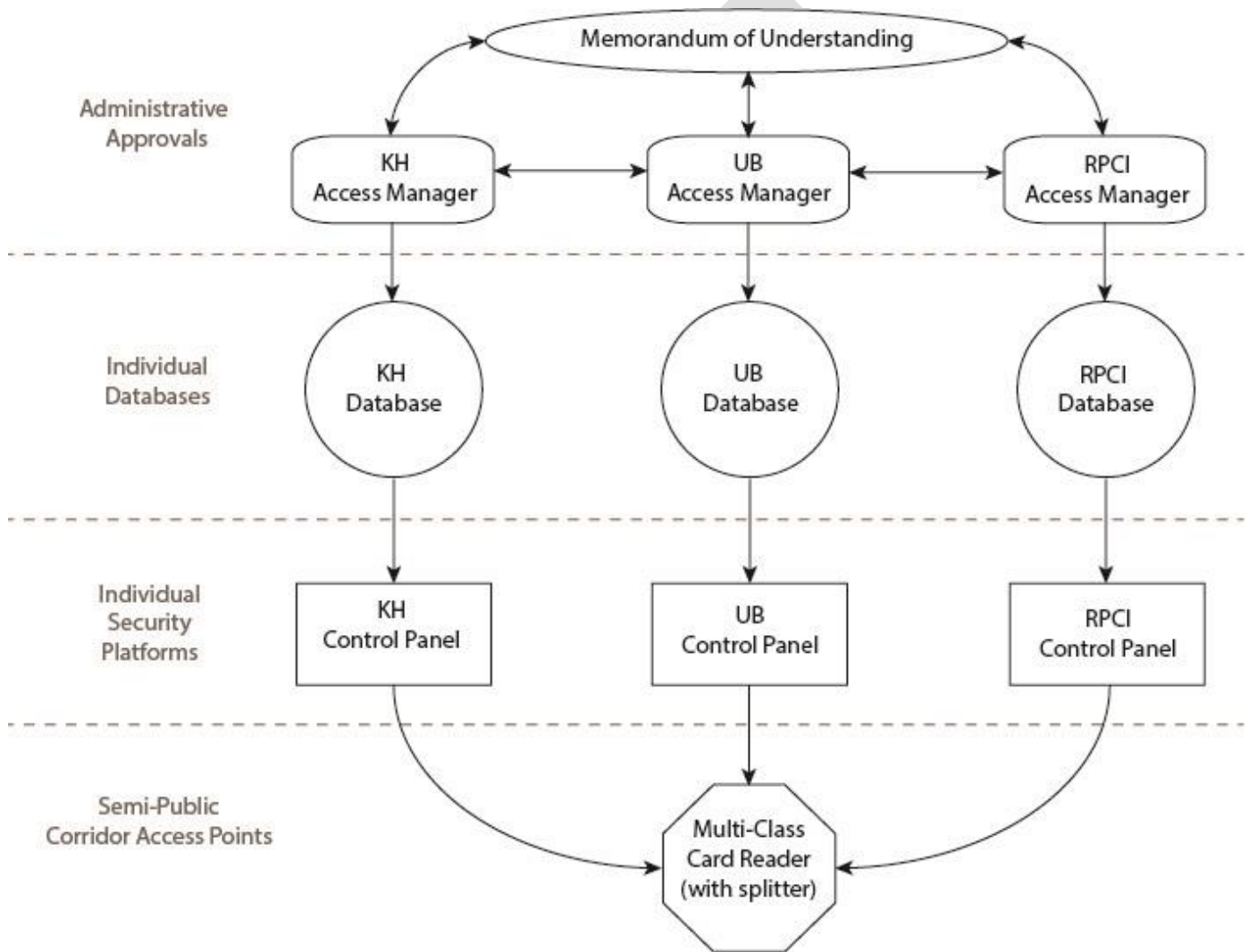
Throughout the months of March and April of 2013, the BNMC Public Safety Project Management Group has been meeting on a bi-weekly basis to discuss safety and security aspects of the proposed semi-public corridor. The goal of these meetings has been to assist in the planning of an integrated security and access controls system throughout the semi-public corridor that will also be compatible with existing systems on the Medical Campus.

To this end, representatives of University at Buffalo (UB), Kaleida Health (KH) and Roswell Park Cancer Institute (RPCI) have each provided a detailed description of the current access control and security systems in place, as seen in **Attachment A**. This information has been provided to the architects and engineers for each of the current capital projects (SMBS, CHOB and Conventus) in order to ensure that new systems under development are coordinated and compatible with existing systems.

The Public Safety PMG has also examined the current operations and credentialing procedures of each involved agency in order to ensure a well-coordinated and efficient method for providing access and security in the semi-public corridor. This has involved examining the current procedures of existing multi-tenant facilities on the Campus, including the NYS Center of Excellence in Life Sciences (UB and RPCI) and the GVI/CTRC (UB and KH).

3. Proposed Access Control System

Based on the discussions held among members of the BNMC Public Safety PMG, the following diagram portrays use of an integrated multi-class card reader that works with multiple database systems and security platforms across various organizations. The uniqueness of this system is that each individual database and control panel is wired directly to each card reader, which contains dual-technology/multi-class capabilities and splitters to accept multiple inputs or streams. In this option, the type of card readers would be for the most part uniform throughout the entire corridor.



Note: KH has proposed a test site for this model at the entrance to the BGMC E-Building in order to accommodate RPCI and UB parkers in the MiGo.

The following provides a step-by-step description of the system portrayed in the above diagram:

1. Administrative Approvals
 - a. Members of the BNMC Public Safety PMG will develop a Memorandum of Understanding (MOU) for the corridor that will include the following:
 - i. Levels of access for various groups
 - ii. Hours of operation and areas of public versus restricted access
 - iii. Procedures for deactivation
 - iv. Installation and maintenance of security equipment
 - v. Monitoring of surveillance equipment and access controls
 - vi. Emergency response
 - b. Each involved organization will dedicate an Access Manager to assign the proper levels of access based on the MOU.
 - c. Access Managers will be responsible for upholding the agreed upon credentialing process as determined in the MOU.
 - d. The Access Managers will communicate directly with each other to address issues such as emergency deactivations and unwanted individuals.
2. Database Management
 - a. Each Access Manager will be responsible for updating the individual database of authorized employees, students, etc... for their respective organizations.
3. Security Platforms
 - a. Each entity will continue to maintain their individual security systems platform, as presented in **Attachment A** (e.g. Pro-Watch, Stanley-Best, Lenel, etc...).
4. Card Readers (see **Attachment B** for cut sheets of proposed readers)
 - a. Each card reader is wired directly to each entity's individual control panels.
 - b. Multi-class card readers contain dual-technology capabilities and splitters to accept multiple feeds. Splitters can be "daisy chained" to connect to as many control panels as necessary as the system grows.
 - c. Employees/students with the proper credentials can navigate the semi-public corridor using his or her unique ID card/badge at each of the permitted access points.

The following provides a list of **pros and cons** associated with the proposed access control system based on feedback provided by members of the Public Safety PMG.

Pros were identified as:

1. Commonly used in multi-tenant buildings and campuses, as seen in **Attachment C: Case Study** from Arizona State University.
2. Allows for both autonomy and integration.
 - a. Card readers will be integrated with multiple databases and individual operating platforms of various entities.
3. Lighter administrative load.
 - a. Each participating entity can permit access to the semi-public corridor without the administrative task of updating all other systems.
4. Flexibility.
 - a. The system/card readers can be easily adjusted for future changes in users, technologies, security policies or credentialing processes.

Cons were identified as:

1. Requires a certain level of trust among entities.
2. There are some concerns associated with the cost of cabling and equipment.
 - a. Requires a significant amount of wiring back to each individual control panel.
 - b. It is assumed that integrated/multi-class card readers are more expensive.

4. Operational Assumptions

The following is a list of assumptions based on discussions with the BNMC Public Safety Project Management Group regarding public safety operations and access controls in the semi-public corridor:

- The corridor will be used by employees and credentialed visitors who will be required to pass through a series of checkpoints.
- Lockdown capabilities between links will be in place for emergency situations.
- Database sharing between organizations will be necessary in order to identify any unwanted or dangerous individuals.
- KH will provide public safety services for Children's Hospital as well as the 2nd and 3rd floors of Conventus where the semi-public corridor is located. Services include:
 - Installation and monitoring of camera and alarm systems.
 - Responding to emergency situations.
 - Maintaining visitor identification programs.
- It is yet to be determined who will be providing public safety services for UB in the SMBS and RIA portions of the corridor. Nonetheless, close coordination with KH Public Safety will be required to monitor connections 2 and 3 as described above.
- RPCI will be installing their own security and access control systems for their portion of Children's Hospital (10th floor); however, it is currently assumed that RPCI will not have an RPCI officer presence in the CHOB, but rather coordinate with KH Public Safety.
- UB will continue use of magnetic stripe cards for student ID's while KH and RPCI continue to utilize proximity cards for employee badges, there will need to be dual-technology readers installed in shared areas, such as throughout the semi-public corridor.
- NFTA will continue to provide for security throughout the NFTA station and a small portion of the semi-public corridor which connects to the station.

Attachment A

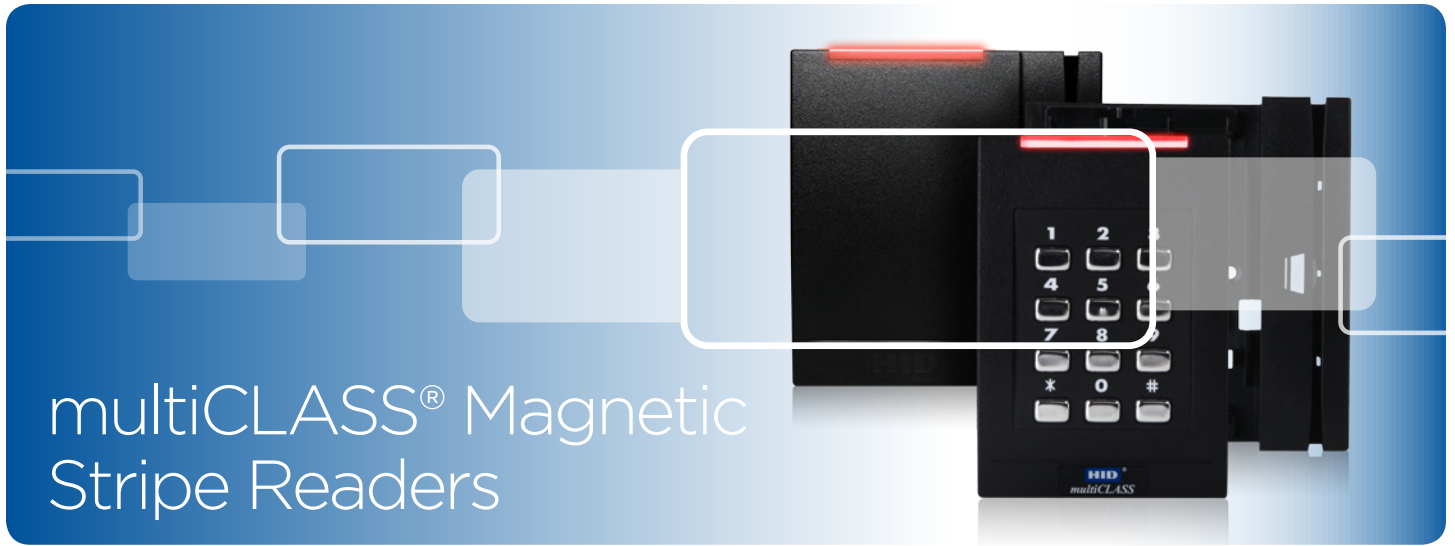
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Access Control Technology	KH	UB
Operating Platform	Pro-Watch® Security Management Suite 4.0	Stanley/Best BASIS system, BASIS ET692 server software w/ RHEL Server release 5.7 and a dedicated Oracle instance
Typical of ID Cards	HID's Corporate 1000	Magnetic Stripe; cr80 card with a hico mag stripe
Typical Access Control Readers	HID 125 MHz prox readers	Controller models BAS-3300, BAS-2220, BAS-2000, BAS-1000, and BAS-500. Readers LNL-2005W (typical)
Security Camera Technology		
Viewing Platform	Viconnet 6.6	Milestone video surveillance software: XProtect Corporate edition, version 5.0
Typical Fixed Cameras	Viconnet Surveyor Network Dome Series HD 1080p	Axis Communications Q1755
Typical Pan/Tilt/Zoom (PTZ) Cameras	Viconnet Indoor/Outdoor Fixed 1080p (2 megapixel)	Axis Communications Q6032-E
Analytical Data Servers	Agent Vi's real-time video analytics software and Vi-System Event Dispatcher notification of real-time events via email, SMS, MMS, pager or other communication application.	Milestone video surveillance software: XProtect Corporate edition, version 5.0
Video Data Management System	Viconnet Storage Area Networks (SANs) and iSCSI Protocol	Milestone video surveillance software: XProtect Corporate edition, version 5.0
Campus Blue Light Alarm Technology		
Typical Mounts and Towers	Code Blue or Talk a Phone	Talk-A-Phone WEBS-MT/R-OP-4
Monitoring Platform	Commend Intercom 2.0	Phones are ring down centrex lines to VoIP at Police Dispatch
Typical Interface Used	Station	Talk-A-Phone Emergency phones: model ETP-400

	<i>KH</i>	<i>UB</i>
Panic Alarm / Intrusion Alarm Technology		
Monitoring Platform	Pro-Watch® Security Management Suite 4.0	ABM Phonenix automation Software
Typical Personal Panic Alarm Devices	Wireless Liner Corp. / Hardwired US Data Control	panic device with NO/NC contacts
Typical Door Contact	Sonitrol	contacts to suit door hardware (NO/NC)
Typical Passive Device	Sonitrol	passive infrared motion sensor
Visitor Pass Management		
Vendor Pass System	VeriRep is a web-based credentialing and compliance management program.	n/a
Visitor Pass System	BadgePass Visitor Manager	n/a
Broadcast Paging		
Zone paging system		Talk-A-Phone WEBS Zone Paging System (ZPS)

Attachment B

DRAFT



13.56 MHZ CONTACTLESS AND 125 KHZ PROXIMITY CARD READERS

- **Simple Migration** - From legacy magstripe and proximity technologies to 13.56 MHz smart card technology
- **Increased On-site Security** - Replace magstripe backplate with standard backplate for contactless 13.56 MHz-only compatibility after site migration
- **Dual Factor Authentication** - Combine contactless card presentation with a PIN
- **GSA-approved** - Included on the U.S. General Services Administration (GSA) FIPS 201 Approved Products List (APL)

multiCLASS® Magnetic Stripe readers are designed for customers upgrading their current access control card system from the popular magnetic stripe (“magstripe”) technology to the enhanced security of 13.56 MHz smart card technology. Supporting access control technology combinations including magnetic stripe, keypad, HID Prox and 13.56 MHz smart card technology (including iCLASS®), the multiCLASS Magnetic Stripe reader line represents the ultimate in flexibility, enabling a cost effective, time-feasible and truly seamless migration solution with no operational disruption.

Migration products without reader and credential components can require large initial capital investments; the multiCLASS Magnetic Stripe reader line features an affordable, standards-based migration path to secure credential technology. By implementing a solution based on multiCLASS Magnetic Stripe readers and HID multi-technology credentials, organizations can integrate the migration into their existing badging programs, supporting a low investment level spread over time for migration to a

secure technology across multiple facilities. Organizations switching to the multiCLASS reader’s enhanced security can also increase convenience and draw more return on credential investment by adding applications enabled by a single card.

The removable vertical magnetic stripe reader and contactless 125 kHz support make user interaction with the reader familiar, maintaining operational access throughout the facility and reducing user confusion during migration. Designed for flexibility, the vertical magstripe backplate can be mounted on the left or right side of the core contactless wallswitch reader frame. After a site fully migrates off magstripe cards, users can replace the magstripe backplate with a standard backplate for increased security from contactless 13.56 MHz-only compatibility.

The multiCLASS family of products provides true iCLASS security, the ease of proximity technology, the power of smart cards and the confidence of choosing Genuine HID.



SPECIFICATIONS

	RMK40 multiCLASS Magnetic Stripe Reader with Keypad	RMPK40 multiCLASS Magnetic Stripe Reader with Prox and Keypad	RM40 multiCLASS Magnetic Stripe Reader	RMP40 multiCLASS Magnetic Stripe Reader with Prox
Part Numbers	6230C (Wiegand) 6238C (Clock-and-Data)	6236C (Wiegand) 6233C (Clock-and-Data)	6220C (Wiegand) 6228C (Clock-and-Data)	6225C (Wiegand) 6223C (Clock-and-Data)
Read Range	iCLASS Card: Up to 4.0" (10.2 cm) iCLASS Key/Tag: Up to 1.25" (3.2 cm) MIFARE/DESFire Card (CSN): Up to 2" (5.1 cm)	iCLASS Card: Up to 4.0" (10.2 cm) iCLASS Key/Tag: 1.25" (3.2 cm) MIFARE/DESFire Card (CSN): Up to 1.75" (4.5 cm) HID Prox ISO Card: Up to 3.25" (8.3 cm) HID Prox Clamshell Card: Up to 3.75" (9.5 cm) HID Prox Keyfob/Tag: Up to 1.5" (3.8 cm)	iCLASS Card: Up to 4.75" (12.1 cm) iCLASS Key/Tag: Up to 2.0" (5.1 cm) MIFARE/DESFire Card (CSN): Up to 2.5" (6.4 cm)	iCLASS Card: Up to 4.25" (10.8 cm) iCLASS Key/Tag : Up to 1.5" (3.8 cm) MIFARE/DESFire Card (CSN): Up to 2.0" (5.0 cm) HID Prox ISO Card: Up to 3.25" (8.3 cm) HID Prox Clamshell Card: Up to 3.75" (9.5 cm) HID Prox Keyfob/Tag: Up to 2.0" (5.0 cm)
Mounting	Two-piece plastic cover/electronics and mounting plate. Mounting plate with built in vertical swipe magnetic reader. Magnetic swipe can be mounted on left or right of reader. Mounting plate attaches to U.S. back box, 52-60 mm screw hole spacing (vertical or horizontal), or to any flat surface. Reader cover/electronics secured to mounting plate with security screw. Increase security by replacing mounting plate with built in vertical swipe magnetic reader with a standard mounting plate after magnetic card migration has complete.			
Color	Black			
Dimensions	4.81" x 4.47" x 1.15" (12.2 cm x 11.4 cm x 2.9 cm)		4.81" x 4.47" x 1.05" (12.2 cm x 11.4 cm x 2.7 cm)	
Weight	9.7 oz (275 g)		8.8 oz (250 g)	
Power Supply	5-16 VDC, Linear supply recommended			
Power Requirements	AVG = 110 mA, PEAK = 169 mA @ 12 VDC		AVG = 90 mA, PEAK = 166 mA @ 12 VDC	
	Nominal Wattage = 1.32 W		Nominal Wattage = 1.08 W	
Operating Temperature	-31° to 150° F (-35° to 65° C)			
Operating Humidity	5% to 95% relative humidity non-condensing			
Transmit Frequency	13.56 MHz	13.56 MHz and 125 kHz	13.56 MHz	13.56 MHz and 125 kHz
13.56 MHz Card Compatibility	iCLASS 15693, Reads Secure HID Access Control Application, All memory sizes ISO 14443A/14443B US Government FIPS-201 (PIV) ISO 14443A (MIFARE [®] and DESFire [®]) - serial number, ISO 15693 - serial number, ISO 14443B - serial number			
125 kHz Card Compatibility	N/A	HID Prox and AWID Credentials	N/A	HID Prox and AWID Credentials
Magnetic Card Data Tracks	1 or 2			
Magnetic Card Speed	8 to 50 inches per second			
Magnetic Card Data Output	All bits Wiegand or Clock-and-Data; Various ABA to Wiegand formats; Supports most Dorado formats ¹			
Cable Distance	Wiegand/Clock-and-Data Interface 500ft (150m) (22AWG)			
Termination	Pigtail or Terminal Strip			
Certifications	UL294/cUL ² (US), FCC Certification (US), IC (Canada), CE (EU), C-tick (Australia, New Zealand), SRRC (China), MIC (Korea), NCC (Taiwan), iDA (Singapore), RoHS			
Housing Material	UL94 Polycarbonate			
Keypad	Yes (4x3)		No	
Family Model	RMK40C	RMPK40C	RM40C	RMP40C
Warranty	Warrantied against defects in materials and workmanship for 2 years			

¹ See 13.56 MHz How To Order Guide for more details

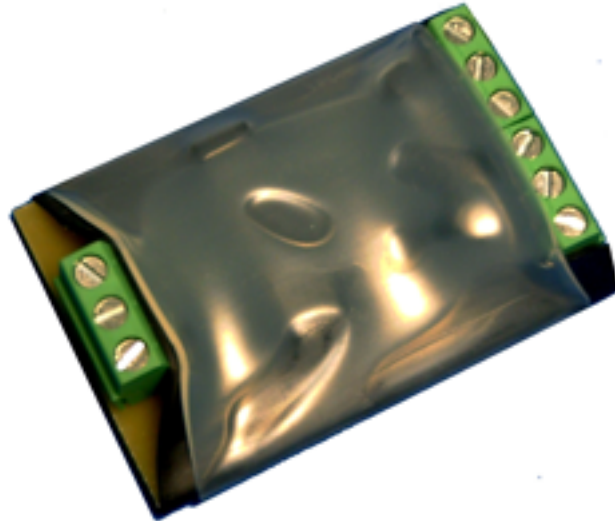
² UL294/cUL certified for Wiegand interface and outdoor use

CYPRESS

CVT-OPTW

Operations Manual

Wiegand Splitter



EXP-1000
Part 15 Class A



CVT-OPTW_MAN_111711

Electrical and Mechanical Specifications

Physical	2.313" x 1.625" x 0.625" -	
Temp	Storage(-55°C to + 150°C) Operating(-40°C to +80°C)	
Humidity	95% (non-condensing)	
Power	Input	+5VDC @100mA
	Output	
Data I/O	Interface	Reader 0- 30VDC LED - 0 - 30VDC Analog 0 - 5 VDC

FCC Part 15 COMPLIANCE



This device complies with part 15 of the FCC Rules.

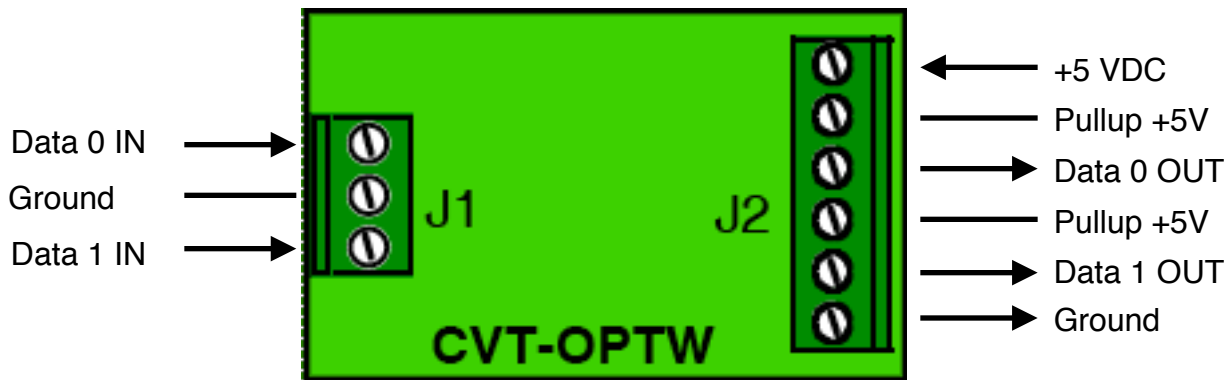
Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

The CVT-OPTW is designed to provide isolation between different Wiegand signal sources.

The CVT-OPTW allows multiple readers and panels to be connected together

The CVT-OPTW also allows systems with different voltage levels to be electrically connected together.



J1 Connector

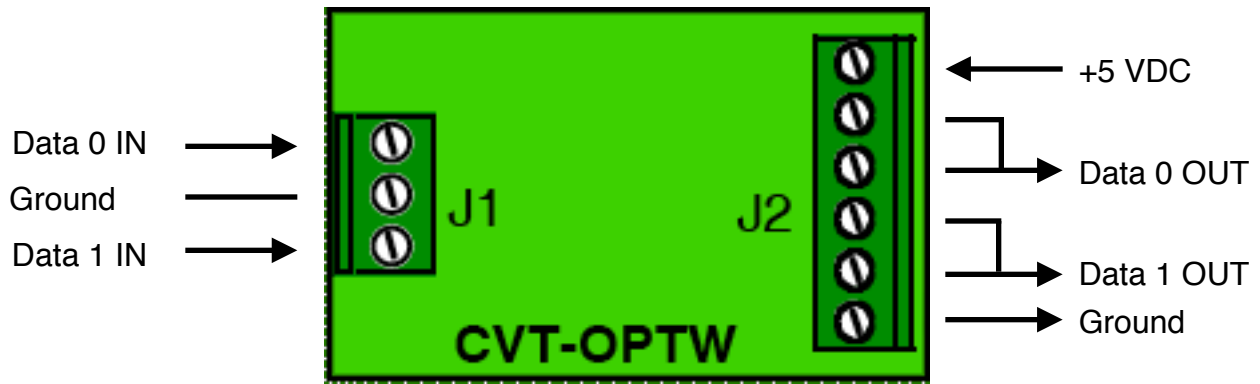
- Gnd - Input Ground
- Data 0 In - Wiegand Data Input 5- 24 VDC
- Data 1 In- Wiegand Data Input 5 - 24 VDC

J2 Connector

- 5 vdc - Input - regulated 5 vdc @ 30ma
- Pullup +5V - Connection to pullup resistor 1k @ 5VDC
- Data 0 OUT - Open collector Wiegand data output
- Pullup +5V - Connection to pullup resistor 1k @ 5VDC
- Data 1 OUT - Open collector wiegand data output
- Gnd - Output ground

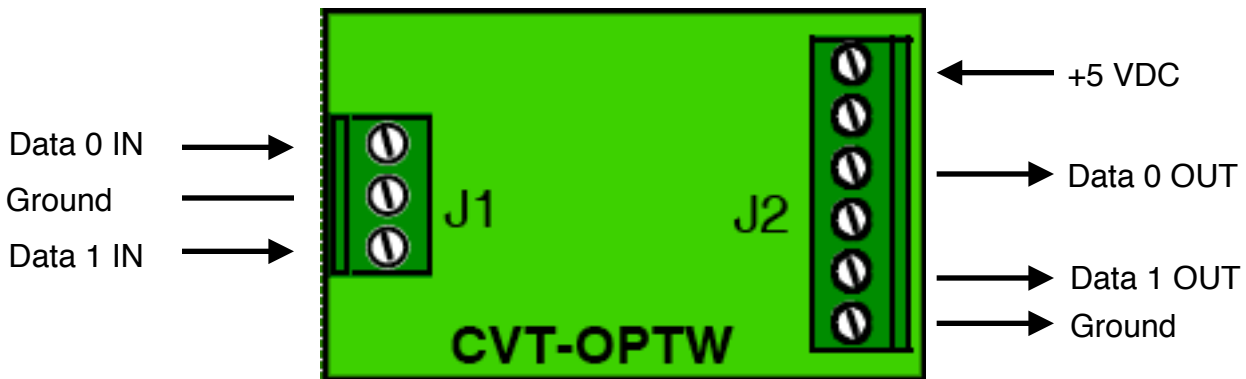
Notes:

1. Input Ground and Output Ground are electrically isolated.
2. +5VDC (Regulated) is required to operate converter.

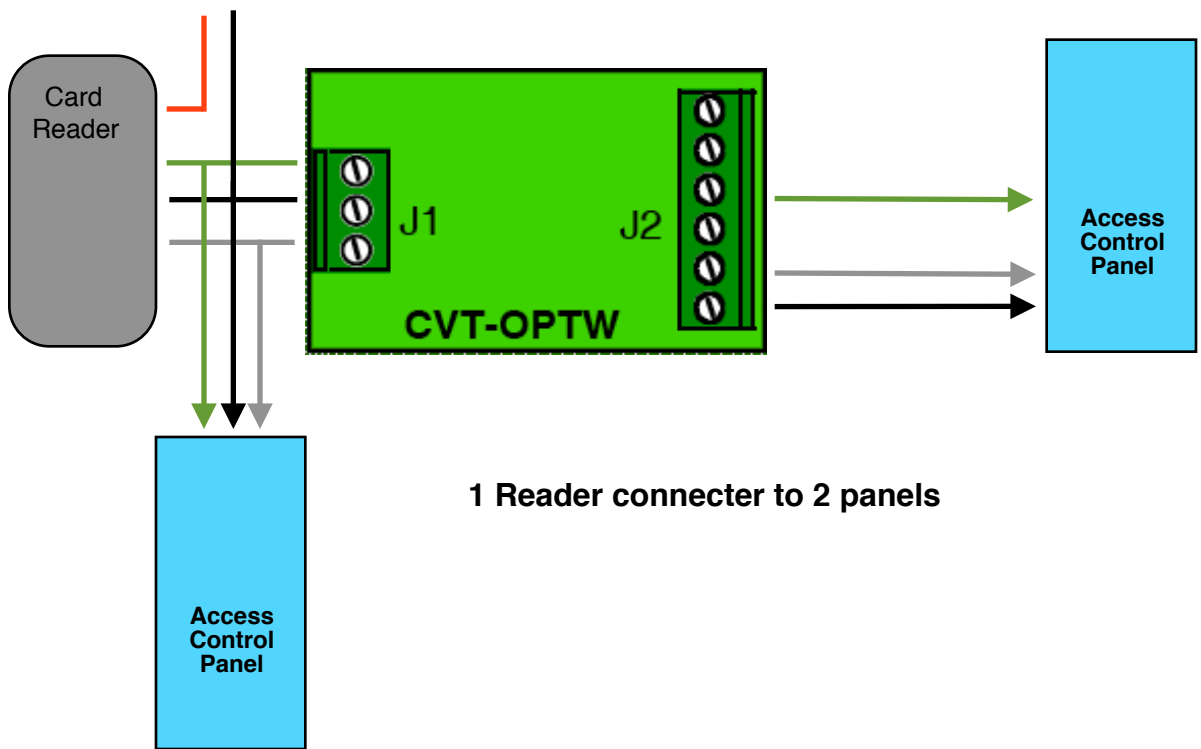
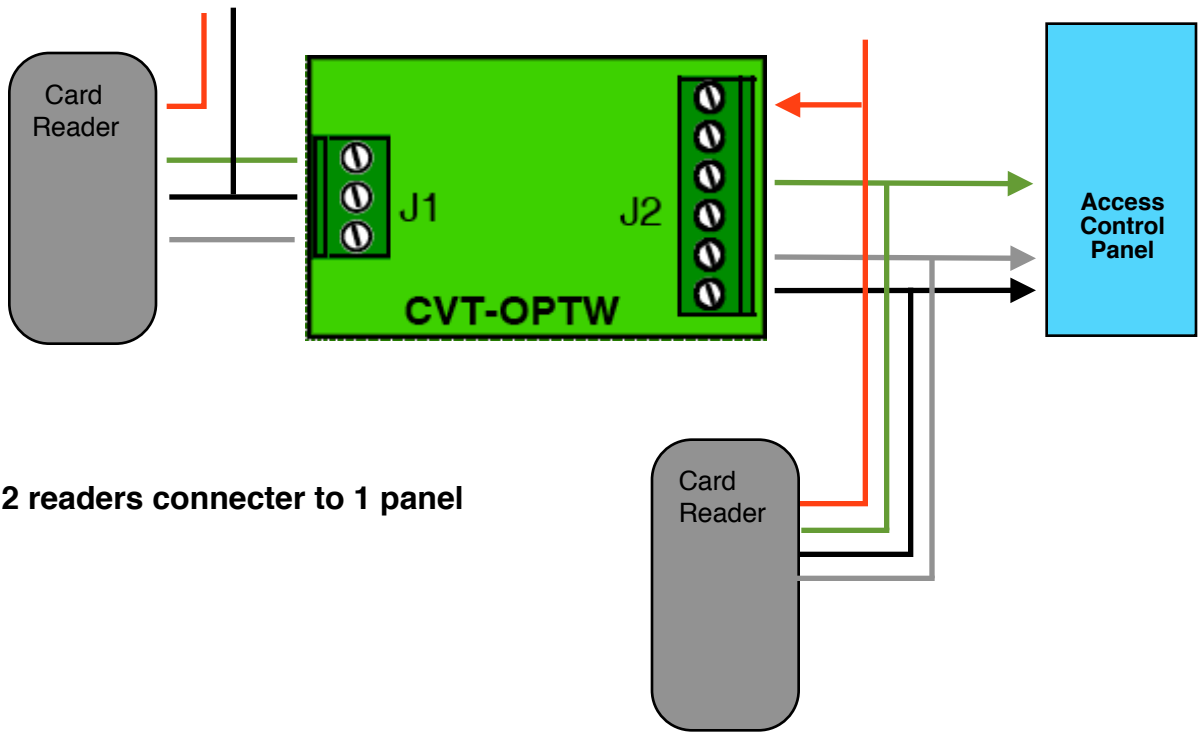


Previous versions of the CVT-OPTW had internal pullup resistors internal connected to the output ports. These pullup resistors were wired to the +5VDC supply. This newer version provides the option of connecting the pullup resistors in order to allow connection as a true open collector output.

With the pullup resistors connected as indicated in the above diagram, the new OPTW is equivalent to the previous version.



If voltage levels other than 5 volts are required at the output, then do not connect the internal pullup resistors. The outputs are now open collector and will work with voltages from 5 to 24 VDC. Depending on the system, pullup resistors to the higher voltage may be required.



Attachment C

DRAFT




ARIZONA STATE UNIVERSITY

Customer Case Study

- Flexible, future-proof integrated security
- Campuswide system functionality

TECHNOLOGY/PRODUCTS

- *iCLASS*® RK40 Keypad Readers
- *iCLASS* R10 and R40 Readers
- *iCLASS* Cards: 16-bit composite with a magnetic stripe
- Corporate 1000 End User Program



"With their expertise and reliability, HID was our preferred integration partner..."

- Mike Tiffin of Henry Bros. Electronics

Future-Proof Multi-Function Card System Expands Campuswide Security for Arizona State University

Arizona State University is one of the premier metropolitan public research universities in the U.S. Enrolling more than 57,000 undergraduate, graduate, and professional students on three campuses in metropolitan Phoenix, including the historic main campus in Tempe, ASU maintains a tradition of academic excellence in core disciplines, and has become an important global center for innovative interdisciplinary teaching and research.

Challenge

Since 1997, ASU's identification/access "Sun Card" system provided students with meal plan, debit, and door access. Heightened security concerns led ASU to re-examine the university's campus security requirements and identify a best-of-breed product that would provide state of the art access control technology. The previous Sun Card system was based on a magnetic stripe cards and readers, which were functional but offered limited flexibility to adapt to future technologies such as biometric identification. The ideal solution would be an advanced contactless smart card that could integrate a multitude of new identification technologies and applications as well as a magnetic stripe for use with existing readers on campus. The cards needed to be custom-printed and have a streamlined, sturdy design ensuring the durability of the single-issue card throughout multiple years of constant use during a student's time on campus.

Solution

The university evaluated both proximity and contactless smart card systems for a centralized campuswide access control solution for doors, buildings, and departments that could be integrated with other smart card applications. Henry Bros. Electronics, a leading end-to-end security solutions integrator based in Phoenix, Arizona, was selected to implement the access control system and incorporated HID's *iCLASS* 13.56 MHz read/write contactless technology for its sophisticated features that enhance traditional RFID contactless technology including cryptographic data storage, mutual authentication, and secure reading and writing of data.



“...the **iCLASS** card’s high-performance, contactless access control and identification technology capabilities provides ASU with a robust, reliable solution for today as well as giving this system the flexibility to address future security needs.”

- Mike Tiffin of Henry Bros. Electronics

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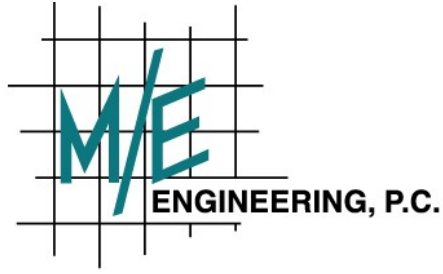
“With their expertise and reliability, HID® was our preferred integration partner, and the **iCLASS**® card’s high-performance, contactless access control and identification technology capabilities provides ASU with a robust, reliable solution for today as well as giving this system the flexibility to address future security needs,” said Mike Tiffin of Henry Bros. Electronics.

The new contactless HID card enables higher security than was previously available using the magstripe card, enabling ASU to use the system software to approve or deny access on any door at any time. Perimeter doors were brought online with HID **iCLASS** R10 and R40 **iCLASS** mullion mounted readers. To meet ADA requirements, an **iCLASS** reader is tied into a door operator and allows entry after a hardwired button is pressed and the valid card is presented. HID **iCLASS** mutual authentication technology insures that readers and cards are programmed to communicate prior to the reader sending any signal to the panel. This same authentication will occur any time the **iCLASS** card is used for IT security or other on-campus applications. In addition, the new **iCLASS**-based technology is more flexible, offering unique time zone and access level setups not previously available. For example, labs may schedule access levels so that students can gain entrance to labs only at their appointed times.

The ASU Sun Card, a 16-bit composite **iCLASS** contactless smart card with magnetic stripe is printed with the student’s photo along with the ASU logo. HID’s Corporate 1000 Program provides the university with a unique 35-bit card format developed specifically for ASU and furnishes over one million plus individual card numbers within the assigned format. The assigned numbers are tracked during the manufacturing process to ensure that card numbers are never duplicated. These Corporate 1000 cards offer the students a single, universal card to use throughout the university’s campus. The university plans to issue over 40,000 student and staff cards over the next two years at a rate of 20,000 per year.

The versatile **iCLASS** card is able to grow with the university’s access control system and add holograms, magstripe, and biometrics.

Appendix C BNMC Smart Card Feasibility Study



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BNMC Smart Card Study

Smart Card Feasibility Study



**Buffalo Niagara
Medical Campus**

Buffalo Niagara Medical Campus

640 Ellicott Street

Buffalo, New York 14203

August 13, 2014

M/E Reference 131231

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TABLE OF CONTENTS

	<u>Pages</u>
I. EXECUTIVE SUMMARY	1 - 4
A. Introduction	
B. Stakeholder Outreach and Engagement	
C. Analysis and Recommendations	
II. GENERAL	5 - 14
A. Introduction	
B. Stakeholder Outreach and Engagement	
C. Analysis	
D. Recommendations	
III. BUFFALO NIAGARA MEDICAL CAMPUS (BNMC)	15 - 18
A. Existing Systems	
B. Analysis	
C. Recommendations	
IV. NIAGARA FRONTIER TRANSIT AUTHORITY (NFTA)	19 - 21
A. Existing Systems	
B. Analysis	
C. Recommendations	
V. BUFFALO CARSHARE	22 - 23
A. Existing Systems	
B. Analysis	
C. Recommendations	
VI. SOCIAL BICYCLES	24 - 25
A. Existing Systems	
B. Analysis	
C. Recommendations	
VII. ROSWELL PARK CANCER INSTITUTE (RPCI)	26 - 28
A. Existing Systems	
B. Analysis	
C. Recommendations	

VIII.	KALEIDA HEALTH (KH)	29 - 32
	A.	Existing Systems
	B.	Analysis
	C.	Recommendations
IX.	SUNY UNIVERSITY OF BUFFALO (UB)	33 - 39
	A.	Existing Systems
	B.	Analysis
	C.	Recommendations
X.	MANAGEMENT AND BACKEND OPERATION	40 - 45
	A.	General
	B.	Accounts Management
	C.	Loyalty Program Opportunities
	D.	Recommendations
XI.	CONCLUSIONS/SUMMARY	46 - 47
XII.	APPENDIX	
	A.	Site Plan
	B.	Meeting Minutes
	C.	Stakeholder Survey Summary
	D.	Schematic Wiring Diagram
	E.	Employer's Tax Guide to Fringe Benefits
	F.	Letter of Recommendation for BNMC Mobility HUB and Bicycle Parking Facility Access Control System
	G.	MIFARE DESFire EV1 Information
	H.	Proposed NFTA Card Reader
	I.	Convadis Hardware
	J.	Autovera Software

I. EXECUTIVE SUMMARY:

A. Introduction:

1. The intent of this study is to identify if and how an integrated access control and fare vending system can be created on the Buffalo Niagara Medical Campus in which a single smart card could be used to access a wide array of transportation services and secured Campus facilities. This smart card would allow a user to access NFTA Metro Rail and Bus services, University at Buffalo Shuttle services, Buffalo CarShare vehicles, Social Bicycle bikes, secure bike parking facilities and shared public corridors that create “coatless connections” between Campus buildings.
2. The project is not seeking to replace the existing access control systems of the Campus stakeholders (BNMC, Inc., Kaleida Health, Roswell Park and University at Buffalo). The objective is to enable a single smart card that has multiple technologies, activate a multitude of transportation options, and grant access to facilities throughout participating Consortium entities.
3. The project is also looking into a loyalty program for the smart card users.

B. Stakeholder Outreach and Engagement:

1. In addition to user meetings between the stakeholders and consulting team, an on-line survey was created to collect information on and understand the access control and fare vending systems that are currently being used or are planned to be used by the individual stakeholders.
2. The main objective of this survey was to define the existing and planned systems and the potential interoperability with the other stakeholder systems.
3. Most stakeholders who participated in the interview process expressed their preference for retaining their own individual card user databases, and did not wish to create a new, centralized mixed-user database.

C. Analysis and Recommendations:

The study first analyzed existing cards and access systems for the stakeholder institutions (BNMC, Inc., Kaleida Health, Roswell Park and University at Buffalo) to see if the existing systems are compatible with one another and with the transportation service provider systems. The study found that these systems are NOT compatible with one another, and to be made compatible, the institutions would have to replace their entire access control systems with a new system. Therefore, the study recommends:

1. Create a new multi-use transportation card that is compatible with the transportation service provider systems. This would allow the institutions to keep their existing access systems, which would be too expensive to replace. This secondary GO CARD would be given to interested employees who utilize these transportation services. The GO CARD would have multiple technologies present and would be ISO 14443 compatible. The GO CARD would have the following components:

- a. MIFARE DESFire EV1: This technology would make the card compatible with the proposed NFTA, UB Shuttle, CarShare, BikeShare and bike storage facility systems.
 - b. Magnetic Stripe: This technology would make the card compatible with potential loyalty/reward programs as well as with other vendors that have yet to be identified.
 - c. 125 kHz Proximity Device (optional): This technology would make the card compatible with BNMC, Inc.'s and Kaleida Health's existing access control systems. Therefore, these two organizations could replace their existing cards with the proposed GO CARD so that employee's only need 1 card to access these services and facilities.
 - d. Cost of Cards: MIFARE + Magnetic Stripe = \$8 per card ; MIFARE + Magnetic Stripe + 125 kHz = \$12 per card
2. Utilize CBORD as the GO CARD's Account Management System. The GO CARD would have an account based system (ABS) to manage access permissions and payments. CBORD has been identified as an ABS that meets this project's goals, and is currently being used by the University at Buffalo and several other local colleges to manage student and employee card accounts. CBORD acts as a user profile with a prepaid debit account that allows a user to put money in to this account to be used at participating vendors. CBORD has single-sign-on and integration capabilities that would allow this account to be linked to service provider accounts so that funds for these services are stored in one location, and so that these services can be accessed from one location, or "portal." The portal would be located on www.gobnmc.org and would allow the user to:
- a. Request a GO CARD / Add funds to GO CARD
 - b. Sign up for NFTA services
 - c. Sign up for UB Shuttle services
 - d. Become a member of Carshare and reserve vehicles
 - e. Become a member of BikeShare and reserve vehicles
 - f. Sign up for access to Bike Storage Facilities
 - g. Find carpool matches
 - h. Register a carpool group
 - i. Sign up for other BNMC transportation demand management programs

3. Install multi-format card readers in shared corridors. Because each stakeholder has a unique access control system for their facilities, and because it would be cost-prohibitive or infeasible because of security measures to replace all controls with a unified system, it is recommended that the stakeholders replace existing card readers or provide new card readers at all shared corridor entrance points. These updated card readers would be multi-technology and multi-format so that they are compatible with all existing cards, as well as the proposed GO CARD. The card readers would output serial communication in Wiegand or RS-485 format protocol in order to interface with most of the existing stakeholder access control systems. The backend system for the shared corridors would enable multiple stakeholders to have the ability to verify permission of the user and unlock doors. The local control system would communicate out, to the appropriate stakeholder database, validate the user access permission, respond back to the local panel, and unlock the entrance. Each stakeholder would control their own employee's access to these shared corridors.

The design make for these readers is: Ingersoll Rand, AptiQ MTMS15

D. Next Steps:

BNMC, Inc. will work with the stakeholders to conduct a demonstration program for the new GO CARD. The following information outlines the steps needed to be taken to implement the demonstration program. Please note that the NFTA will not be part of the demonstration program due to its new fare vending system not being ready until late 2016. The demonstration program will prepare the system for integration with the NFTA system, however.

1. Develop GO BNMC Account Management System
 - a. BNMC, Inc. will work with UB's Faculty Student Association to estimate the cost of gobnmc.org's account management system, which will utilize CBORD software created by UB.
 - b. BNMC, Inc., in coordination with UB's Faculty Student Association, will develop the backend system for gobnmc.org and for the GO CARD. This will include the development of single-sign-on functions that integrate service provider user accounts with the new GO BNMC user accounts.
 - c. BNMC, Inc. will develop administrative responsibilities in relation to the creation and activation of the new GO CARDS, including the purchase of the GO CARDS and card printers/accessories.
2. Install multi-format card readers on Bike Storage Facilities
 - a. BNMC, Inc. will purchase and install the preferred card readers for the Ellicott-Virginia Bike Storage Facility, and this facility will become part of the initial demonstration program. The construction of the GO ZONE/Mobility Hub bicycle complex has been delayed at the state level, and therefore the complex cannot become part of the demonstration project until completed, which is tentatively scheduled for the summer of 2015.

- b. BNMC, Inc. will integrate GO BNMC user accounts with the Bike Storage Facility accounts via the CBORD system.
 3. Integrate NFTA system into the GO CARD system.
 - a. BNMC, Inc. will work with the NFTA on ways to integrate NFTA's customer accounts for their future vending system in to the GO BNMC Account Management System.
 - b. BNMC, Inc. will work with Campus institutions so that their employee's pre-tax transit funds can be deposited in to the BNMC Account Management System automatically through payroll deduction. This will allow employees to pay for transit using pre-tax dollars.
 4. Integrate Buffalo CarShare system into the GO CARD system.
 - a. The hardware and software currently being used by CarShare is not compatible with the proposed GO CARD. BNMC, Inc. will work with CarShare to identify the cost of, purchase and install their preferred hardware and software upgrades (either INVERS or METAVERA Autovera).
 - b. BNMC, Inc. will integrate GO BNMC user accounts with CarShare accounts via the CBORD system.
 5. Integrate Social Bicycles system into the GO CARD system.
 - a. Social Bicycles are currently not compatible with the proposed GO CARD, but Social Bicycles is upgrading their fleet to a system that will be compatible. BNMC, Inc. will work with Social Bicycles to integrate GO BNMC user accounts with BikeShare accounts via the CBORD system.
 6. Integrate UB Shuttle system into the GO CARD system.
 - a. BNMC, Inc. will work with UB to install the preferred access control system on the UB Blue Line and Wave Shuttles.
 - b. BNMC, Inc. will integrate GO BNMC user accounts with UB Shuttle accounts via the CBORD system.
 7. Identify vendors for Loyalty Programs.
 - a. BNMC, Inc. will identify local vendors who are interested in participating in a GO CARD Loyalty Program, based on UB's FlexiBull Program. BNMC, Inc. will provide the vendors with the necessary hardware/software to be incorporated in to the system.

II. GENERAL:

A. Introduction:

1. M/E Engineering, P.C. and U&S Services Inc. were selected by the Buffalo Niagara Medical Campus (BNMC) to provide a Smart Card Feasibility Study as part of the BNMC Smart Card Feasibility Study and Demonstration Project which is funded by NYSERDA and NYSDOT as outlined in BNMC's RFP dated December 4, 2013. This study will be utilized as the basis for a future small-scale demonstration project, which is not included in this scope of services.
2. The intent of this study is to provide analysis and recommendations for the development of an integrated access control and fare vending systems in which an integrated single smart card can be used to access a wide array of transportation services and secured facilities on the Medical Campus. The project is not seeking to replace existing access control systems. The study will determine if existing cards being used by stakeholders are compatible with other stakeholders access systems, how they can be made to be compatible with the other access systems, or if a new card is needed to ensure integration and compatibility. The project is also looking to investigate a loyalty program for the smart card users.
3. The project involves the Buffalo Niagara Medical Campus located in Buffalo, NY. The BNMC is a consortium of nine (9) research, healthcare and educational institutions and over 50 smaller companies all located on 120 acres just north of the City of Buffalo's Central Business District. The Campus is roughly bounded by Michigan Avenue to the east, North Street to the north, Main Street to the west, and Goodell Street to the south, refer to Appendix-A for Site Plan.
4. The specific scope of work for this study includes the following tasks:
 - a. Stakeholder outreach and engagement.
 - b. Determine compatibility solutions and costs for existing and future/planned access control and fare vending systems.
 - c. Determine the preferred management and backend operation system for the proposed Smart Card.
 - d. Determine preferred accounts management system for the user.
 - e. Identify loyalty program opportunities.

B. Stakeholder Outreach and Engagement:

1. On February 26, 2014 a project kick-off meeting was held with the Consultant Team and the Stakeholders in order to outline the project scope, goals and objectives. Meeting minutes are included in Appendix B.

2. The Stakeholder Project Team includes a wide array of transportation service providers, advocates, and healthcare/educational institutions including:
 - a. Buffalo Niagara Medical Campus (BNMC, lead agency for this project)
 - b. University at Buffalo (UB)
 - c. Roswell Park Cancer Institute (RPCI)
 - d. Kaleida Health (KH)
 - e. Niagara Frontier Transportation Authority (NFTA)
 - f. GoBike Buffalo
 - g. Buffalo CarShare
 - h. Social Bicycles
 - i. NYSDOT
 - j. NYSERDA
3. It was agreed upon to utilize an online survey in order to collect data on each stakeholder's existing system as well as their individual goals for the Smart Card Program. A description of existing access control and fare vending systems is below. Additional information collected in the survey is included in Appendix C.

C. Analysis:

1. The objective is to enable a single smart card that supports multiple technologies, that could activate a multitude of transportation options, and grant access to facilities throughout participating Consortium entities. For instance, an NFTA Metro Rail commuter that works at the BNMC and has a Buffalo CarShare membership could use their Smart Card to access (1) the light-rail rapid transit to get to work, (2) access the building where they work, and (3) access a CarShare vehicle for getting to a lunch meeting across town.
2. Description of Different Card Technologies:
 - a. Magnetic Stripe Card:
 - 1) A magnetic stripe card stores its user data on a magnetic band of material contained in a stripe on the card. The magnetic stripe, sometimes called swipe card or magstripe, is read by swiping the band of magnetic material past a magnetic read head within the card reader.
 - 2) Magstripes come in two (2) main varieties: High-coercivity and low-coercivity.

- a) Low coercivity cards are generally less expensive to produce and are suitable for cards meant to be disposed after a few uses. Low coercivity magnetic stripes are a light brown color.
 - b) High coercivity stripes are resistant to damage from most magnets (i.e.: cell phone) likely to be carried by cardholders. High coercivity stripes are nearly black or silver.
- 3) There are up to three tracks of information contained on magnetic cards referred to as Tracks 1, 2, and 3. Point-of-sale card readers almost always read Track 1 or Track 2 (and sometimes both) in case one track is unreadable. The minimum cardholder account information needed to complete a transaction is present on both tracks. Track 1 has a higher bit density (210 bits per inch vs. 75), is the only track that may contain alphabetic text, and hence is the only track that contains the cardholder's name. Track 3 is virtually unused by the major worldwide networks and often is not even physically present on the card by virtue of a narrower magnetic stripe.
- b. Proximity Card/Radio Frequency Identification Card (RFID):
- 1) A proximity card (or prox card) is a card which can be read without inserting it into a reading device, as required by magnetic stripe cards (such as credit cards). The proximity card is held near an electronic reader unit for a moment. The reader usually produces a beep or other sound to indicate the card has been read.
 - 2) The card contains electronically stored information. Some cards are powered by and read at short ranges (a few feet) via magnetic fields. Others use a local power source such as a battery or other power source and then act as a passive transponder. Battery powered cards/readers operate at greater distances, compared to non-powered cards/readers.
 - 3) Proximity cards typically have a range of around 2 to 4 inches. The term "proximity card" can refer to the older 125 kHz devices or the newer 13.56 MHz contactless cards.
 - 4) Proximity/RFID technology uses an electronic chip, which may be applied via a sticker or built-into the card. The information it contains may be read, recorded, or rewritten.
 - 5) Proximity cards can hold more data than magnetic stripe cards.

c. Smart Card:

- 1) A smart card, chip card, or integrated circuit card (IC) is any pocket-sized card with an embedded integrated circuit. Smart cards are made of plastic, can provide identification, authentication, data storage and application processing. Smart cards may provide strong security authentication for single sign-on (SSO) within large organizations.

3. Access Control:

- a. The various Stakeholder Access Control card technologies in use today are not inter-compatible due to the different types of card technologies, the different types of systems and card readers. Currently, the individual Stakeholder's systems are not configured to read all the various types of card technologies being presented by stakeholders, nor are they configured (or capable in some cases) of routing through the internet, to connect to the various stakeholder databases for user verification.
- b. The table below shows the compatibility between existing stakeholder access cards, existing stakeholder access control systems and the proposed "GO CARD." The "GO CARD" compatibility is assuming no modifications to existing access systems. Access is either door control or transportation account verification.

EXISTING CARD COMPATIBILITY MATRIX

		STAKEHOLDER ACCESS SYSTEM						
		BNMC	UB	KH	RPCI	NFTA	Social Bike	CarShare
CARD	BNMC	●						
	UB		●			●		
	KH			●				
	RPCI				●			
	NFTA					●		
	Social Bike						●	
	CarShare							●

- c. Any new building access card readers that need to allow a multi-stakeholder access, such as shared public corridors between facilities or secure bicycle parking, would need to be multi-technology, multi-format, with the capability of reading multiple technologies (magnetic stripe, proximity, etc.) and capable of being installed in a variety of environments.
- d. The existing stakeholder systems need to be able to read and recognize the cards used by all of the stakeholders. There are two (2) solutions that can be implemented:

- 1) Replace existing card readers where multi-stakeholder access is desired. The new card reader would need to be a multi-technology, multi-format reader and capable of being installed in a variety of environments.
 - 2) Issue each existing and new user a new "smart card" that has multiple technologies integrated in it. The intent would be to provide a card technology that could communicate with the existing card readers.
- e. To allow permission or access to facilities the credentials on the "smart card" would need to be verified by one of the stakeholders. Currently, only one (1) stakeholder can verify the credentials at each access point/facility. To allow multiple stakeholders the permission to verify card credentials, one (1) of the following must be implemented:
- 1) Facilities with multiple Stakeholders present at site would need to connect to individual stakeholder databases for building access via splitters, routers and controllers; refer to Appendix D for typical wiring schematics.
 - 2) Individual users would be entered and tracked in multiple databases. Requests for additional access could be managed through a web portal; refer to "Accounts Management for Users" for additional information.
 - 3) Create a shared, centrally managed database. Though technically this is a viable solution, it is not recommended due to the desire of most Stakeholders not to replace their existing systems, HIPPA law restrictions, and the magnitude of data management by one entity.
4. Fare Vending:
- a. Stakeholders who collect fees for their services, such as the NFTA, CarShare and BikeShare, do so by individual arrangement between the user or stakeholder, the user account, and the vendor. A common web portal should be created for the interface between users and fare vending services. The web portal would be similar to UB's "FlexiBull" Program and would be managed by BNMC and distributed to all of the stakeholders.
 - b. Since card technologies are so varying and incompatible, it is recommended that a second multi-format, multi-technology smart card be implemented. This new "GO CARD" would be compatible with the future fare vending systems and readers; along with some access control systems.

- c. Management, access control and billing for parking areas should be implemented on a site-by-site basis depending on ownership of parking area(s). The solution would have parking fees charged against the participating stakeholder/user ID card account, after having their user rights verified, providing access to the parking area.
 - 5. Loyalty Program:
 - a. Certain vendors have agreements in place that allow their client access to other participating vendor services, but this arrangement is not typical for the majority of the stakeholders.
 - b. Refer to the individual stakeholder sections for specific loyalty programs offered.
- D. Recommendations:
 - 1. Access Control:
 - a. For any access points requiring access from various Stakeholders, replace existing card readers with a multi-technology and multi-format card reader that connects to the Stakeholder's local building access control panel. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance.
 - 1) The multi-technology, multi-format card reader would be able to read magnetic stripe credentials, most proximity credentials, MIFARE classic and MIFARE DESFire, and shall be FIPS 201-1 compliant, and NFC (Smart Phone) compatible. Card reader equipment shall be ISO/IEC 14443 compatible. The card reader shall output serial communication in Wiegand or RS-485 format protocol, in order to interface with most of the existing stakeholder access control panels.
 - a) Design Make: Ingersoll Rand, AptiQ MTMS15.
 - b) Installed Unit Cost: \$1,000.00 per reader.
 - b. Provide networked access to multiple databases that would enable multiple stakeholders the ability to verify permission of user and unlock doors. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance; refer to Appendix C for typical schematic wiring diagram. This solution would require a level of trust between Stakeholders, since more than one entity could open a door.

- 1) Wiegand Communication Splitters and Data Router:
 - a) Where the installation of the multi-technology, multi-format card readers occurs, additional signal processing hardware is required. To accommodate the duplicating and routing of the multi-tenant access cards data strings, a number of Wiegand splitters and data routers need to be installed. These devices are needed at each multi-format card reader installation location.
 - b) Installed Unit Cost: \$2,000.00 per Stakeholder database connection.
 - 2) Card System Controller:
 - a) Card System Controller Features should include:
 - (1) Support for multiple reader and card formats
 - (2) Support for all major reader technologies
 - (3) Scalable system architecture
 - (4) Expandable
 - (5) Independent of direct control from a host computer.
 - b) Design Make: Honeywell N-1000 series controller.
 - c) Unit Cost: \$1,500.00 to \$2,000.00 per Stakeholder database connection.
2. Fare Vending:
- a. Since the existing access cards and systems are not compatible with each other or the different transportations vendors, it is recommended that a separate dedicated transportation (GO CARD) be implemented and made available to all interested users via the GO BNMC.org website.
 - b. The GO CARD would be used for the following:
 - 1) Pay for NFTA Transit
 - 2) Access to CarShare Vehicles
 - 3) Access to BikeShare bicycles
 - 4) Access bike storage facilities
 - 5) Access to UB Shuttles

- 6) Potentially integrate with access control system
- c. The new GO CARDS issued should have multiple technologies present. For integration of multiple stakeholders, all new access cards and equipment should be ISO/IEC 14443 compatible. At a minimum, it is recommended to have:
- 1) 125 kHz Proximity Device:
 - a) Proximity device should work with BNMC and Kaleida Health existing access control systems. Note the encryption code would need to be coordinated with each stakeholder access control system.
 - b) Provide 200-Bit encryption for compatibility with RPCI access control system.
 - 2) MIFARE DESFire EV1:
 - a) MIFARE DESFire should work with proposed/future UB, Social Bike, NFTA and potentially CarShare systems.
 - b) Only one (1) 13.56 MHz technology can be on the Smart Card. The card can have 125 KHz proximity with one (1) of the following:
 - (1) iClass Technology (13.56 MHz)
 - (2) Prox with MIFARE
 - (3) Prox with MIFARE DESFire EV1
 - 3) Magnetic Stripe:
 - a) Magnetic stripe would be required for "FlexiBull" system and most parking lot systems.
 - 4) Design Make: HID Part # 3850crg1mm.
- d. There are two (2) options for the "GO CARD":
- 1) "GO CARD" with access control integrated for one (1) stakeholder.
 - a) Provide three (3) card technologies as described above.
 - b) Unit Cost: \$12.00 per card (minimum order of 100 cards) includes programming.

- 2) "GO CARD" for fare vending services only.
 - a) Provide iClass Technology and prox with MIFARE DESFire.
 - b) Unit Cost: \$8.00 per card (minimum order of 100 cards).

- e. The table below shows the compatibility between proposed/revised stakeholder access systems. Refer to individual stakeholder sections for proposed revisions.
 - 1) The "GO CARD" can be ordered to coordinate with one (1) stakeholder access control system technology built-in. This would allow stakeholder to issue one card in lieu of two (2) to staff/user.

FUTURE SYSTEM COMPATIBILITY

		PROPOSED FUTURE SYSTEM						
		BNMC	UB	KH	RPCI	NFTA	GoBike	CarShare
CARD	BNMC	●						●
	UB		●			●	●	●
	KH			●				
	RPCI				●			
	NFTA					●		
	GoBike		●				●	
	CarShare	●	●					●
	GO CARD	●	●	●		●	●	●

- f. Each vendor will need to have the ability to read the technology on the new GO CARD. If multiple vendors use different RFID technology (i.e. 13.56MHz proximity chips with iClass or MIFARE) then multiple chips must be present on the smart card.
 - 1) Smart cards with the same technology is available but typically this can lead to the following user annoyances:
 - a) Longer time to read smart card. The sensor will need time to figure out which proximity chip to communicate with.

- b) Distance from card reader to card will decrease; since there are two (2) signals on the same frequency they will interfere with one another shortening their transmitting distance. Therefore the card will need to be put closer to the sensor or you will have to move the card around the sensor for activation.
 - (1) It could mean that you might have to remove your card from your wallet to be read.
- g. Kaleida Health and BNMC currently use 125 KHz technology in their access control systems.

III. BUFFALO NIAGARA MEDICAL CAMPUS (BNMC):

BNMC, Inc. owns several buildings on the Medical Campus and controls the access systems for these buildings. The Feasibility Study is looking to see if the access cards currently being used by BNMC, Inc. are compatible with other existing/planned stakeholder systems.

A. Existing Systems:

1. The existing building card access and parking control system on the BNMC Innovation Center Building uses a combination of proximity and magnetic stripe technologies.
 - a. The 125 kHz 34-bit encryption proximity cards are used for building access. The 34-bit encryption used on these particular proximity cards is uncommon and would be incompatible with current readers and software at other Stakeholder facilities.
 - b. The magnetic stripes cards are used for accessing the parking lot area and are used by the fare collection system. The fare collection system accepts credit cards as the method of payment.

B. Analysis:

1. Access Control:
 - a. The 34-bit encryption code is unique to BNMC and not compatible with the other stakeholder encryption codes.
 - b. Any building access card readers that need to allow a multi-stakeholder access would need to be multi-technology, multi-format, with the capability of reading multiple technologies (magnetic stripe, proximity, etc.) and capable of being installed in a variety of environments.
 - c. The existing stakeholder systems need to be able to read and recognize the cards used by all of the stakeholders. BNMC should replace existing card readers where multi-stakeholder access is desired. The new card reader would need to be a multi-technology, multi-format reader and capable of being installed in a variety of environments.
 - d. To allow permission or access to facilities the credentials on the "smart card" Facilities with multiple Stakeholders present at site would need to connect to individual stakeholder databases for building access via splitters, routers and controllers; refer to Appendix D for typical wiring schematics.
 - e. Kaleida Health and BNMC use 125 KHz technology.

2. Fare Vending:
 - a. The existing access card is not compatible with transportation fare vending services (NFTA, CarShare and SocialBike) and making the fare vending services compatible with BNMC technology would make them incompatible with other stakeholder technologies.
 - b. Since card technologies are so varying and incompatible, it is recommended that a second multi-format, multi-technology smart card be implemented. This new "GO CARD" would be compatible with the future fare vending systems and readers. Refer to Section II for additional information on "GO CARD."
 - c. Management, access control and billing for parking areas should be implemented on a site-by-site basis depending on ownership of parking area(s). The solution would have parking fees charged against the participating stakeholder/user ID card account, after having their user rights verified, providing access to the parking area.

C. Recommendations:

1. Access Control:
 - a. For any access points requiring access from various Stakeholders, replace existing or provide new card readers with a multi-technology and multi-format card reader that connects to the Stakeholder's local building access control panel. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance.
 - 1) The multi-technology, multi-format card reader would be able to read magnetic stripe credentials, most proximity credentials, MIFARE classic and MIFARE DESFire, and shall be FIPS 201-1 compliant, and NFC (Smart Phone) compatible. Card reader equipment shall be ISO/IEC 14443 compatible. The card reader shall output serial communication in Wiegand or RS-485 format protocol, in order to interface with most of the existing stakeholder access control panels.
 - a) Design Make: Ingersoll Rand, AptiQ MTMS15.
 - b) Installed Unit Cost: \$1000 per reader.
 - b. Provide networked access to multiple databases that would enable multiple stakeholders the ability to verify permission of user and unlock doors. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance; refer to Appendix C for typical schematic wiring diagram. This solution would require a level of trust between Stakeholders, since more than one entity could open a door.

- 1) Wiegand Communication Splitters and Data Router:
 - a) Where the installation of the multi-technology, multi-format card readers occurs, additional signal processing hardware is required. To accommodate the duplicating and routing of the multi-tenant access cards data strings, a number of Wiegand splitters and data routers need to be installed. These devices are needed at each multi-format card reader installation location.
 - b) Installed Unit Cost: \$2,000.00 per Stakeholder database connection.
 - 2) Card System Controller:
 - a) Card System Controller Features should include:
 - (1) Support for multiple reader and card formats
 - (2) Support for all major reader technologies
 - (3) Scalable system architecture
 - (4) Expandable
 - (5) Independent of direct control from a host computer.
 - b) Design Make: Honeywell N-1000 series controller.
 - c) Unit Cost: \$1,500.00 to \$2,000.00 per Stakeholder database connection.
2. Fare Vending:
- a. Create a separate "GO CARD" that is compatible with multiple fare vending services. A separate card is required since the access technologies are to varying and incompatible. BNMC could also replace their existing cards with this new GO CARD if desired so that employees only need one card for all services.
 - b. The GO CARD would be used for the following:
 - 1) Pay for NFTA Transit
 - 2) Access to CarShare Vehicles
 - 3) Access to BikeShare bicycles
 - 4) Access bike storage facilities

- 5) Access to UB Shuttles
 - 6) Access to BNMC-owned buildings (if desired)
- c. The new GO CARDS issued should have multiple technologies present. For integration of multiple stakeholders all new access cards and equipment should be ISO/IEC 14443 compatible. For more integration compatibility, it is recommended to have:
- 1) 125 kHz Proximity Device for integration with BNMC access control systems:
 - a) Proximity device should work with BNMC and Kaleida Health existing systems.
 - 2) MIFARE DESFire EV1:
 - a) MIFARE DESFire should work with UB, Social Bike, NFTA and potentially CarShare.
 - 3) Magnetic Stripe:
 - a) Magnetic stripe would be required for "FlexiBull" system and most parking lot systems
 - 4) Design Make: HID Part # 3850crg1mm.
 - 5) Unit Cost: \$12.00 per card if for access to BNMC-owned buildings as well (minimum order of 100 cards) includes programming. \$8.00 per card only for fare vending services.
- d. Create a fare vending web portal associated with the GO BNMC website. Refer to the Management and Backend Operation Section for additional information.

D. Next Steps:

1. Work with UB's Faculty Student Association (UB FlexiBull) to integrate GO BNMC into UB FlexiBull network and system.
2. Install preferred access control system on the Ellicott-Virginia Bike Storage Facility and on the GO ZONE/Mobility Hub for future demonstration project.
3. Schedule meeting with fare vending stakeholders and Mr. Curtachio to go over software, hardware and web portal integration.
4. Proceed with demonstration showing "GO CARD" integration with fare vending services.

IV. NIAGARA FRONTIER TRANSIT AUTHORITY (NFTA):

The NFTA will be upgrading their fare collection system in the near future. The Feasibility Study is looking to see how third party cards will be compatible with this system so that an integrated transportation system can be created that allows a user to have one card to gain access to and pay for public transit, carsharing, bikesharing, UB shuttles and bike storage facilities.

A. Existing Systems:

1. The NFTA uses proximity cards with high-level security encryption for access to the NFTA's facilities. Additional access control information was not provided due to security concerns at NFTA facilities. This report is focusing on integration of their transportation systems with the stakeholders.
2. The existing passenger transportation and fare collection cards are a combination of passive (no technology) Photo ID and magnetic stripe card technologies.
 - a. The existing fare collection system used is GenFare SPX with magnetic stripe technology.
 - b. Public School students are issued passive (no technology) plastic cards with photo ID and a schedule of free public transportation. Students show their ID for visual identification. The public schools maintain their student database via a web portal that is provided by the NFTA.
 - c. Social Service programs are provided temporary cards or bus tokens, which are given to individuals on an as-needed basis.
 - d. University students use their Metro College pass with magnetic stripe technology to access student transportation services.
3. On an annual basis, Metro rail provides the administration at participating colleges with unlimited transit uses for the entire undergraduate student body. The front of the pass is customized with a college logo, an individual student's photo with name and an expiration date. The back of the passes contain a magnetic strip that is encoded for authenticity. (Note: Each pass belongs to an individual student and are non-transferable). For students using Metro bus, they swipe their card in the farebox upon boarding and for those using Metro rail, they show it when asked by Metro personnel. Student college passes may be disabled on an individual basis if they are lost, stolen, used fraudulently or if the student withdraws from the college. Participating colleges are invoiced each semester based on the appropriate enrollment data.
4. Currently, public transportation on NFTA buses and other transportation services are made available to public school and University students through either the visual inspection of the public school passive (no technology) Photo ID cards or by reading the magnetic stripe on the University Metro card. Similar integration would need to be implemented for Stakeholder users for access to NFTA services. Cards with magnetic stripe technology would need to be integrated into the NFTA database. Cards without magnetic stripe technology would continue to require visual inspection of the photo ID by the driver.

B. Analysis:

1. The NFTA will be upgrading their vending system in the near future. The new fare collection system will be compatible with cards issued by the NFTA and other stakeholders. The 3rd party cards will need to be registered and set-up on an account based system with validation at real time.
 - a. The new card readers will be Smart Card compatible and be able to accept:
 - 1) MIFARE DESFire EV1
 - 2) HID iClass Prox
 - 3) Magnetic Stripe
 - 4) Cash
 - 5) Coins/Tokens
 - b. Refer to Appendix H for additional information on the new card readers.
2. The 3rd party cards need to be ISO14443 and valid without nearing end of life with one (1) of the technologies compatible with the new reader. Any card that meets these requirements can be used with the new NFTA system.
3. The system is an account based system; that is a pay-per-use as long as the 3rd party card has a stored value account in the NFTA database and linked to an auto-load via BNMC website then the 3rd party card can be used for fare payment.
 - a. The third party cards cannot be used as a “credit” token, whereby the money is sent to the agency post travel.
 - b. At this time, there is no requirement to use open payment methods such as debit/credit cards unless they are used at a vending machine to purchase a product.
4. The card would be registered in the back end and then be placed on a “white list” so that the user will be able to ride any form of NFTA transportation for which the account is authorized to register the card, a user would need to do the following via web portal.
 - a. Create an NFTA account
 - b. Transfer card information from GO BNMC account to NFTA account.
 - c. Establish a payment program so funds are transferred from BNMC to NFTA in order to pay-per-ride.

- 1) Payments could either be monthly or activated when a minimum balance is achieved. The minimum balance would require 2-way communication between BNMC and NFTA.

C. Recommendations:

1. NFTA should proceed with their request for proposal to upgrade their fare vending system as described.
2. The new GO CARD with MIFARE DESFire EV1 technology would be compatible with new NFTA fare vending system.
3. NFTA should work with BNMC to allow user activation of GO CARD via GO BNMC website for Account Management.

D. Next Steps:

1. Set up meeting with NFTA and UB's Faculty Student Association (UB FlexiBull) to go over software and how services can be linked and activated via GO BNMC web portal.
2. Proceed with demonstration showing "GO CARD" integrating with fare vending services.

V. BUFFALO CARSHARE:

Buffalo CarShare's current access system is not compatible with third party cards, and therefore would not be compatible with an integrated transportation system that allows a user to have one card to gain access to public transit, carsharing, bikesharing, UB shuttles and bike storage facilities. The Feasibility study is looking to see what hardware and software upgrades could be made to CarShare's fleet so that they can be compatible with third party cards.

A. Existing Systems:

1. CarShare uses a proximity card (AWID 37-bit Key FOB) for access to and use of vehicles, by Open Car. The system is ten (10) years old with 2000 fobs issued, but only 700 fobs are active.
2. The Account Management System is web based and mobile friendly (no apps), with the server located in Toronto, Canada.
3. Credit cards can be accepted and therefore, theoretically, CarShare could be tied into UB "FlexiBull" and the GO BNMC web portal.

B. Analysis:

1. The current system is old and out-of-date. Buffalo CarShare is exploring several systems to upgrade to including INVERS, but no time table or system has been identified. INVERS software with the right reader would be compatible with "GO CARD."
2. AWID FOB's used by CarShare are not directly compatible with any stakeholders system. There are no known multi-technology cards offered by HID, AWID or Allegion that merge AWID technology with other card technologies. The only way it appears possible is with a multi-technology reader.

C. Recommendations:

1. Option #1 - Hardware Upgrade: Until a new system is implemented, replace existing card readers in dash with a multi-technology and multi-format card reader that connects to the Stakeholder's access cards.
 - a. The multi-technology, multi-format card reader would be able to read Hitag, MIFARE, Legic Advant, Kapod and all-card types meeting standards ISO 14445 or ISO 15693. Refer to Appendix I for additional information on proposed reader.
 - 1) Design Make: Metavera CBox Microbox on Convadis Platform.
 - 2) Installed Unit Cost: \$1,500.00 per reader.
 - b. The reader should provide the following features:
 - 1) GPS: In order to locate vehicle at any time.
 - 2) Mileage: The distance traveled by vehicle is always reported.

- 3) Time: Accurate times for trip starting and ending as well as other events is reported.
 - 4) Battery Levels: An event is produced for batteries with low charge.
 - 5) Fuel Level: An event is produced for vehicles with low fuel levels.
 - 6) CBox is compatible with over eighteen (18) manufacturers including Ford, Honda, Mazda and Toyota. Though dependent on manufactured installation takes about 1.5 to 2 hours per car.
2. Option #2 - Software Upgrade: Replace existing ten (10) year old system with new system that is compatible with both UB "FlexiBull" and "GO CARD" technologies.
 - a. Upgrade vending system with either 125 kHz or MIFARE DESFire EV1 technology that accepts 3rd party cards.
 - b. Software should be upgraded to current version of Metavera Autovera. Refer to Appendix J for additional information on software.
 - c. Provide new card for integration with new reader.
 3. CarShare should work with BNMC to allow user activation of GO CARD via GO BNMC website for Account Management. Payments would be monthly and would include membership dues plus usage costs.
- D. Next Steps:
1. Receive cost estimates from INVERS and METAVERA and upgrade to the preferred system.
 2. Set up meeting with CarShare and UB's Faculty Student Association (UB FlexiBull) to go over software and how services can be linked and activated via GO BNMC web portal.
 3. Proceed with demonstration showing "GO CARD" integrating with fare vending services.

VI. SOCIAL BICYCLES:

Social Bicycles, Buffalo BikeShare's vendor, is upgrading their access control system to allow for MIFARE cards to be used as access keys. The Feasibility Study is looking to see if third party cards, including the proposed GO CARD, are or could be made compatible with this proposed upgrade.

A. Existing Systems:

1. Social Bicycles use solar powered RFID readers mounted on their bicycles to control a locking mechanism. Social Bicycles has tried other technologies and feels this is the most reliable technology for their equipment.
2. The existing Social Bicycles RFID fare collection systems would require the integration of additional card reader technologies to make their services more readily accessible to potential clients. Most Stakeholders do not use RFID technology devices. The majority of the Stakeholders currently have magnetic stripe technologies on their cards.
 - a. RFID technology may be added to a card by using an RFID sticker. However, there have been reported cases where the RFID sticker has been peeled off by certain types of card readers.

B. Analysis:

1. Social Bike is considering upgrading their fare vending system to a MIFARE Family system. MIFARE is a prox card technology based system that is ISO 14443 compliant. MIFARE DESFire EV1 is ideal for service providers wanting to use multi-application Smart Cards in transport schemes and identity; refer to Appendix G for additional information.

C. Recommendations:

1. Social Bike should upgrade their system and readers to the MIFARE DESFire EV1 system. This would make them compatible with the "GO CARD" and potentially, the new UB Student Cards.
2. Social Bike should work with BNMC to incorporate account activation through the GO BNMC website.
3. Ideally, power could be delivered to the storage unit and allow for the universal card reader to be installed. The universal card reader would not work with the current solar power available.

D. Next Steps:

1. Set up meeting with Social Bike and Mr. Keith Curtachio (UB FlexiBull) to go over software and how services can be linked and activated via GO BNMC web portal.
2. Proceed with demonstration showing "GO CARD" integrating with fare vending services.

VII. ROSWELL PARK CANCER INSTITUTE (RPCI):

Roswell owns several buildings on the Medical Campus and controls the access systems for these buildings. The Feasibility Study is looking to see if the access cards currently being used by Roswell are compatible with other existing/planned stakeholder systems.

A. Existing Systems:

1. The existing building card access and parking control systems on the RPCI campus use a combination of proximity and magnetic stripe cards. RPCI has issued approximately 1,000 cards to users.
 - a. The 200-bit PIV proximity cards are used with Lenel controllers for building access. The 200-bit encryption is a high level encryption and would be incompatible with current readers and software at other Stakeholder facilities.
 - b. A separate magnetic stripe card must be used at the parking lot turnstiles and integrated into the parking lot fare collection system.
2. Vendors may use their own ID cards to access the RPCI facility providing they have signed up for and met the VeriRep System ID requirements.

B. Analysis:

1. Access Control:
 - a. The 200-Bit encryption code is unique to RPCI and not compatible with the other stakeholder encryption codes.
 - b. The 200-bit encryption must be maintained to retain patient privacy (HIPAA laws) and research integrity. RPCI is not willing to revise/modify their access system at this time.
 - c. Any building access card readers that need to allow a multi-stakeholder access would need to be multi-technology, multi-format, with the capability of reading multiple technologies (magnetic stripe, proximity, etc.) and capable of being installed in a variety of environments.
 - d. The existing stakeholder systems need to be able to read and recognize the cards used by all of the stakeholders. It is recommended to replace the existing card readers where multi-stakeholder access is desired. The new card reader would need to be a multi-technology, multi-format reader and capable of being installed in a variety of environments.
 - e. To allow permission or access to facilities the credentials on the "smart card" would need to be verified by RPCI. Individual users would be request and entered and tracked in RPCI's databases. Requests for additional access could be managed through a web portal; refer to "Accounts Management for Users" for additional information.

2. Fare Vending:
 - a. The existing access card is not compatible with fare vending services (NFTA, CarShare and SocialBike) and making the fare vending services compatible with RPCI technology would make them incompatible with other stakeholder technologies.
 - b. Since card technologies are so varying and incompatible, it is recommended that a second multi-format, multi-technology smart card be implemented. This new "GO CARD" would be compatible with the future fare vending systems and readers. Refer to Section II for additional information on "GO CARD."
 - c. Management, access control and billing for parking areas should be implemented on a site-by-site basis depending on ownership of parking area(s). The solution would have parking fees charged against the participating stakeholder/user ID card account, after having their user rights verified, providing access to the parking area.

C. Recommendations:

1. Access Control:
 - a. For any access points requiring access from various Stakeholders, replace existing or provide new card readers with a multi-technology and multi-format card reader that connects to RPCI's local building access control panel. The local control system would communicate out, to the appropriate RPCI's database, validate user access permission, respond back to the local panel, and unlock the entrance.
 - 1) The multi-technology, multi-format card reader would be able to read magnetic stripe credentials, most proximity credentials, MIFARE classic and MIFARE DESFire, and shall be FIPS 201-1 compliant, and NFC (Smart Phone) compatible. Card reader equipment shall be ISO/IEC 14443 compatible.
2. Fare Vending:
 - a. Since the existing access cards and systems are not compatible with each other or the different transportations vendors, it is recommended that a separate dedicated transportation (GO CARD) be implemented and made available to all interested users via the GO BNMC.org website.
 - b. The GO CARD would be used for the following:
 - 1) Pay for NFTA Transit
 - 2) Access to CarShare Vehicles
 - 3) Access to BikeShare bicycles

- 4) Access bike storage facilities
 - 5) Access to UB Shuttles
- c. The new GO CARD's issued should have multiple technologies present. For integration of multiple stakeholders all new access cards and equipment should be ISO/IEC 14443 compatible. For more integration compatibility, it is recommended to have:
- 1) 125 kHz Proximity Device (optional):
 - a) Proximity device should be compatible with 200-bit encryption at RPCI.
 - 2) MIFARE DESFire EV1:
 - a) MIFARE DESFire should work with Social Bike, NFTA and potentially CarShare.
 - 3) Magnetic Stripe:
 - a) Magnetic stripe would be required for parking lot systems.
 - 4) Design Make: HID Part # 3850crg1mm.
 - 5) Unit Cost: \$12.00 per card if including 125 kHz (minimum order of 100 cards) includes programming. \$8.00 per card if not including 125 kHz.
- d. Create a fare vending portal associated with the GO BNMC website. Refer to the management and backend operation section for additional information.

VIII. KALEIDA HEALTH (KH):

Kaleida Health owns several buildings on the Medical Campus and controls the access systems for these buildings. The Feasibility Study is looking to see if the access cards currently being used by Kaleida Health are compatible with other existing/planned stakeholder systems.

A. Existing Systems:

1. The existing building card access and parking control systems on the Kaleida Health Campus use a combination of proximity and magnetic stripe, bar, and QR coded cards. The use of bar codes and magnetic stripes will be discontinued in the near future.
 - a. The 26-bit, 125 kHz Corp1000 proximity cards are used with Honeywell controllers on Prowatch Security 4.0 software for building access. There are approximately 1,000 cards.
 - b. The magnetic stripes are used at the parking lot turnstiles and integrated into the parking lot fare collection system.
2. Vendors may use their own ID cards to access the KH facility providing they have signed up for and met the VeriRep System ID requirements. VeriRep provides a program to KH for integration of databases and manages the vendors on their database.

B. Analysis:

1. Access Control:
 - a. The 26-bit encryption code is unique to Kaleida Health and not compatible with the other stakeholder encryption codes.
 - b. Any building access card readers that need to allow a multi-stakeholder access would need to be multi-technology, multi-format, with the capability of reading multiple technologies (magnetic stripe, proximity, etc.) and capable of being installed in a variety of environments.
 - c. The existing stakeholder systems need to be able to read and recognize the cards used by all of the stakeholders. Kaleida Health should replace existing card readers where multi-stakeholder access is desired. The new card reader would need to be a multi-technology, multi-format reader and capable of being installed in a variety of environments.
 - d. To allow permission or access to facilities the credentials on the "smart card" would need to be verified by one of the stakeholders. Currently, only one (1) stakeholder can verify the credentials at each access point/facility. To allow multiple stakeholders the permission to verify card credentials ffacilities with multiple Stakeholders present at site would need to connect to individual stakeholder databases for building access via splitters, routers and controllers; refer to Appendix D for typical wiring schematics.

C. Recommendations:

1. Access Control:

- a. For any access points requiring access from various Stakeholders, replace existing card readers with a multi-technology and multi-format card reader that connects to the Stakeholder's local building access control panel. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance.
 - 1) The multi-technology, multi-format card reader would be able to read magnetic stripe credentials, most proximity credentials, MIFARE classic and MIFARE DESFire, and shall be FIPS 201-1 compliant, and NFC (Smart Phone) compatible. Card reader equipment shall be ISO/IEC 14443 compatible. The card reader shall output serial communication in Wiegand or RS-485 format protocol, in order to interface with most of the existing stakeholder access control panels.
 - a) Design Make: Ingersoll Rand, AptiQ MTMS15.
 - b) Installed Unit Cost: \$1000 per reader.
- b. Provide networked access to multiple databases that would enable multiple stakeholders the ability to verify permission of user and unlock doors. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance; refer to Appendix C for typical schematic wiring diagram. This solution would require a level of trust between Stakeholders, since more than one entity could open a door.
 - 1) Wiegand Communication Splitters and Data Router:
 - a) Where the installation of the multi-technology, multi-format card readers occurs, additional signal processing hardware is required. To accommodate the duplicating and routing of the multi-tenant access cards data strings, a number of Wiegand splitters and data routers need to be installed. These devices are needed at each multi-format card reader installation location.
 - b) Installed Unit Cost: \$2,000.00 per Stakeholder database connection.
 - 2) Card System Controller:
 - a) Card System Controller Features should include:
 - (1) Support for multiple reader and card formats

- (2) Support for all major reader technologies
 - (3) Scalable system architecture
 - (4) Expandable
 - (5) Independent of direct control from a host computer
 - b) Design Make: Honeywell N-1000 series controller.
 - c) Unit Cost: \$1,500.00 to \$2,000.00 per Stakeholder database connection.
- 2. Fare Vending:
 - a. Use a separate "GO CARD" that is compatible with the fare vending services. A separate card is required since the access technologies are to varying and incompatible. Refer to the General Section for additional information. Kaleida could also replace their existing cards with the proposed GO CARD if desired.
 - b. The GO CARD would be used for the following:
 - 1) Pay for NFTA Transit
 - 2) Access to CarShare Vehicles
 - 3) Access to BikeShare bicycles
 - 4) Access bike storage facilities
 - 5) Access to UB Shuttles
 - 6) Access to Kaleida facilities (if desired)
 - c. The new GO CARD's issued should have multiple technologies present. For integration of multiple stakeholders all new access cards and equipment should be ISO/IEC 14443 compatible. For more integration compatibility, it is recommended to have:
 - 1) 125 kHz Proximity Device (optional):
 - a) Proximity device should work with Kaleida Health access control.
 - 2) MIFARE DESFire EV1:
 - a) MIFARE DESFire should work with Social Bike, NFTA and potentially CarShare.

- 3) Magnetic Stripe:
 - a) Magnetic stripe would be required for most parking lot systems.
- 4) Design Make: HID Part # 3850crg1mm.
- 5) Unit Cost: \$12.00 per card if also used for access to Kaleida facilities (minimum order of 100 cards) includes programming. \$8.00 per card if only for fare vending services.

IX. SUNY UNIVERSITY OF BUFFALO (UB):

UB is currently constructing a new School of Medicine on the BNMC. UB also owns several other facilities already located on the BNMC, but allows Kaleida to control the access system for these existing facilities. The Feasibility Study is looking to see if the access cards currently being used by UB are compatible with other existing/planned stakeholder systems.

The University at Buffalo currently operates three different shuttle services: The UB Stampede is a series of buses operated by UB that connect the University's North Campus to its South Campus. The UB Blue Line is a series of shuttles that connect its South Campus to the BNMC. The Wave Shuttle is a circulator that takes employees and visitors to various locations on the Campus. The Stampede currently has access readers installed on their buses, while the Blue Line and Wave do not. The Feasibility Study is looking to see if Stampede Shuttle access readers are or can be made compatible with the proposed GO CARD, and what access control system should be installed on the UB Blue Line and Wave shuttles so that the GO CARDS can be used for them.

A. Existing Systems:

1. The existing building card access and parking control systems on the University of Buffalo (UB) campuses use a combination of proximity and magnetic stripe, bar codes, and Smart Chip coded cards. The use of bar codes and magnetic stripes on the campus is likely to decline in the near future.
 - a. There are approximately 22,000 to 24,000 carded students and staff members. The carded student population has a high rate of turnover.
2. UB has a "campus cash" feature called "FlexiBull" that allows users and students to make purchases throughout the campus and at participating businesses off-campus using their student ID cards.

B. Analysis:

1. Access Control:
 - a. UB will be upgrading their access control system in the near future and rolled out over the next couple years. The new access control system will be compatible with the new Smart Card and be able to accept both:
 - 1) MIFARE DESFire EV1
 - 2) Magnetic Strip
 - b. Any new building access card readers that need to allow a multi-stakeholder access would need to be multi-technology, multi-format, with the capability of reading multiple technologies (magnetic stripe, proximity, etc.) and capable of being installed in a variety of environments.
 - c. The existing stakeholder systems need to be able to read and recognize the cards used by all of the stakeholders. There are two (2) solutions that can be implemented:

- 1) Replace existing card readers where multi-stakeholder access is desired. The new card reader would need to be a multi-technology, multi-format reader and capable of being installed in a variety of environments.
 - 2) Issue each existing and new user a new "smart card" that has multiple technologies integrated in it. The intent would be to provide a card technology that could communicate with the existing card readers.
- d. To allow permission or access to facilities the credentials on the "smart card" would need to be verified by one of the stakeholders. Currently, only one (1) stakeholder can verify the credentials at each access point/facility. To allow multiple stakeholders the permission to verify card credentials one of the following must be implemented:
- 1) Facilities with multiple Stakeholders present at site would need to connect to individual stakeholder databases for building access via splitters, routers and controllers; refer to Appendix D for typical wiring schematics.
 - 2) Individual users would be entered and tracked in multiple databases. Requests for additional access could be managed through a web portal; refer to "Accounts Management for Users" for additional information.
 - 3) Create a shared, centrally managed database. Though technically this is a viable solution, it is not recommended due to the desire of most Stakeholders not to replace their existing systems, HIPPA law restrictions, and the magnitude of data management by one entity.
- e. The 3rd party cards need to be ISO14443 and valid without nearing end of life with one (1) of the technologies compatible with new reader. Any card that meets these requirements can be used with the new NFTA system.
- 1) Any new building access card readers that need to allow a multi-stakeholder access would need to be multi-technology, multi-format, with the capability of reading multiple technologies (magnetic stripe, proximity, etc.) and capable of being installed in a variety of environments.
 - 2) The existing stakeholder systems need to be able to read and recognize the cards used by all of the stakeholders. There are two (2) solutions that can be implemented:
 - a) Replace existing card readers where multi-stakeholder access is desired. The new card reader would need to be a multi-technology, multi-format reader and capable of being installed in a variety of environments.

- b) Issue each existing and new user a new "smart card" that has multiple technologies integrated in it. The intent would be to provide a card technology that could communicate with the existing card readers.
 - f. To allow permission or access to facilities the credentials on the "smart card" would need to be verified by one of the stakeholders. Currently, only one (1) stakeholder can verify the credentials at each access point/facility. To allow multiple stakeholders the permission to verify card credentials Facilities with multiple Stakeholders present at site would need to connect to individual stakeholder databases for building access via splitters, routers and controllers; refer to Appendix D for typical wiring schematics.
2. Fare Vending:
- a. The existing cards are integrated with the "FlexiBull" program that allows students to make purchases at participating businesses both on and off campus. The students are able to manage their own accounts as required.
 - b. Stripe on the existing and new ideally the new fare vending system will be compatible with the existing magnetic student ID cards. The "FlexiBull" web portal should be expanded to allow students to activate SocialBike and CarShare.
 - c. An agreement between NFTA and UB should be established and integrated with NFTA's new card readers.
3. UB Shuttles:
- a. The UB Shuttle is provided for students to travel between the North and South Campuses as well as some off-campus locations and free to all students and staff. There are three (3) UB Shuttles currently:
 - 1) Stampede: Provides services between North and South Campuses.
 - 2) Blue: Provides service between South Campus and Downtown/BNMC.
 - 3) Wave: Provides service between destinations on BNMC.
 - b. The Stampede shuttles use the Pasio Smart Track System to authenticate ID cards. This system is not a "real time/on-line" system and credit cards cannot be used. The Blue and Wave shuttles do not have access systems at this time.
 - c. Each Stampede shuttle bus is equipped with an on-board database that verifies if an ID card is a valid rider. This database is upgraded nightly via a download.

- d. Currently Pasio can accept two (2) technologies:
 - 1) Magnetic Stripe
 - 2) Proximity Card
- e. The Pasio Smart Track System can accept multiple user databases. There is no personal data kept in the local database, just the account number and status.

C. Recommendations:

1. Access Control:

- a. For access points requiring access from various Stakeholders, replace existing card readers with a multi-technology and multi-format card reader that connects to the Stakeholder's local building access control panel. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance.
 - 1) The multi-technology, multi-format card reader would be able to read magnetic stripe credentials, most proximity credentials, MIFARE classic and MIFARE DESFire, and shall be FIPS 201-1 compliant, and NFC (Smart Phone) compatible. Card reader equipment shall be ISO/IEC 14443 compatible. The card reader shall output serial communication in Wiegand or RS-485 format protocol, in order to interface with most of the existing stakeholder access control panels.
 - a) Design Make: Ingersoll Rand, AptiQ MTMS15.
 - b) Installed Unit Cost: \$1000 per reader.
- b. Provide networked access to multiple databases that would enable multiple stakeholders the ability to verify permission of user and unlock doors. The local control system would communicate out, to the appropriate Stakeholders database, validate user access permission, respond back to the local panel, and unlock the entrance; refer to Appendix C for typical schematic wiring diagram. This solution would require a level of trust between Stakeholders, since more than one entity could open a door.
 - 1) Wiegand Communication Splitters and Data Router:
 - a) Where the installation of the multi-technology, multi-format card readers occurs, additional signal processing hardware is required. To accommodate the duplicating and routing of the multi-tenant access cards data strings, a number of Wiegand splitters and data routers need to be installed. These devices are needed at each multi-format card reader installation location.

- b) Installed Unit Cost: \$2,000.00 per Stakeholder database connection.
- 2) Card System Controller:
 - a) Card System Controller Features should include:
 - (1) Support for multiple reader and card formats
 - (2) Support for all major reader technologies
 - (3) Scalable system architecture
 - (4) Expandable
 - (5) Independent of direct control from a host computer.
 - b) Design Make: Honeywell N-1000 series controller.
 - c) Unit Cost: \$1,500.00 to \$2,000.00 per Stakeholder database connection.
- 2. Fare Vending:
 - a. Start issuing a student ID card with multiple technologies to allow access, continued use of "FlexiBull" system, and allow for additional fare vending services.
 - 1) Of all the stakeholders, UB has the highest rate of turnover of card users (roughly 25% of the users graduate and a new 25% enroll) which allows them to easily update their cards to all users in 4-8 year period.
 - b. Integrate the new NFTA fare vending technology capabilities into the UB Student Card by providing MIFARE DESFire EV1 and therefore, remove the need for a 2nd transportation card.
 - c. The new student ID would be used for the following:
 - 1) Pay for NFTA Transit
 - 2) Access to CarShare Vehicles
 - 3) Access to BikeShare bicycles
 - 4) Access bike storage facilities
 - 5) Access to UB Shuttles

- d. The new student card issued should have multiple technologies present. For integration of multiple stakeholders all new access cards and equipment should be ISO/IEC 14443 compatible. For more integration compatibility, it is recommended (at a minimum) to have:
 - 1) 125 kHz Proximity Device:
 - a) Proximity device should work with BNMC and Kaleida Health existing systems.
 - 2) MIFARE DESFire EV1:
 - a) MIFARE DESFire should work with UB, Social Bike, NFTA and potentially CarShare.
 - 3) Magnetic Stripe:
 - a) Magnetic stripe would be required for "FlexiBull" system and most parking lot systems.
 - 4) Design Make: HID Part # 3580crg1mm.
 - 5) Unit Cost: \$12.00 per card (minimum order of 100 cards) includes programming.
 - e. In the future UB Shuttle (if desired) should be upgraded to a fare vending system similar to NFTA with Pasio Readers. Refer to Section IV for additional information on NFTA future system.
3. UB Shuttles:
- a. Provide new card readers on Blue and Wave Lines that are multi-technology, multi-format type that would be able to read MIFARE and Magstripe Cards Meeting Standards ISO 14443 or ISO 15693.
 - b. BNMC shall create, via backend operation, a link with UB Shuttle database that validates and register valid "GO CARD" users. These valid users would be downloaded to the local databases.
 - 1) The existing tracking system can work with MIFARE Technologies.
 - c. Individual partnerships between stakeholders and UB Shuttle would need to establish and handle monthly payments between Stakeholder and UB Shuttle System.

D. Next Steps:

- 1. Install preferred access system on the Blue and Wave shuttles to be used in a future demonstration program.

2. Work with BNMC to show integration of fare vending services with "GO CARD" to each stakeholder.
3. Proceed with demonstration showing "GO CARD" integrating with fare vending services and web portal.

X. MANAGEMENT AND BACKEND OPERATION SYSTEM:

A. General:

1. It is desired to have a Management and Operating System for the "Smart Cards," which would allow each Stakeholder the ability to maintain their individual access control, and allow users to activate an account for fare vending system platforms. The hardware and software would be integrated with multiple databases and individual operating platforms of various entities and allow for flexibility and be easily adjusted for future changes in: users, technologies, security policies or credentialing processes.
2. A preferred BNMC Account Based System (ABS) would be identified for the Smart Card for services that require a fee. The BNMC ABS would allow the BNMC to manage monetary transactions between employees, employers and a Stakeholder such as NFTA. Employees/employers could transfer funds to BNMC to pay for access to these services and then the BNMC would transfer funds to the service provider along with the respective Smartcard user account information.
3. The Faculty/Staff FlexiBull Bucks plan is a prepaid debit account (Campus Cash) that is accessible only to students with a UB card. The UB card can be used to make purchases such as food, supplies and gifts at numerous locations both on and off Campus. Some participating companies offer additional discounts to the students through the card.
 - a. The UB system is run through the IT department via the UB Facility Student Association (FSA).
 - b. Mr. Keith Curtachio is the director and is extremely open to incorporating stakeholders into the system. The "FlexiBull" website can be tailored for GO BNMC and incorporate transportation vendors.
 - c. The system is powered by CBORD (www.CBORD.com) with Shibboleth (an authentication software), which is in use at UB, Canisius College and other state universities.
 - d. The actual server resides on the UB campus. There is adequate capacity on the existing servers for BNMC to reside on.
 - e. A web portal similar to GO BNMC.org or FlexiBull (myubcard.com/FlexiBull) can be used to enable/link multiple fare vending and access requests.
4. Additional staff could be required to manage offerings and integration of information on the use of cards.

5. Accounts based management should provide/allow the following:
 - a. The smart card to be read at the cash register or vending machine, the amount of purchase is deducted and the remaining card balance is displayed.
 - b. Use of the portal on their web page for participants. The web portal would allow the participants to update their user database entries and add funds to or check on account balances.
 - c. The web portal would allow the Stakeholders to link their personnel database accounts to other services.
 - d. The web portal should allow individual participants (non-Stakeholder personnel) to link their credit cards or bank accounts to their service account.
 - e. The software should also alert an individual participant whose account balances are deficient.
 - f. Funds should be subtracted from user accounts when a service or any of their subsidiaries services are accessed.
 - g. The smart card to be read at the cash register or vending machine, the amount of purchase is deducted and the remaining card balance is displayed.
 - h. Account balances should not expire and will continue to carry over year to year until you officially cancel the account.

B. Accounts Management:

1. The individual stakeholders do NOT want to share database/account management for software/operation information. Consideration must be given to the HIPPA laws that govern the privacy of medical records and security issues.
2. Management System Operation:
 - a. The management software should have the ability to import data from multiple external data sources. Importing of data from an external data source would be accomplished using an automatic Data Transfer Utility.
3. The Ability to Receive Updates from Other Systems Databases:
 - a. Stakeholders may wish to automatically push their user database updates to the other stakeholders, transportation services and fee collections control system. This feature would keep user databases synchronized and current. This is important for the new entries or when a person leaves, and those rights need to be restricted. The Data Transfer Utility should support a variety of data transfer protocols and would have the means to receive updated user data as often as needed.

- b. Any user may use the same card for both physical access to the buildings and vendor services. When a multi-purpose card gets lost and a new one is issued, the necessary deletions and additions, both in the physical access and the vendor services databases, need to be made and synchronized quickly. Stakeholders may accomplish this by making the edits in their system(s) and then exporting their edited data to the BNMC databases.
 - c. User account data should be able to be entered automatically and manually as well. BNMC should consider making a portal on their web page for Stakeholders to access. The web portal would allow for the Stakeholder who wishes to manually update their user database entries or deletions and does not desire to automatically push their user database changes to the BNMC system.
4. System should allow the following:
- a. Currently a new user creates an account on line via a browser and is prompted for services to purchase or add on to their "plan." The new user would be able to access the GO BNMC page and create an account; this account would then be set up custom for offerings from GO BNMC. BNMC would process the information and store it on their servers.
 - b. The system can have a credit card attached to it and store pre-paid funds. These funds then can be transferred to and from other participating merchants as credit card or real-time transactions. UGryd is the division of CBORD that handles the processing of funds.
 - c. A vendor (store) can participate in the program by "leasing" equipment. Depending on the existing Point of Sale system being used to link the "GO CARD" it can be a software upgrade only or it may need new hardware and software.
 - 1) The vendor would be responsible for the software and hardware costs to enroll in the system.
 - 2) Fees/Fares for integrating with "GO CARD" between vendor and BNMC.
 - d. Monetary transactions typically occur through Magstripe. There are some vending machines being deployed in the medical corridor that will work 100% through smart phone apps with this UGryd system via FAS. This is seen as the future means of transactions.
5. The IRS offers monthly pre-tax benefits for purchasing a transit pass (\$130), qualified parking (\$250) and qualified bicycle commuting reimbursement (\$20). Refer to Appendix E and a tax advisor for additional information.

C. Loyalty Program Opportunities:

1. Currently there not many loyalty programs offered by the stakeholders, though some of the stakeholders have shown an interest in starting loyalty programs.
2. The NFTA offers rebates for frequent riders.
3. Individual loyalty programs should be offered on a service-by-service basis and managed by the fare vending provider. BNMC account management can help track rentals and purchases and enable loyalty benefits on smart card.
4. Loyalty Benefits could include:
 - a. Mobile marketing with push notifications to clients.
 - b. Service reminders.
 - c. Automatic notification (at time of purchase) of loyalty benefits.
 - d. Two-way communication between Fare Vending service and User/Client.
 - e. Potential loyalty programs via BNMC account management could include:
 - f. Buffalo Car: Offer a free car rental after so many rentals or offer monthly discounts (% of cost) for long term memberships.
 - g. GoBike/Social Bicycles: Offer a free bike rental after so many rentals.
 - h. NFTA: Offer discounts on monthly or yearly pass purchases.
 - i. Parking: Offer discounts on monthly or yearly pass purchases.

D. Recommendations:

1. Management and Backend Operation:
 - a. BNMC should consider a program similar to the UB FlexiBull Program which can be offered to all of interested Stakeholders. UB has expressed a willingness to incorporate the Stakeholders into their program, it is recommended that BNMC manage the backend operation through a dedicated web portal that is "piggy-backed" onto UB's system.
 - 1) Advantages to mirroring UB's system:
 - a) Pre-populate the card database with faculty and students for testing.
 - b) Easily tie into other Campus systems like UB Shuttles.
 - c) UB system has already integrated vendors successfully.

- d) UB has developed a mobile version.
- b. The existing system would need to be expanded and integrated for fare vending services, using CBORD, into the GO BNMC website. Upgrades include:
 - 1) Links to individual Stakeholder websites.
 - 2) Links to participating Fare Vending services.
 - 3) Portal to manage account information, balances and services.
 - 4) Provide programs to transfer funds to NFTA for pay-per-use funding.
 - 5) Integrate pre-tax transportation purchases with HR Department.
- c. A system similar to CBORD Solutions with Shibboleth software for Business and Industry (<https://corporate.cbord.com/solutions/>) which offers a cashless system to a variety of market systems should be integrated into the GO BNMC.org website.
 - 1) A new server/hosting package will need to be developed. The current server/hosting with NYSDOT is not compatible/comfortable with commerce hosting.
- d. Cost to update Backend and Operating System: T.B.D. (need to meet with UB to finalize details).
- e. There is a yearly maintenance fee with CBORD or similar software system
 - 1) Cost: T.B.D.
- 2. Accounts Management for Users:
 - a. The accounts management system should provide a web based system that potentially can be linked to the GO BNMC site. Users would be able to access the account system and activate/purchase fare and transportation options. This would help minimize internal resources required to maintain and administer the system.
 - b. The system should allow users to deduct expenses per IRS Guidelines for pre-tax purchases of fare vending options. The individual Human Resources groups would need to incorporate this into paychecks and W2 forms.
 - c. The Cost for Accounts Management is included in Management and Backend Operation estimate.

3. Loyalty Program Opportunities:
 - a. Fare vending services should explore loyalty programs on a service-by-service basis and have them tracked or enabled through the BNMC account management system. It is not recommended that BNMC manage or create a loyalty program.
 - b. Loyalty Buffalo Rewards (<http://loyaltyrewardsbuffalo.com>) or Belly (bellycard.com) can help establish a loyalty program for fare vending services and market the program to potential users.
 - c. Unit Cost: \$50.00 - \$100.00 monthly service fee plus text messaging.

XI. CONCLUSIONS/SUMMARY

- A. This study analyzed the existing cards and access systems for the stakeholder institutions (BNMC, Inc., Kaleida Health, Roswell Park and University at Buffalo) to see if the existing systems are compatible with one another and with the transportation service provider systems. The study has found that these systems are NOT compatible with one another, and to be made compatible, the institutions would have to replace their entire access control systems with a new system.
- B. Therefore, the study recommends:
1. Create a new multi-use transportation card that is compatible with the transportation service provider systems. This would allow the institutions to keep their existing access systems, which would be too expensive to replace. This secondary GO CARD would be given to interested employees who utilize these transportation services. The GO CARD would have multiple technologies present and would be ISO 14443 compatible. The GO CARD would have the following components:
 - a. MIFARE DESFire EV1: This technology would make the card compatible with the proposed NFTA, UB Shuttle, CarShare, BikeShare and bike storage facility systems.
 - b. Magnetic Stripe: This technology would make the card compatible with potential loyalty/reward programs as well as with other vendors that have yet to be identified.
 - c. 125 kHz Proximity Device (optional): This technology would make the card compatible with BNMC, Inc.'s and Kaleida Health's existing access control systems. Therefore, these two organizations could replace their existing cards with the proposed GO CARD so that employee's only need 1 card to access these services and facilities.
 - d. Cost of Cards: MIFARE + Magnetic Stripe = \$8 per card ; MIFARE + Magnetic Stripe + 125 kHz = \$12 per card
 2. The GO CARD would have an account based system (ABS) to manage access permissions and payments. CBORD has been identified as an ABS that meets this project's goals, and is currently being used by the University at Buffalo and several other local colleges to manage student and employee card accounts. CBORD acts as a user profile with a prepaid debit account that allows a user to put money in to this account to be used at participating vendors. The user portal, located on www.gobnmc.org, would allow the user to:
 - a. Request a GO CARD / Add funds to GO CARD
 - b. Sign up for NFTA services
 - c. Sign up for UB Shuttle services
 - d. Become a member of Carshare and reserve vehicles

- e. Become a member of BikeShare and reserve vehicles
 - f. Sign up for access to Bike Storage Facilities
 - g. Find carpool matches
 - h. Register a carpool group
 - i. Sign up for other BNMC transportation demand management programs
3. Because each stakeholder has a unique access control system for their facilities, and because it would be cost-prohibitive to replace all controls with a unified system, it is recommended that the stakeholders replace existing card readers or provide new card readers at all shared corridor entrance points. These updated card readers would be multi-technology and multi-format so that they are compatible with all existing cards, as well as the proposed GO CARD.
4. The backend system for the shared corridors would enable multiple stakeholders to have the ability to verify permission of the user and unlock doors. The local control system would communicate out, to the appropriate stakeholder database, validate the user access permission, respond back to the local panel, and unlock the entrance. Each stakeholder would control their own employee's access to these shared corridors.

APPENDIX A

SITE PLAN

APPENDIX B
MEETING MINUTES

TITLE: BNMC Smart Card Feasibility Study Consultant Kick-Off Meeting

DATE: 2/26/14

LOCATION: Innovation Center, 640 Ellicott Street, Buffalo NY, 14203

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
	Patrick Whalen	Chief Operating Officer
	Vic Nole	Facilities and Entrepreneurism Manager
	Mark McGovern	Senior Project Manager
M/E Engineering	Anthony Thomas	Principal
	James Michalski	Senior Designer
U&S Services	Timothy Natalino	System Operations Manager
Social Bicycles	Ryan Rzepecki (call-in)	Executive Director
Kaleida Health	Paul Drabinski	Manager of Safety and Security
Roswell Park Cancer Institute	Harvey Strassburg	Director of Public Safety and Transportation
University at Buffalo	John Kisker	Senior Staff Assistant
NFTA	Darren Kempner	Manager of Grants and Government Affairs
Buffalo CarShare	Michael Galligano	Operating Director
GObike Buffalo	Justin Booth	Executive Director

AGENDA ITEM 1. INTRODUCTIONS

Notes:

- The stakeholder team introduced themselves to the consultant team.
- The consultant team, comprised of M/E Engineering as the prime consultant, and U&S Services and Social Bicycles as sub-consultants, introduced themselves and their companies to the stakeholder team.

AGENDA ITEM 2. PROJECT GOALS AND OBJECTIVES

Notes:

- Mr. Hamann-Burney discussed the goals of the Smart Card Project:

“Develop an integrated access control system in which a single smart card can be used to access a wide-array of transportation services and secure facilities on the Buffalo Niagara Medical Campus, thereby creating a more efficient and user-friendly access and transportation system for employees, and creating a scalable model that can be replicated elsewhere.”

- Mr. Hamann-Burney also briefly discussed the project objectives and the main tasks in the Scope of Work. These tasks were discussed in more detail during Agenda Item 2: Review Project Scope.

AGENDA ITEM 3. REVIEW PROJECT SCOPE

Notes:

- Mr. Thomas of M/E Engineering provided an overview of the project’s Scope of Work. Task 1 for the Scope of Work is as follows:

Task 1. Outreach and Engagement

Task 1.1 Kick-Off Meeting

Task 1.2 Stakeholder Engagement

- Mr. Thomas discussed that in addition to this initial kick-off meeting, the consultant team would be meeting with each stakeholder group individually in the month of March. Prior to these meetings, the stakeholders will be sent an online survey to collect data.
- Mr. Michalski presented an overview of the survey, and asked the stakeholders for feedback.
- Task 2 for the Scope of Work is as follows:

Task 2. Conduct Feasibility Study

Task 2.1 Determine compatibility solutions for existing access control systems

Task 2.2 Determine compatibility solutions for future/planned access control systems

Task 2.3 Determine preferred management and backend operation system

Task 2.4 Determine preferred accounts management system for the user

Task 2.5 Identify loyalty program opportunities

- Mr. Strassburg asked if the feasibility study could look at whether or not vendors who require access to certain areas within facilities on the Medical Campus could be given a Smart Card to provide them with this access.

- Mr. Rzepecki discussed data that would need to be collected in order to identify whether or not the institutions' existing smart cards could be used to access alternative transportation services. The data collected would address the following questions:
 - Are cards issued by the institution stakeholders currently compatible with RFID systems that are likely to be deployed by the transportation providers?
 - What numbering/inventory system is currently being used by each institution partner? RFID strings are not necessarily unique and there could be overlap.
 - Are the partner organizations willing to add RFID stickers to existing cards and/or issue new cards to be compatible with the RFID readers to be deployed by the transportation operators?
- Mr. Galligano asked if the priority of this project was to integrate access control systems for facilities on the Campus, or to integrated access credentials with transportation systems. Mr. Smith responded by saying that the priority of the project is to create a smart card system that allows existing access credentials or new access credentials to be used to access various transportation systems, and that if the project cannot do this, then the project is a failure.
- Mr. Thomas discussed that the final report of the feasibility study will include analysis and design concepts with options and cost estimates.
- Task 3 for the Scope of Work is not currently part of the contract with M/E, but was discussed at the meeting. Task 3 is as follows:

Task 3. Implementation Plan and Demonstration Program (if necessary)

Task 3.1 Demonstration of compatibility solutions for existing access control systems

Task 3.2 Develop implementation plan and demonstration program

Task 3.3 Execute demonstration program

- Mr. Thomas addressed Task 3 by discussing the more imminent need to identify an access control system for Ciminelli's Conventus building and for future bridges connecting existing/planned buildings that would allow access readers to accept both Kaleida and RPCI access cards. Mr. Thomas proposed that this demonstration program be a part of the Smart Card Project for an additional fee.
- Mr. Smith of the BNMC discussed ongoing efforts to address this matter, and proposed that these efforts become a part of M/E's study.
- Mr. Drabinski of Kaleida Health said that the E Building entrance, adjacent to the Michigan Goodrich Parking Garage, could be used for the demonstration program, since it is currently

used by both Kaleida and RPCI employees. The program would involve installing a new multi-class reader at the entrance that would accept both Kaleida and RPCI cards.

- Mr. Natalino asked if Near Field Communication (NFC) technology could be tested as well.
- Mr. Drabinski proposed that the demonstration program be begin by **May 1st, 2014**, and that it be coordinated with the Smart Card Project consultant team.

AGENDA ITEM 4. SCHEDULE

- Mr. Hamann-Burney discussed the project schedule, which is as follows:

Kick-Off Meeting, 2/26/14

Stakeholder Meetings, 3/10/14 – 3/21/14

Study-Analysis, 3/24/14 – 5/23/14

Draft Report, 5/26/14

3.1 Implementation Plan and Demonstration Program, TBD

Phase 2 Implementation Plan and Demonstration Program, TBD

AGENDA ITEM 5. NEXT STEPS

- Mr. Hamann-Burney will send the stakeholder's a survey that should be filled out by all stakeholder groups in advance of the individual stakeholder meetings.
- Mr. Hamann-Burney will identify the times for the individual stakeholder meetings.

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: Social Bicycles

DATE: 3/14/14

LOCATION: Conference Call; Innovation Center, 640 Ellicott Street, Buffalo NY, 14203

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
M/E Engineering	James Michalski	Senior Designer
U&S Services	Timothy Natalino	System Operations Manager
Social Bicycles	Ryan Rzepecki (call-in)	Executive Director

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- Ryan filled out the online questionnaire. The consultant team did not have any direct questions for Ryan related to the questionnaire.

AGENDA ITEM 2. SOBI SYSTEM UPGRADE PLANS

Notes:

- Social Bicycles is currently replacing their existing access control system, which currently includes a punch pad attached to the bicycle where members punch in their member id's to unlock the bike, to an RFID system that would allow members to use smart cards to unlock the bike.
- SoBi will be replacing their entire existing bicycle fleet, including the Buffalo Bicycles, with the new RFID bicycles by the end of the year.
- SoBi may be able to provide a demonstration bike to Buffalo in early summer.

AGENDA ITEM 3. SOBI VISION/NEEDS FOR BNMC SMART CARD PROGRAM

Notes:

- SoBi's RFID system is utilizing MiFare technology and requires smart cards to have a 13.56 MHZ frequency.
- RPCI, Kaleida Health and BNMC, Inc. cards currently have 125 MHZ frequency, meaning they might not be compatible with SoBi's new access control system.
- UB's existing cards are mag swipe and therefore are not compatible with the planned access control system either.
- Ryan suggested using RFID stickers for existing UB cards and having UB move towards a RFID card over time, possibly starting with students/employees on the Medical Campus.
- Ryan suggested the Stakeholders switch to a card that has both 13.56 and 125 MHZ frequencies.
- The cost of switching existing cards to both a 13.56 and 125 MHZ frequency might be a factor.
- Ryan believes the new RFID system on the bikes will also support NFC.

Deliverables

- The consultant team requested that Ryan send them cut-sheets for the new RFID access control system.

AGENDA ITEM 4. SOBI'S EXPERIENCE WITH INCENTIVE PROGRAMS

- The group discussed incentive program possibilities associated with using Social Bicycles.
- One possible type of incentive program is to have users accrue points on the Card every time they reserve the bicycle.
- The group also discussed incentive programs based on mileage travelled. However, Ryan noted that most SoBi trips taken are short, and that rewarding repeat usage rather than distance travelled might be a better scenario.
- Ryan suggested the group look into BELLY CARD REWARDS PROGRAM. www.bellycard.com

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: BNMC, Inc.

DATE: 3/14/14

LOCATION: Innovation Center, 640 Ellicott Street, Buffalo NY, 14203

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
	Mark McGovern	Senior Project Manager
M/E Engineering	James Michalski	Senior Designer
U&S Services	Timothy Natalino	System Operations Manager

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- Mark filled out the online questionnaire. The consultant team had no direct follow up questions relating to the questionnaire.

AGENDA ITEM 2. BNMC'S VISION/NEEDS FOR SMART CARD PROGRAM

Notes:

- BNMC is creating transportation "Bundles" for alternative commuters. BNMC would like the Smart Card to be tied into the transportation bundles by having the Card provide access to the services provided by the Bundles.
- BNMC would like to explore the possibility of utilizing Smart Cards for their Guaranteed Ride Home Program. More information about the GRH Program can be found in **Appendix A**.
- The Consultant Team might have to contact Liberty Taxi to see what solutions might exist.
- BNMC would like to explore the possibility of utilizing Smart Cards for their Parking Validation Program. More information about the Parking Validation Program can be found in **Appendix B**.
- BNMC would like to develop a program where their existing Smart Cards can provide access to NFTA Metro Rail and Bus, Buffalo CarShare Buffalo BikeShare, secure bicycle parking facilities, and shared-corridors within buildings on the BNMC.
- BNMC envisions each institution controlling a Card user's access to secure buildings on the Campus, and having BNMC manage a Card user's access to the different transportation services. For instance, BNMC could sign users up for different transportation services, and then send the

user's Card ID to the transportation service provider who would then activate the Card for that service.

- BNMC would also like to explore the possibility of a pay-per-use system being built into the Card.
- BNMC would like to explore the possibility of the Smart Card program being tied into BNMC's Parking Access Revenue Control System (PARCS) and Accounts Management System (PARIS).

AGENDA ITEM 3. PARCS SYSTEM

Notes:

- BNMC requested the consultants look into how the Project can be tied into BNMC's PARCS System.
- BNMC would like to explore the possibility of being able to utilize cards for visitor management, including access to buildings and access to parking lots.

Tasks:

- BNMC and Consultant Team will meet with PARC service provider.

AGENDA ITEM 4. MOBILITY HUB AND E-V BIKE STORAGE FACILITY

Notes:

- BNMC needs recommendations for an access control system for the Mobility Hub and 927 Washington Street and the Ellicott-Virginia Bike Storage Facility. The Mobility Hub must be operational by May 1st, 2014. The BNMC would like the Bike Storage Facility to be operational by the same time.

Tasks:

- BNMC needs to figure out who will be managing the access control and security system at the Mobility Hub before recommendations can be provided. The two scenarios now are BNMC, Inc. manages the system or Kaleida Health manages the system.
- BNMC needs to figure out how the Bike Storage Facility will be powered before recommendations can be provided. The access controls can be wireless, but they still require power.

APPENDIX A: Guaranteed Ride Home Program Overview



GUARANTEED RIDE HOME PROGRAM

What if I carpool and the driver has to leave work early? What if I miss the last bus? What if my child is sick at school or I have to stay at work late? What if I don't have my car with me at work and an emergency occurs? Won't I be stranded?

Well, no. Thanks to our Guaranteed Ride Home Program, we will pay for your taxi ride to wherever you need to be when the unexpected occurs.

It's our way to help provide you with peace of mind, and to say "thank you" for choosing a greener commuting option.

HOW DOES IT WORK?

Once you register, we will send you a free taxi-ride voucher in the mail. You hold on to the voucher and use it when an emergency occurs. You simply have to follow the instructions on the back of the voucher: Call Liberty Taxi Company, get picked up, hand the voucher to the driver, and take off to your destination.

The voucher will cover the first \$60 of the taxi ride (or 20 miles).

Once you have used your voucher, Liberty Taxi will send it back to us along with an invoice. We will then send you another voucher in the mail. You are allowed to use up to four (4) vouchers annually from the time you sign up for the GRH program.

WHO IS ELIGIBLE?

- If you work on the Buffalo Niagara Medical Campus.
- If you alternatively commute at least 2 times per week.
- If you did not drive alone to work the day the voucher is needed.

- Only the participant who has their name printed on the voucher can use it.

WHAT TRIPS ARE ELIGIBLE?

- You can only use the voucher if the trip originates on the Buffalo Niagara Medical Campus. You cannot use the voucher to get to work.
- Unplanned personal emergencies, such as:
 - Personal or family illness
 - Family crisis
 - Carpool is unexpectedly unavailable
 - Having to unexpectedly stay work at work
 - Missing the last bus
- Planned trips are NOT eligible, such as:
 - Running errands while at work
 - Lunch
 - Doctor appointments
- The voucher will cover the first \$60 of the trip (20 miles). The participant must pay any additional costs, including gratuity.

FOR MORE INFORMATION

www.gobnmc.org

716.566.2316

gobnmc@bnmc.org

APPENDIX B: Parking Validation Program Overview

PURPOSE OF THE PROGRAM

The main objective of the “2 Parking Validations per Month” Program is to provide employees who carpool, take transit, bicycle or walk to work with an economical commuting alternative when these options are not feasible. The Program is intended to provide existing alternative commuters with the peace of mind in knowing that they have a back-up commuting plan, and is intended to encourage employees who are currently commuting via single-occupancy-vehicle (SOV) to switch to an alternative option by making these options more appealing.

The 2 Parking Validations per Month Program will be tied in to GO BNMC’s Bundles, which include the Guaranteed Ride Home Program – another emergency program managed by the BNMC TMA for alternative commuters.

PROGRAM OVERVIEW

The 2 Parking Validations per Month Program will provide eligible employees with free or reduced cost parking on the Buffalo Niagara Medical Campus no more than twice per month. Employees who sign up for the following GO BNMC Bundles will be automatically enrolled in the program:

- Casual Walker/Biker Bundle
- Bicyclist Bundle
- Transit Bundle
- Give Transit a Try Bundle
- Carpool Bundle
- GO GETTER Bundle

OPERATING PROCESS

1. Employees who sign up for a GO BNMC Bundle will be automatically enrolled in the 2 Parking Validations per Month Program.
2. BNMC Staff will provide Campus Ambassadors/Parking Attendants with an updated monthly list of employees enrolled in the program, with two check boxes next to each name.
3. Participating employees must park in the Ellicott Goodrich Garage. When leaving the Garage, the employee must notify the Parking Attendant that they are enrolled in the Program. The Attendant will fill in the check boxes next to the employee’s name.
4. If an employee has already used both validations for the month, they must pay the full parking rate.

ELIGIBILITY REQUIREMENTS AND PROGRAM RULES

- Program is good for up to 2 parking validations per month, per participant.
- Participants must work at least 3 days per week on the Buffalo Niagara Medical Campus.

- Participants must be signed up for a GO BNMC Bundle.

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: University at Buffalo

DATE: 3/19/14

LOCATION: 106 Spaulding, SUNY UB North Campus

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
M/E Engineering	James Michalski	Senior Designer
U&S Services	Timothy Natalino	System Operations Manager
UB	Maria Wallace	Director of P and T Services
	John Kisker	Senior Staff Assistant
	Sean Brodfuehrer	Architectural Planner
	Keith Curtachio	Director FSA IT

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- M/E and U&S do not currently have any follow-up questions regarding the online survey.

AGENDA ITEM 2. UB's Existing and Future Card Plans

Notes:

- UB's main door access system is Stanley BASIS.
- UB's primary ID card is a mag stripe with bar code in front.
- UB also has two specialty cards:
 - School of Medicine cards contain a contact chip.
 - Student Union cards are proximity and mag stripe – desfire iclass
- Existing mag stripe cards are approximately \$0.20, while prox cards are \$3-5.
- There is an existing fee for the proximity smart card - \$35
- The existing proximity card has 125 frequency.
- Existing cards can be used as campus cash – cards can be preloaded with money that can be used at participating vendors. There are around 50 participating vendors currently.
- The existing proximity cards ISO number cannot be legally duplicated, which prevents any duplicate ID's from being created by another institution.

AGENDA ITEM 3. UB's Vision/Needs for BNMC Smart Card Program

Notes:

- UB could provide students/employees who work on the Buffalo Niagara Medical Campus with a proximity card, possibly with a mag swipe and both 13.56 and 125 frequencies.
 - There will be approximately 1,000 medical students and around 500 faculty staff who will be going to the new Medical School on the Medical Campus.
- These cards, if they are 13.56 and 125 frequencies, could be used on the NFTA's, CarShare's and BikeShare's planned access control system upgrades.
- These cards could be used in the semi-public corridors within new buildings on the BNMC that will link the buildings together. One current possibility is to install multi-class readers in these corridors that would allow each institution to provide access for their own students/staff. For instance, UB would control which students/staff have access to these areas, instead of having to ask RPCI or Kaleida to provide these students/staff with access.
- Administrative Procedures
 - One current possibility is to continue allowing UB to manage access controls for buildings on the BNMC, and to allow BNMC, Inc. to activate slots on a UB proximity card that would allow eligible students/staff to access secure bicycle parking, NFTA, BikeShare and CarShare services. The Mobility Hub at 927 Washington Street is envisioned to be the location where students/staff take their cards to get them activated for these transportation services.
- What is the protocol for when a student's/staff person's card is lost or stolen? There must be a system put in place that alerts all stakeholders, so that they can deactivate the card as well (deactivate the slots that the other stakeholders control).
- UB and BNMC are interested in exploring the possibility of tying the Smart Card project into the PARCS system on the Medical Campus.

AGENDA ITEM 4. UB Shuttle System

Notes:

- UB Stampede Shuttles currently only accept mag swipe cards. UB's vendor is aware that UB might in the future prefer the access readers to accept both mag swipe and proximity cards.
- UB and BNMC are interested in exploring the possibility of opening UB's Blue Line Shuttle System up to non-UB persons. This could be a temporary solution to the inadequate service provided by Metro Rail due to ongoing construction/renovation projects.
 - UB's existing Blue Line Shuttles do not have access readers.

- If the Blue Line were opened up to non-UB employees, the system's capacity would have to expand.
- The Smart Card Feasibility Study will determine if existing smart cards for BNMC, Inc., Kaleida and RPCI could be used onboard UB Shuttles if the shuttle's featured proximity readers.
- UB and BNMC would like to explore account based system options that would allow UB to charge non-UB persons to ride their shuttle system. Two options could be unlimited monthly access and pay-per-use access.

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: Roswell Park

DATE: 3/19/14

LOCATION: Innovation Center, 640 Ellicott Street

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
M/E Engineering	James Michalski	Senior Designer
U&S Services	Timothy Natalino	System Operations Manager
RPCI	Harvey Strassburg	Director; Parking, Transportation and Safety

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- M/E and U&S do not currently have any follow-up questions regarding the online survey.

AGENDA ITEM 2. RPCI's Existing and Future Card Plans

Notes:

- RPCI recently upgraded their smart card system and does not plan any other upgrades in the imminent future.
- The card appears to be 13.56 frequency, Corporate 1000. This still needs to be verified.
 - If this is the case, the cards would all have unique ID's which means no other institution could have a duplicate ID number.
- RPCI is setting up a system where employees can purchase lunch from the RPCI cafeteria using their ID cards. The costs would be deducted from their next paycheck.
- Employees can also "clock-in" with their card.
- Current ID cards are around \$20 each.

AGENDA ITEM 3. RPCI's Vision/Needs for BNMC Smart Card Program

Notes:

- If a RPCI card is lost or stolen, a system needs to be put in place to alert all other organizations that may have activated slots on those cards, so that they too can deactivate the card. RPCI would also have to alert the organizations that the employee now has a new ID card/number.
- One possible administrative process for the Smart Card system is where RPCI still controls access to all RPCI buildings, controls access to semi-public corridors for their employees only, and where BNMC facilitates the activation of slots that provide employees with access to secure bicycle parking and NFTA, UB Shuttle, CarShare and BikeShare services.
- If RPCI' existing cards are 13.56 frequency, it will be more likely that they will be compatible with the transportation services mentioned above.

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: NFTA

DATE: 3/20/14

LOCATION: 181 Ellicott Street, NFTA Headquarters

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
M/E Engineering	James Michalski	Senior Designer
NFTA	Dennis Lupp	Project Manager
	Darren Kempner	Grants Manager
	James Morrell	Planning Manager

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- M/E and U&S do not currently have any follow-up questions regarding the online survey.

AGENDA ITEM 2. NFTA's Existing and Future Card Plans

Notes:

- NFTA's RFP for their fare vending/collection system is at 95% design documents. NFTA believes the RFP will go out to bid within a month.
- The project is expected to take 2 years.

AGENDA ITEM 3. NFTA's Vision/Needs for BNMC Smart Card Program

Notes:

- The NFTA will look into the possibility of utilizing multi-class readers on their bus and rail fare vending systems. The readers could accept mag swipe and 13.56 and 125 frequency RFID.
 - GenFare currently has new technology on the market that has multi-class reader features.
- The NFTA would like to create an accounts based system that allows the BNMC to activate cards themselves, instead of having to send card ID's to the NFTA to activate.

- NFTA envision and monetary deduction system for third party cards in which cards are pre-loaded. Every time the employee uses NFTA, the fare would be deducted from their account. There would be a maximum amount that an employee could pay every month – when the employee reaches that maximum amount, their additional trips are registered but do not cost anything. This is the same concept as an unlimited monthly pass.
 - Once scenario for this deduction system is for the BNMC to collect the money, and for the NFTA to bill the BNMC on a monthly basis for the fare's used by employees signed up with the BNMC program.
- How can pre-tax deductions (Metro Perks) be automatically loaded on cards? What administrative process on BNMC's end would be necessary to facilitate monetary transactions?
- The BNMC is creating a "Metro Rail and Bus Bundle" that employees can sign up for. The bundle includes:
 - A metro rail and bus monthly pass
 - Pre-tax enrollment and additional subsidies when eligible
 - Enrollment in BNMC's Guaranteed Ride Home Program
 - 2 free parking validations per month on days when taking Metro is not feasible
- NFTA is interested in using BNMC students/employees for a beta test for their new system once it is installed.

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: Buffalo CarShare

DATE: 3/20/14

LOCATION: Innovation Center, 640 Ellicott Street

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
M/E Engineering	James Michalski	Senior Designer
Buffalo CarShare	Mike Galligano	Director of Operations

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- M/E and U&S do not currently have any follow-up questions regarding the online survey.

AGENDA ITEM 2. CarShare's Existing and Future Card Plans

Notes:

- CarShare's current hardware system is Open Car.
- CarShare's current software system is Meta Vera.
- Open Car only supports AWID key fobs, which is what CarShare currently uses for access keys.
- Open Car is not compatible with third party cards, and Buffalo CarShare is exploring other hardware solutions to make their cards compatible with the Smart Card Project.
- Funding can be an issue in regards to upgrading hardware, and CarShare would like to keep Meta Vera as their software provider.

AGENDA ITEM 3. CarShare's Vision/Needs for BNMC Smart Card Program

Notes:

- CarShare is exploring their options. Hardware upgrades are typically \$1,200 per car, plus monthly dues.
- CarShare's timeline for upgrading is 6-12 months.

- MetaVera supports other hardware besides Open Car. If Meta Vera can provide a list of what hardware is compatible with their software, the consultants can recommend what new hardware CarShare should pursue.
- The new hardware should support, at a minimum, 13.56 and 125 frequency prox cards.

Next Steps:

- Consultants will contact Emily at Meta Vera and ask what other hardware is compatible with their software.
- Consultants will determine which hardware systems would be compatible with the existing cards of the BNMC institutions and offer recommendations.
- CarShare will provide the consultants with a test key fob.

TITLE: BNMC Smart Card Feasibility Study Stakeholder Meeting: Kaleida Health

DATE: 3/21/14

LOCATION: Larkin Offices – LCO 270

FACILITATOR: Jamie Hamann-Burney

ATTENDEES:

Company	Name	Title
BNMC, Inc.	Jamie Hamann-Burney	Project Manager
	William Smith	Director of Access and Security
M/E Engineering	James Michalski	Senior Designer
U&S Services	Tim Natalino	Systems Operating Manager
Kaleida Health	Paul Drabinski	Director of Safety and Security
	Rob Bragg	VP Campus Development

AGENDA ITEM 1. SURVEY FOLLOW-UP

Notes:

- M/E and U&S do not currently have any follow-up questions regarding the online survey.

AGENDA ITEM 2. Kaleida’s Existing and Future Card Plans

Notes:

- Kaleida facilities on the BNMC recently switched to Corporate 1000 proximity cards at a 125 frequency for employees. Close to 100% of Kaleida’s employees on the BNMC now have these cards.
- Employees at Children’s will switch to these cards when they move to the BNMC.
- These cards also feature a QR code on the front, a barcode on the back, and a magnetic stripe.
- Kaleida currently has a centralized database – 1 server and all locations go there, except for Children’s. However, when Children’s moves to the BNMC, it will move to the single server as well.
- Existing access readers in Kaleida buildings on the BNMC support both mag swipe and 125 frequency proximity cards.
- Kaleida wants to move to a Badge Pass Management System for visitors at BNMC locations – this is currently in place at Children’s.
- Kaleida is exploring the possibility of employee’s being able to load money on their cards which they can then use to pay for things like lunch in Kaleida’s cafeteria.

AGENDA ITEM 3. Kaleida's Vision/Needs for BNMC Smart Card Program

Notes:

- Multi-class readers in shared corridors will allow Kaleida and other institutions to control their own employee's access to these readers.
- Kaleida's 125 frequency card will not be compatible with Social Bicycles, which are being upgraded to include a 13.56 frequency reader.
- UB and NFTA are looking to upgrade to multi-class readers that would allow Kaleida's 125 frequency cards to be used for their services. CarShare is also exploring this possibility, but currently cannot support 125 frequency 3rd party cards.

AGENDA ITEM 4. Mobility Hub Access Control and Security System

Notes:

- The under-construction Mobility Hub at 927 Washington needs an access control system. There will be 24/7 member-only access to half of the Hub's first floor, which will feature indoor bicycle parking and bicycle amenities.
- The primary goal is for BNMC to control access to the Hub by activating a slot on an employee's existing card.

Next Steps

- Consultants will be determining if Johnson Controls (BNMC's current hardware and software provider) will be compatible with 3rd party cards.
- BNMC will discuss security features for the Hub with Kaleida.

APPENDIX C

STAKEHOLDER SURVEY SUMMARY

Time Stamp	Please provide your contact information	Which organization(s) are you affiliated with?	Who supports your existing Building Carding system?	May we contact your system support provider(s) regarding your system(s)?	Do you have any drawings showing how your access control system is installed that we may use for this project?	What Building access control hardware do you use in your facility?	How many entrances at your facility currently have access control?	Do security agencies have administrative access credentials to your building?	What type of card(s) are being used on your system?	What type of card encryption are you currently deploying?	May we have a sample card to test with?	What Site (AKA Facility) codes are you currently using in your facility?	Internal to your facility, are your access credentials used for any other purpose, if yes then what?	Any plans to change or upgrade your current carding system(s)?	Do you utilize a visitors management software?	What is your existing management system?	What is the software revision?	Do you have an installer password for the software system?
3/10/2014 2:15:24 PM	Galligano, Mike	Car Share, Bike Share	N/A	Yes					Proximity		Yes			yes		Key fob reader. Awid. (opencard hardware) Metavera solutions software	?	No
3/10/2014 3:40:25 PM	Strassburg, Harvey	BNMC, Roswell	Outside Contractor	Yes	Yes			1	Proximity	26	Yes	Unknown	No	No	no			Yes
3/10/2014 5:58:46 PM	Bragg, Robert	Kaleida	In House Staff Personnel	Yes	Not Sure			0	Magnetic Stripe, Proximity, Bar Coded		Yes	Not sure. Consut security	Parking access	3 to 5 years	No	NA	not sure	Yes
3/12/2014 11:18:06 AM	ryan rzepecki	Bike Share	In House Staff Personnel	Yes	No		0		Smart		Yes							
3/26/2014 4:51:50 PM	Kisker, John	NY State University at Buffalo	In House Staff Personnel	Yes														
4/14/2014 10:13:05 AM	Hamann-Burney, Jamie	BNMC	Outside Contractor	Yes	Not Sure				Smart		Yes			hopefully not				

Time Stamp	Please provide your contact information	Which organization(s) are you affiliated with?	Who supports your existing Building Carding system?	May we contact your system support provider(s) regarding your system(s)?	Do you have any drawings showing how your access control system is installed that we may use for this project?	What Building access control hardware do you use in your facility?	How many entrances at your facility currently have access control?	Do security agencies have administrative access credentials to your building?	What type of card(s) are being used on your system?	What type of card encryption are you currently deploying?	May we have a sample card to test with?	What Site (AKA Facility) codes are you currently using in your facility?	Internal to your facility, are your access credentials used for any other purpose, if yes then what?	Any plans to change or upgrade your current carding system(s)?	Do you utilize a visitors management software?	What is your existing management system?	What is the software revision?	Do you have an installer password for the software system?
4/15/2014 9:18:10 AM	McGovern, Mark	BNMC	Outside Contractor	Yes	Not Sure		15	1	Proximity	26	Yes	General access doors and tenant access doors	no	no other than regularly scheduled system upgrades	no		P2000	Yes
4/15/2014 2:22:32 PM	Kempner, Darren	NFTA	Outside Contractor	Yes	Yes		1	1	Magnetic Stripe, Proximity		Yes			Yes. Within the next 2-3 years.	No			Yes

What Operating System Does your access control software currently run on?	System Support Provider Contact Info.	Service Provider Email Address	May we contact your service provider in regards to your system?	Please provide the contact information of your staff person we should contact for building access system information.	Please provide the contact information of your staff person we should speak with about your building access system information.	Please provide the contact information of your staff person(s) responsible for your building access system.	What are your organizations uses of their current Carding System(s)?	Who supports your current Fare Collection System?	Please provide the contact information of your staff person(s)	What do you see as your organizations future applications of a Smart Card System?	Please provide your E-Mail
Chrome							Semi-Public Transportation / Car Share / Bike Share	Outside Contractor		Semi-Public Transportation / Car Share / Bike Share	m.galligano@buffalocarshare.org
7	Terry Queeno - Installation Manager - Upstate, Central & Western NY NY State Alarm License Qualifier #12000293169 40 Gardenville Pkwy West, Suite 105 West Seneca, NY 14224 United States O: 716-668-1485 C: 716-983-4609 F: 716-608-7601						Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Visitor Passes / Identification / Tracking, Public Transportation, Rail & Bus / Fare Collection, Parking Access / Fee Collection	In House Staff Personnel		Employee Identification / Time Keeping, On & Off Campus Services / Vendors, Semi-Public Transportation / Car Share / Bike Share, Food Services	harvey.strassburg@roswellpark.org
Not sure	Need to contact Paul Drabinski of Kaleida Security						Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Purchase discounts	N/A		Building Access / Medical Campus Passage, Employee Identification / Time Keeping, On & Off Campus Services / Vendors, Public Transportation, Rail & Bus / Fare Collection, Semi-Public Transportation / Car Share / Bike Share, Shuttle Bus Services, Parking Access / Fee Collection, Loyalty / Rewards Program Tracking	rbragg@kaleidahealth.org
	Patrick Hoffman						bikeshare	In House Staff Personnel		Public Transportation, Rail & Bus / Fare Collection, Semi-Public Transportation / Car Share / Bike Share	ryan@socialbicycles.com
							Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Student Identification / Dorm Access, On & Off Campus Services / Vendors, Public Transportation, Rail & Bus / Fare Collection, Shuttle Bus Services	N/A		Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Student Identification / Dorm Access, On & Off Campus Services / Vendors, Public Transportation, Rail & Bus / Fare Collection, Semi-Public Transportation / Car Share / Bike Share, Shuttle Bus Services	johnkisk@buffalo.edu
	Johnson Controls						Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Visitor Passes / Identification / Tracking	N/A		Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Visitor Passes / Identification / Tracking, On & Off Campus Services / Vendors, Public Transportation, Rail & Bus / Fare Collection, Semi-Public Transportation / Car Share / Bike Share, Shuttle Bus Services, Parking Access / Fee Collection, Loyalty / Rewards Program Tracking	jhamannburney@bnmc.org

What Operating System Does your access control software currently run on?	System Support Provider Contact Info.	Service Provider Email Address	May we contact your service provider in regards to your system?	Please provide the contact information of your staff person we should contact for building access system information.	Please provide the contact information of your staff person we should speak with about your building access system information.	Please provide the contact information of your staff person(s) responsible for your building access system.	What are your organizations uses of their current Carding System(s)?	Who supports your current Fare Collection System?	Please provide the contact information of your staff person(s)	What do you see as your organizations future applications of a Smart Card System?	Please provide your E-Mail
Windows	Heather Cuenin Major Projects Account Executive Systems Northeast Johnson Controls, Inc. 116 Railroad Avenue Albany, NY 12205 Mobile: 781-752-6736 Main: 518- 451-2712 Fax: 518-451-2701 heather.cuenin@jci.com						Building Access / Medical Campus Passage, Employee Identification / Time Keeping	N/A		Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Visitor Passes / Identification / Tracking, On & Off Campus Services / Vendors, Public Transportation, Rail & Bus / Fare Collection, Semi-Public Transportation / Car Share / Bike Share, Shuttle Bus Services, Parking Access / Fee Collection, Loyalty / Rewards Program Tracking	mmcgovern@bnmc.org
	GFI Nick Logisz nick.logisz@spx.com (847) 871-1182						Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Public Transportation, Rail & Bus / Fare Collection	Outside Contractor		Building Access / Medical Campus Passage, Employee Identification / Time Keeping, Public Transportation, Rail & Bus / Fare Collection, Semi-Public Transportation / Car Share / Bike Share, Parking Access / Fee Collection, Loyalty / Rewards Program Tracking	darren_kempner@nfta.com

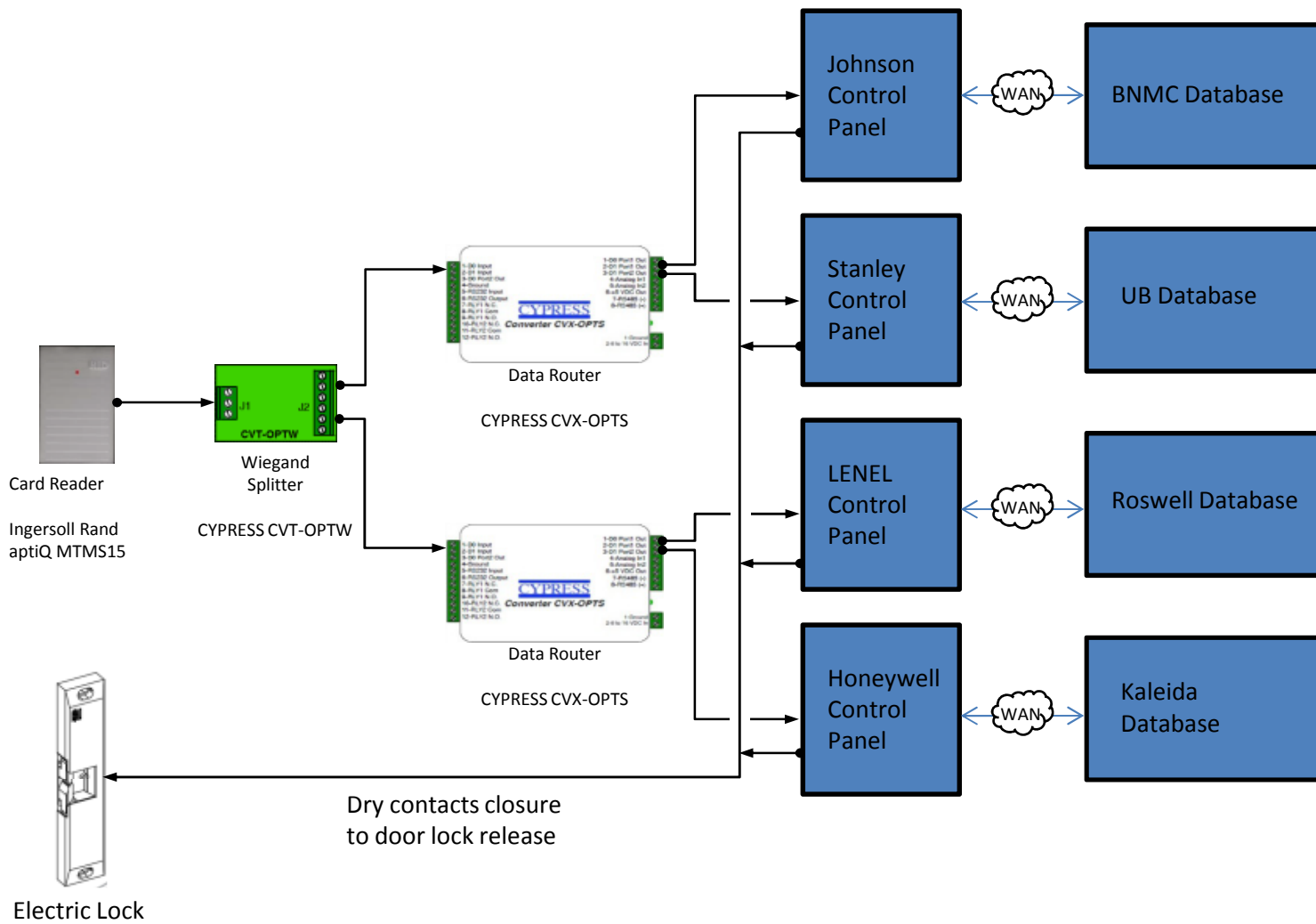
Please provide your Phone Number and extension	What Building Security measures are in use at your facility?	System Support Provider Contact Info.	What Building Security features do you see needed in the future at your facility?	In conjunction with Smart Cards, Smart Phones can be used for access and commerce. Approximately how many users in your organization carry smart phones?	For future considerations, would you find it convient if you could use your Smart Phone as a Smart Card?	What is the name of the Software you use for your access control system?	What is the name of the Software you use for your access control system?	Currently, how many on staff / students / members are issued ID / Access / Transportation cards?	How many of these carded persons will be accessing the BNMC facilities?	You Made it! Thank You for completing the Survey!	What features are currently in use by your Visitor Management system?	It is expected that the demands for parking spaces in the downtown area will increase dramatically in the near future.	How many of these carded persons will be accessing OTHER card accessed facilities?	How are the cards created, activated and deactivated for users?
898.085				75%	Yes	Metavera	501 ~ 2500	1 to 500				1 to 500	Outsourced	
716 845-1798	Electric Accessed Doors, Door Intercom, Cameras, Visitors Pass, Elevator Floor Restriction, Parking Control, Public Safety		Visitor Card (Kiosk)	50%	Yes	On Guard	2501 ~ 5000	N/A		Building Access, Parking Access / Fare collection	Convenience, Rewards Programs, Parking Expense, Health / Fitness		House Staff	
716 462-2510	Security Personnel, Electric Accessed Doors, Cameras, Visitors Pass, Elevator Floor Restriction, Parking Control, Parking access control		Security Personnel, Electric Accessed Doors, Cameras, Visitor Card (Kiosk), Visitors Pass, Elevator Floor Restriction, Parking Control, Parking access control	Don't Know	Yes	Contact Kaleida Security	2501 ~ 5000	501 ~ 2500			Convenience, Rewards Programs	501 ~ 2500	security Office	
646.283.6548	NA	Patrick Hoffman	NA	Higher than 75%	Yes		1 to 500	0			Convenience	0	House Staff	
716-645-2707				Don't Know	Yes		28000+	501 ~ 2500			Convenience, Parking Expense, Expansion of service times / routes, Reduce Carbon Footprint	10000+	House Staff	
716-566-2316	Electric Accessed Doors, Cameras, Visitor Card (Kiosk), Visitors Pass		Security Personnel, Visitor Card (Kiosk), Visitors Pass, Parking Control	Higher than 75%	Yes		1 to 500	1 to 500			Convenience, Rewards Programs, Parking Expense, Expansion of service times / routes, Reduce Carbon Footprint, Health / Fitness	1 to 500	House Staff	

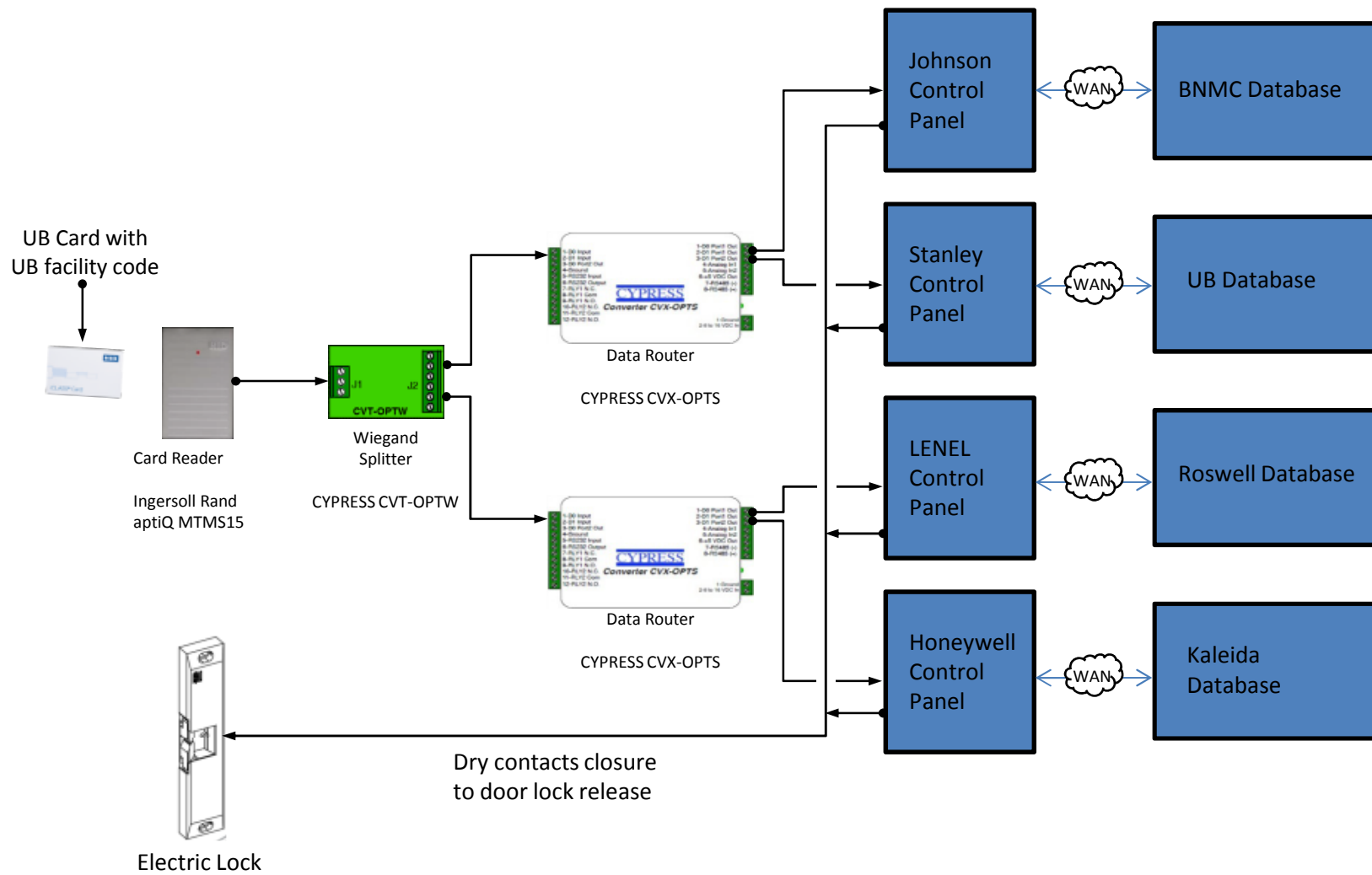
Please provide your Phone Number and extension	What Building Security measures are in use at your facility?	System Support Provider Contact Info.	What Building Security features do you see needed in the future at your facility?	In conjunction with Smart Cards, Smart Phones can be used for access and commerce. Approximately how many users in your organization carry smart phones?	For future considerations, would you find it convient if you could use your Smart Phone as a Smart Card?	What is the name of the Software you use for your access control system?	What is the name of the Software you use for your access control system?	Currently, how many on staff / students / members are issued ID / Access / Transportation cards?	How many of these carded persons will be accessing the BNMC facilities?	You Made it! Thank You for completing the Survey!	What features are currently in use by your Visitor Management system?	It is expected that the demands for parking spaces in the downtown area will increase dramatically in the near future.	How many of these carded persons will be accessing OTHER card accessed facilities?	How are the cards created, activated and deactivated for users?
716-218-7153	Electric Accessed Doors, Cameras, Visitors Pass	Corinna Hopkins Sales Engineer, Security & Fire Building Efficiency Johnson Controls 130 John Muir Drive Suite 100 Amherst, NY 14228 Cell : 716-432-7841 Fax : 716-688-7453 corinna.hopkins@jci.com www.johnsoncontrols.com	Security Personnel, Electric Accessed Doors, Door Intercom, Cameras, Visitor Card (Kiosk), Visitors Pass, Parking Control	Higher than 75%	Yes		JCI	1 to 500	1 to 500		Building Access	Convenience, Rewards Programs, Parking Expense, Expansion of service times / routes, Reduce Carbon Footprint, Health / Fitness	1 to 500	House Staff
716.855.7305	Electric Accessed Doors, Cameras, Visitor Card (Kiosk)			Don't Know	Yes		GFI	Greater than 5000	Not sure			Convenience, Rewards Programs, Parking Expense, Expansion of service times / routes	501 ~ 2500	House Staff

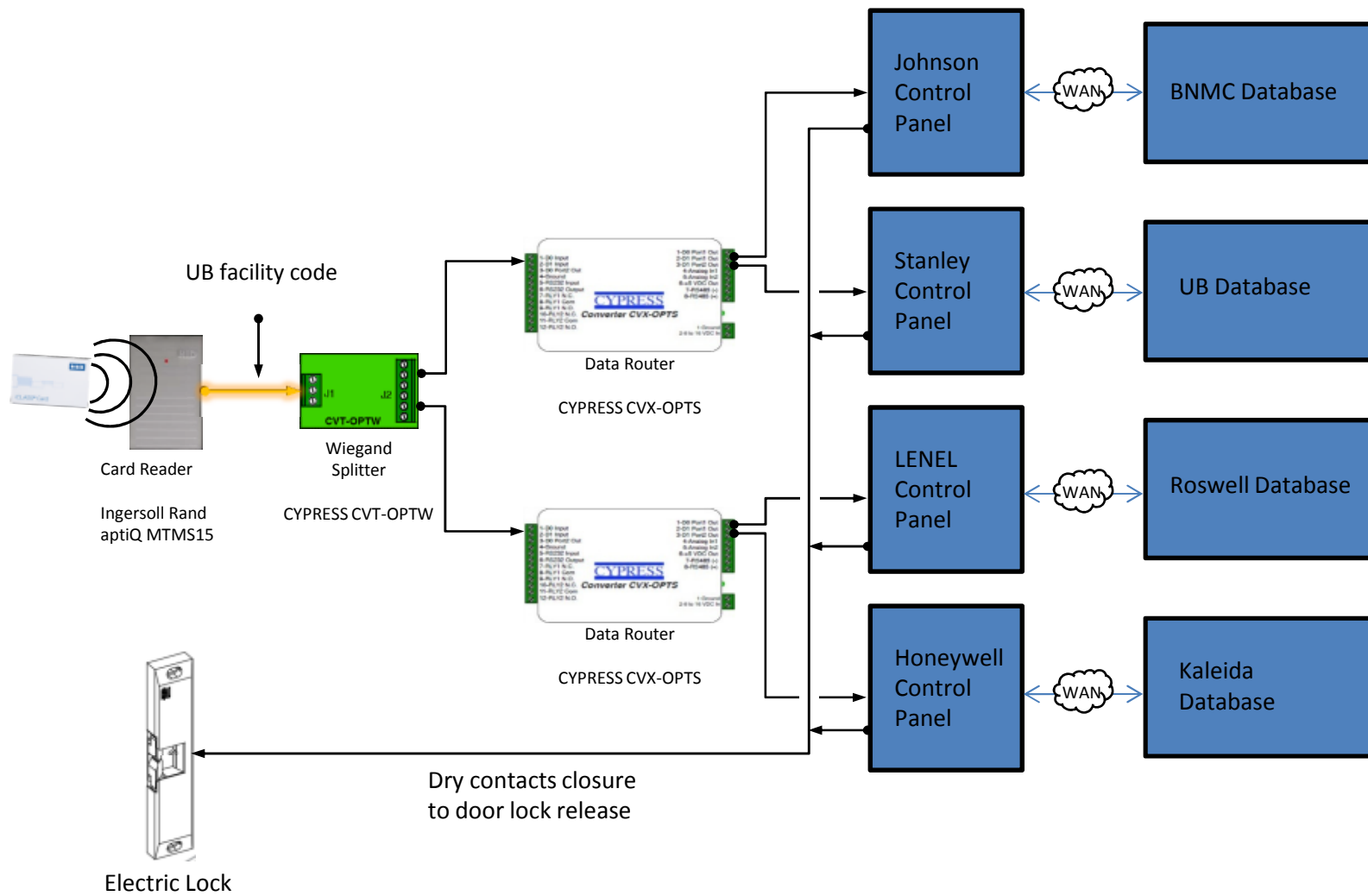
What RFID (if applicable) is being used?	Who programs your cards?	What is the part number for the access credentials used on your system?	What type(s) of hardware / software is currently in use?	What do you require as credentials?	What do you require as credentials to create a visitors pass?
AWID Key Fobs	Outside Contractor		Metavera Solutions (Software) 416.598.9300 Emily Fleck Opencar (Hardware) 754.444.6736	Drivers ID #, Name Address, etc.	
	In House Staff Personnel	2101CGGNN			
None at this time	In House Staff Personnel	not sure	NA	NA	Not sure
http://en.wikipedia.org/wiki/MIFARE	In House Staff Personnel	xxx			

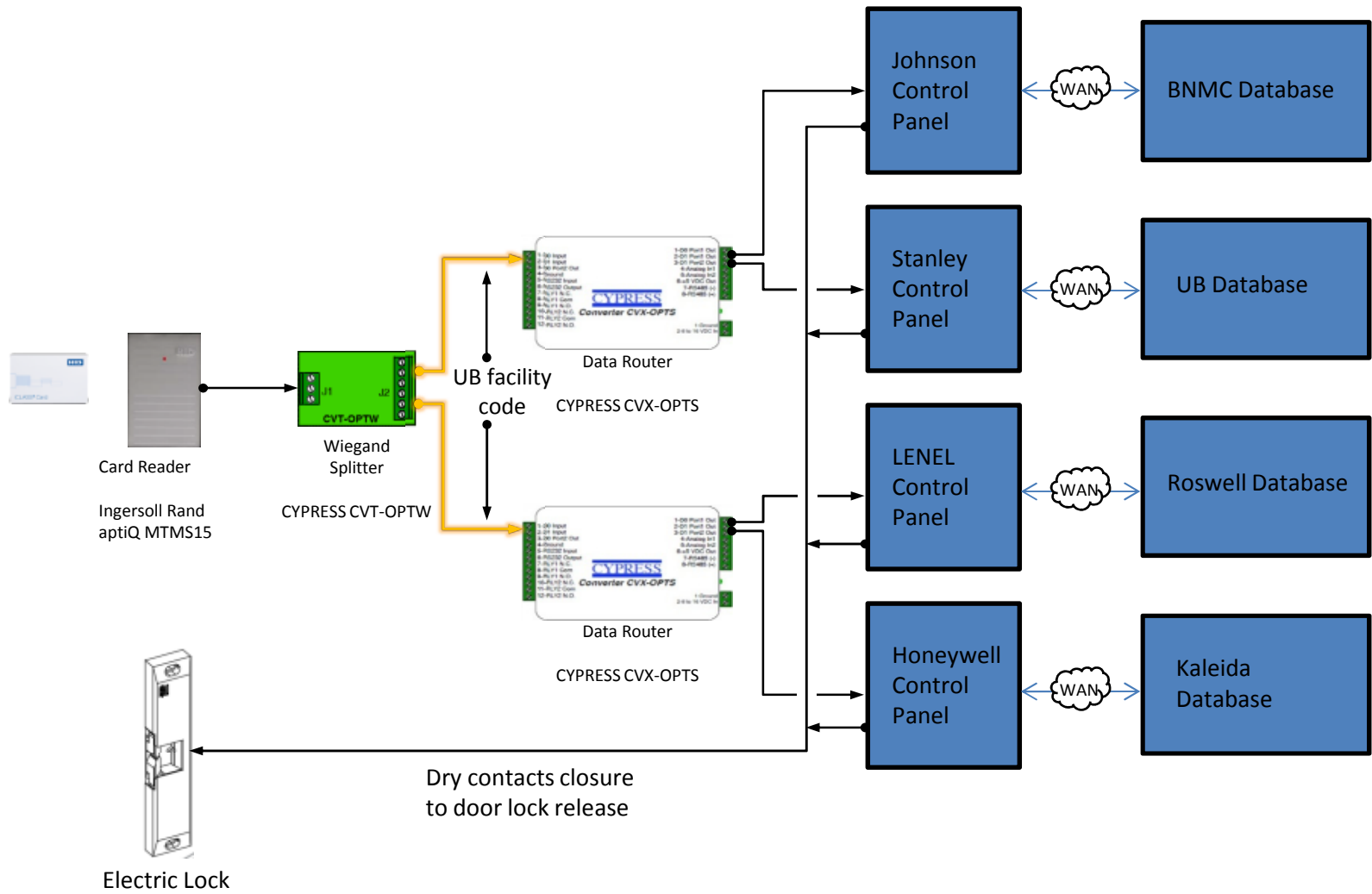
What RFID (if applicable) is being used?	Who programs your cards?	What is the part number for the access credentials used on your system?	What type(s) of hardware / software is currently in use?	What do you require as credentials?	What do you require as credentials to create a visitors pass?
not sure	In House Staff Personnel	1336LGGMN-C100P			Name Email
	In House Staff Personnel				N/A

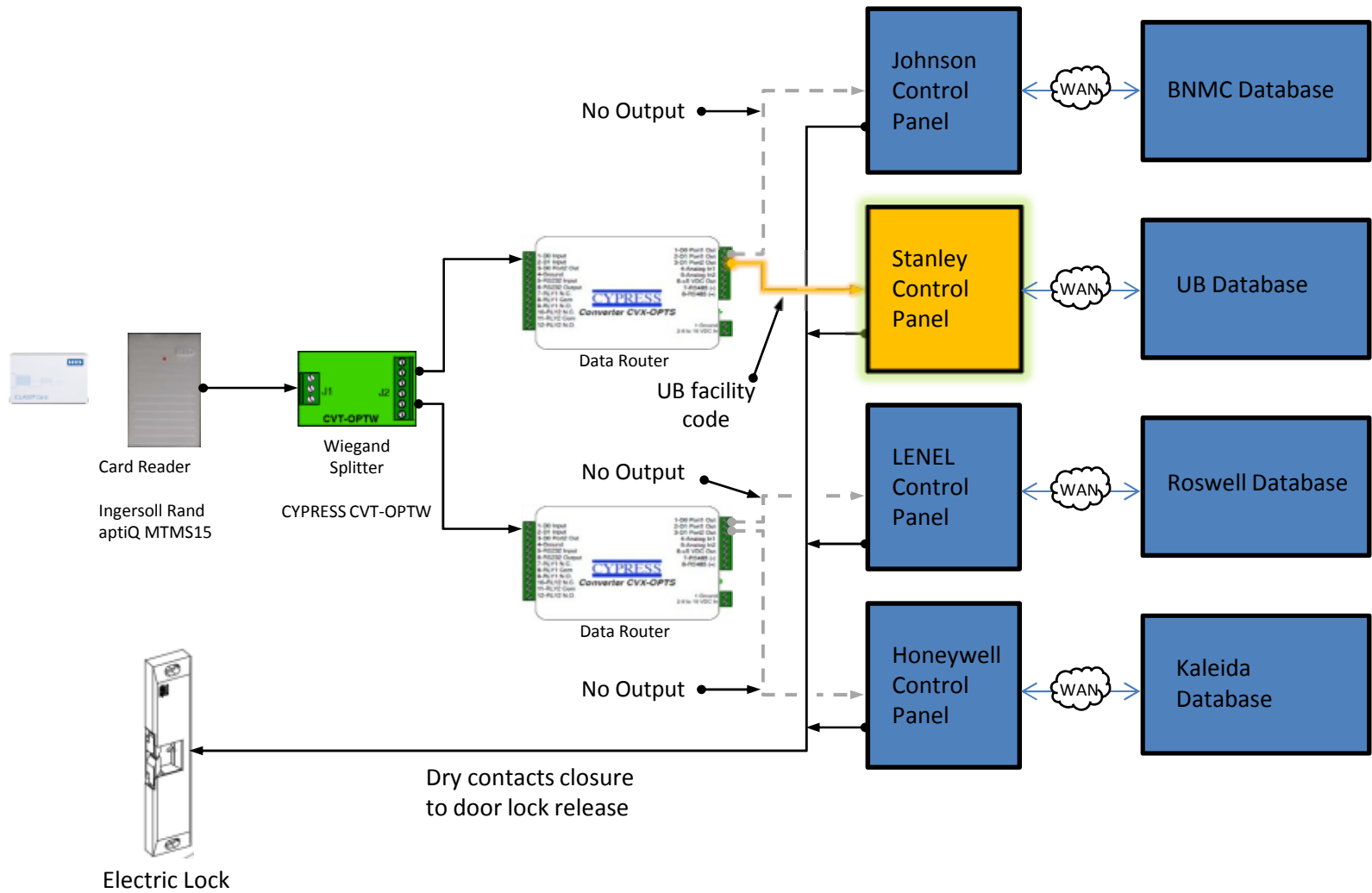
APPENDIX D
SCHEMATIC WIRING DIAGRAM

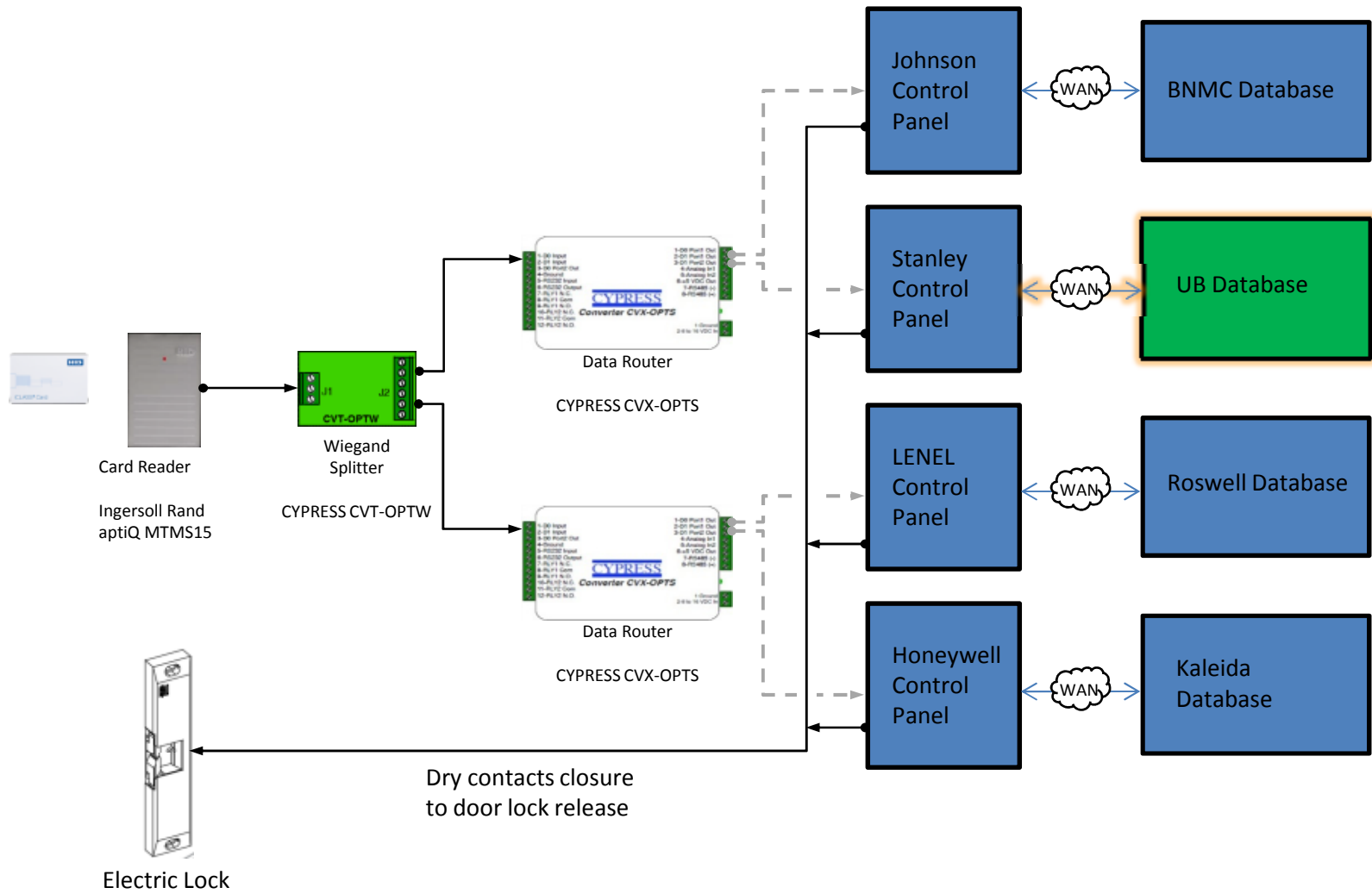


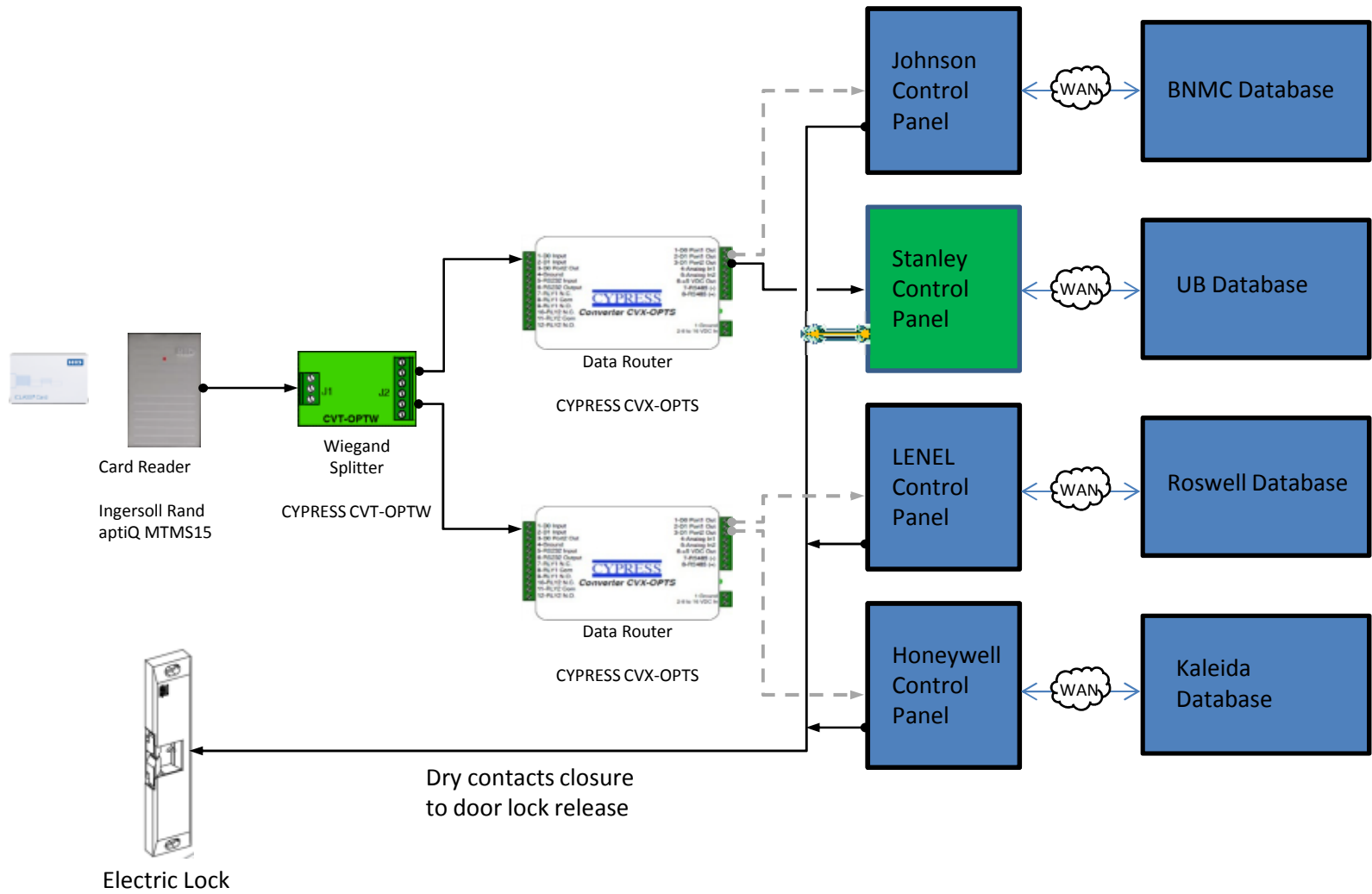


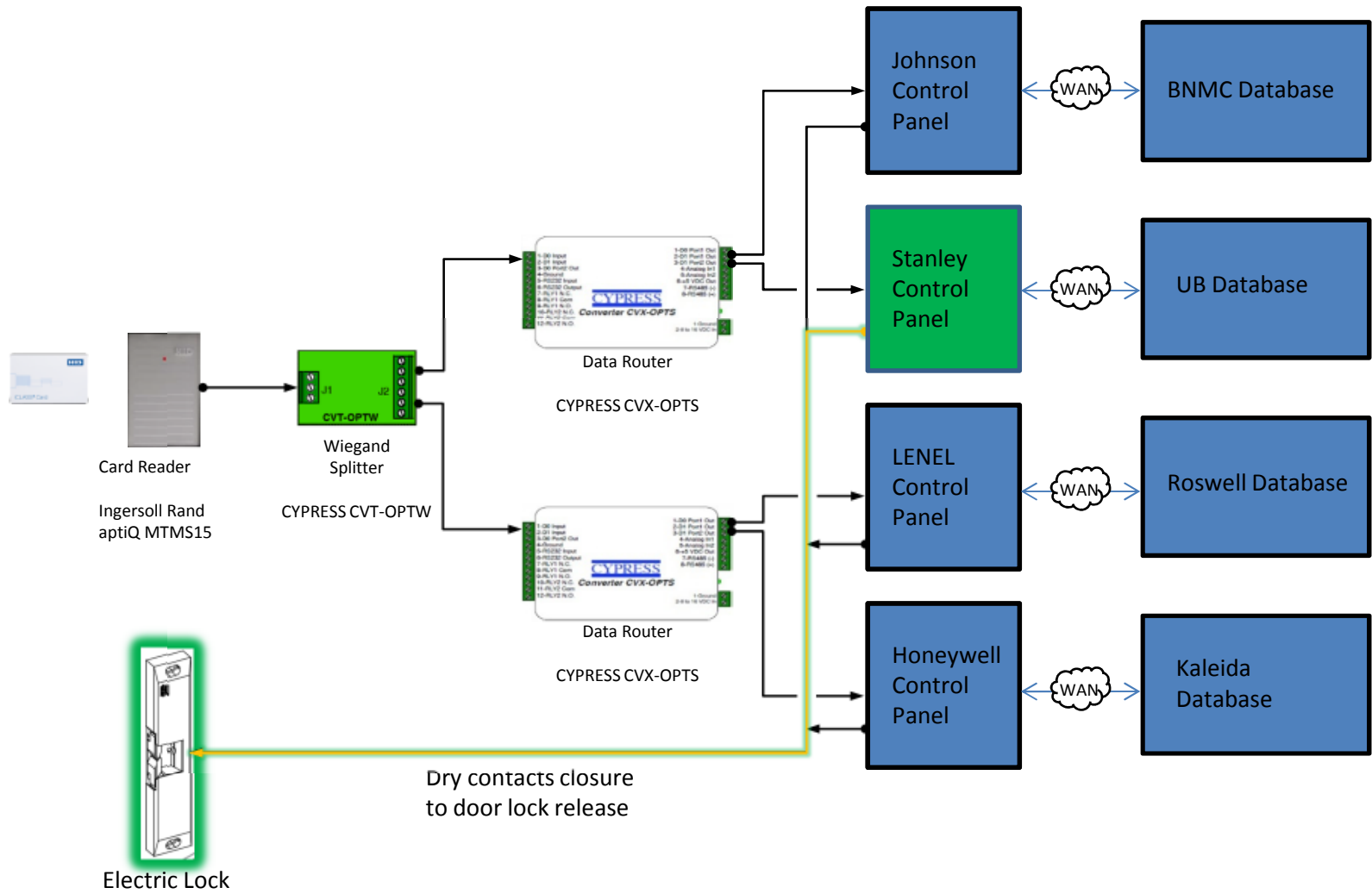












APPENDIX E

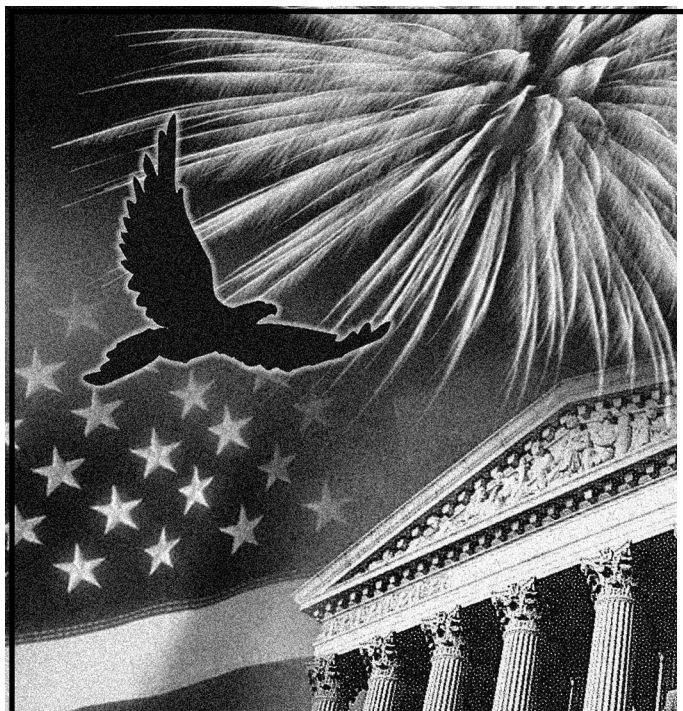
EMPLOYER'S TAX GUIDE TO FRINGE BENEFITS

Publication 15-B

Cat. No. 29744N

Employer's Tax Guide to Fringe Benefits

For use in **2014**



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Contents

What's New	1
Reminders	2
Introduction	2
1. Fringe Benefit Overview	2
2. Fringe Benefit Exclusion Rules	5
Accident and Health Benefits	5
Achievement Awards	7
Adoption Assistance	7
Athletic Facilities	8
<i>De Minimis</i> (Minimal) Benefits	8
Dependent Care Assistance	8
Educational Assistance	9
Employee Discounts	10
Employee Stock Options	10
Employer-Provided Cell Phones	11
Group-Term Life Insurance Coverage	11
Health Savings Accounts	14
Lodging on Your Business Premises	15
Meals	15
Moving Expense Reimbursements	17
No-Additional-Cost Services	17
Retirement Planning Services	18
Transportation (Commuting) Benefits	18
Tuition Reduction	20
Working Condition Benefits	20
3. Fringe Benefit Valuation Rules	22
General Valuation Rule	22
Cents-Per-Mile Rule	22
Commuting Rule	23
Lease Value Rule	24
Unsafe Conditions Commuting Rule	26
4. Rules for Withholding, Depositing, and Reporting	27
How To Get Tax Help	28
Index	31

Future Developments

For the latest information about developments related to Publication 15-B, such as legislation enacted after it was published, go to www.irs.gov/pub15b.

What's New

Cents-per-mile rule. The business mileage rate for 2014 is 56 cents per mile. You may use this rate to reimburse an employee for business use of a personal vehicle, and under certain conditions, you may use the rate under the



cents-per-mile rule to value the personal use of a vehicle you provide to an employee. See [Cents-Per-Mile Rule](#) in section 3.

Qualified parking exclusion and commuter transportation benefit. For 2014, the monthly exclusion for qualified parking is \$250 and the monthly exclusion for commuter highway vehicle transportation and transit passes is \$130. See [Qualified Transportation Benefits](#) in section 2.

Same-sex Marriage For federal tax purposes, individuals of the same sex are considered married if they were lawfully married in a state (or foreign country) whose laws authorize the marriage of two individuals of the same sex, even if the state (or foreign country) in which they now live does not recognize same-sex marriage. For more information, see Revenue Ruling 2013-17, 2013-38 I.R.B. 201, available at www.irs.gov/irb/2013-38_IRB/ar07.html. Notice 2013-61 provides special administrative procedures for employers to make claims for refund or adjustments of overpayments of social security and Medicare taxes with respect to certain same-sex spouse benefits before expiration of the period of limitations. Notice 2013-61, 2013-44 I.R.B. 432, is available at www.irs.gov/irb/2013-44_IRB/ar10.html.

Recent changes to certain rules for cafeteria plans. Notice 2013-71, 2013-47 I.R.B. 532, available at www.irs.gov/irb/2013-47_IRB/ar10.html, discusses recent changes to the “use-or-lose” rule for health flexible spending arrangements (FSAs) and clarifies the transitional rule for 2013-2014 non-calendar year salary reduction elections. See Notice 2013-71 for details on these changes.

Reminders

\$2,500 limit on a health flexible spending arrangement (FSA). For plan years beginning after December 31, 2012, a cafeteria plan may not allow an employee to request salary reduction contributions for a health FSA in excess of \$2,500. For plan years beginning after December 31, 2013, the limit is unchanged at \$2,500. For more information, see *Cafeteria Plans* in section 1.

Additional Medicare Tax withholding. In addition to withholding Medicare tax at 1.45%, you must withhold a 0.9% Additional Medicare Tax from wages you pay to an employee in excess of \$200,000 in a calendar year. You are required to begin withholding Additional Medicare Tax in the pay period in which you pay wages in excess of \$200,000 to an employee and continue to withhold it each pay period until the end of the calendar year. Additional Medicare Tax is only imposed on the employee. There is no employer share of Additional Medicare Tax. All wages that are subject to Medicare tax are subject to Additional Medicare Tax withholding if paid in excess of the \$200,000 withholding threshold. Unless otherwise noted, references to Medicare tax include Additional Medicare Tax.

For more information on what wages are subject to Medicare tax, see Table 2-1, later, and the chart, *Special Rules for Various Types of Services and Payments*, in section 15 of Publication 15, (Circular E), Employer's Tax

Guide. For more information on Additional Medicare Tax, visit IRS.gov and enter “Additional Medicare Tax” in the search box.

Photographs of missing children. The IRS is a proud partner with the National Center for Missing and Exploited Children. Photographs of missing children selected by the Center may appear in this publication on pages that would otherwise be blank. You can help bring these children home by looking at the photographs and calling 1-800-THE-LOST (1-800-843-5678) if you recognize a child.

Introduction

This publication supplements Publication 15 (Circular E), Employer's Tax Guide, and Publication 15-A, Employer's Supplemental Tax Guide. It contains information for employers on the employment tax treatment of fringe benefits.

Comments and suggestions. We welcome your comments about this publication and your suggestions for future editions.

You can write to us at the following address:

Internal Revenue Service
Tax Forms and Publications Division
1111 Constitution Ave. NW, IR-6526
Washington, DC 20224

We respond to many letters by telephone. Therefore, it would be helpful if you would include your daytime phone number, including the area code, in your correspondence.

You can also send us comments from www.irs.gov/formspubs. Click on *More Information* and then click on *Comment on Tax Forms and Publications*.

Although we cannot respond individually to each comment received, we do appreciate your feedback and will consider your comments as we revise our tax products.

1. Fringe Benefit Overview

A fringe benefit is a form of pay for the performance of services. For example, you provide an employee with a fringe benefit when you allow the employee to use a business vehicle to commute to and from work.

Performance of services. A person who performs services for you does not have to be your employee. A person may perform services for you as an independent contractor, partner, or director. Also, for fringe benefit purposes, treat a person who agrees not to perform services (such as under a covenant not to compete) as performing services.

Provider of benefit. You are the provider of a fringe benefit if it is provided for services performed for you. You are considered the provider of a fringe benefit even if a third party, such as your client or customer, provides the

benefit to your employee for services the employee performs for you. For example, if, in exchange for goods or services, your customer provides day care services as a fringe benefit to your employees for services they provide for you as their employer, then you are the provider of this fringe benefit even though the customer is actually providing the day care.

Recipient of benefit. The person who performs services for you is considered the recipient of a fringe benefit provided for those services. That person may be considered the recipient even if the benefit is provided to someone who did not perform services for you. For example, your employee may be the recipient of a fringe benefit you provide to a member of the employee's family.

Are Fringe Benefits Taxable?

Any fringe benefit you provide is taxable and must be included in the recipient's pay unless the law specifically excludes it. Section 2 discusses the exclusions that apply to certain fringe benefits. Any benefit not excluded under the rules discussed in section 2 is taxable.

Including taxable benefits in pay. You must include in a recipient's pay the amount by which the value of a fringe benefit is more than the sum of the following amounts.

- Any amount the law excludes from pay.
- Any amount the recipient paid for the benefit.

The rules used to determine the value of a fringe benefit are discussed in section 3.

If the recipient of a taxable fringe benefit is your employee, the benefit is subject to employment taxes and must be reported on Form W-2, Wage and Tax Statement. However, you can use special rules to withhold, deposit, and report the employment taxes. These rules are discussed in section 4.

If the recipient of a taxable fringe benefit is not your employee, the benefit is not subject to employment taxes. However, you may have to report the benefit on one of the following information returns.

If the recipient receives the benefit as:	Use:
An independent contractor	Form 1099-MISC, Miscellaneous Income
A partner	Schedule K-1 (Form 1065), Partner's Share of Income, Deductions, Credits, etc.

For more information, see the instructions for the forms listed above.

Cafeteria Plans

A cafeteria plan, including a flexible spending arrangement, is a written plan that allows your employees to choose between receiving cash or taxable benefits

instead of certain qualified benefits for which the law provides an exclusion from wages. If an employee chooses to receive a qualified benefit under the plan, the fact that the employee could have received cash or a taxable benefit instead will not make the qualified benefit taxable.

Generally, a cafeteria plan does not include any plan that offers a benefit that defers pay. However, a cafeteria plan can include a qualified 401(k) plan as a benefit. Also, certain life insurance plans maintained by educational institutions can be offered as a benefit even though they defer pay.

Qualified benefits. A cafeteria plan can include the following benefits discussed in section 2.

- Accident and health benefits (but not Archer medical savings accounts (Archer MSAs) or long-term care insurance).
- Adoption assistance.
- Dependent care assistance.
- Group-term life insurance coverage (including costs that cannot be excluded from wages).
- Health savings accounts (HSAs). Distributions from an HSA may be used to pay eligible long-term care insurance premiums or qualified long-term care services.

Benefits not allowed. A cafeteria plan **cannot** include the following benefits discussed in section 2.

- Archer MSAs. See [Accident and Health Benefits](#) in section 2.
- Athletic facilities.
- *De minimis* (minimal) benefits.
- Educational assistance.
- Employee discounts.
- Employer-provided cell phones.
- Lodging on your business premises.
- Meals.
- Moving expense reimbursements.
- No-additional-cost services.
- Transportation (commuting) benefits.
- Tuition reduction.
- Working condition benefits.

It also cannot include scholarships or fellowships (discussed in Publication 970, Tax Benefits for Education).

\$2,500 limit on a health flexible spending arrangement (FSA). For plan years beginning after December 31, 2012, a cafeteria plan may not allow an employee to request salary reduction contributions for a health FSA in

excess of \$2,500. For plan years beginning after December 31, 2013, the limit is unchanged at \$2,500.

A cafeteria plan offering a health FSA must be amended to specify the \$2,500 limit (or any lower limit set by the employer). While cafeteria plans generally must be amended on a prospective basis, an amendment that is adopted on or before December 31, 2014, may be made effective retroactively, provided that in operation the cafeteria plan meets the limit for plan years beginning after December 31, 2012. A cafeteria plan that does not limit health FSA contributions to the dollar limit is not a cafeteria plan and all benefits offered under the plan are includible in the employee's gross income.

For more information, see Notice 2012-40, 2012-26 I.R.B. 1046, available at www.irs.gov/irb/2012-26_IRB/ar09.html.

Employee. For these plans, treat the following individuals as employees.

- A current common-law employee. See section 2 in Publication 15 (Circular E) for more information.
- A full-time life insurance agent who is a current statutory employee.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.

Exception for S corporation shareholders. Do not treat a 2% shareholder of an S corporation as an employee of the corporation for this purpose. A 2% shareholder for this purpose is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Plans that favor highly compensated employees. If your plan favors highly compensated employees as to eligibility to participate, contributions, or benefits, you must include in their wages the value of taxable benefits they could have selected. A plan you maintain under a collective bargaining agreement does not favor highly compensated employees.

A highly compensated employee for this purpose is any of the following employees.

1. An officer.
2. A shareholder who owns more than 5% of the voting power or value of all classes of the employer's stock.
3. An employee who is highly compensated based on the facts and circumstances.
4. A spouse or dependent of a person described in (1), (2), or (3).

Plans that favor key employees. If your plan favors key employees, you must include in their wages the value of taxable benefits they could have selected. A plan favors

key employees if more than 25% of the total of the nontaxable benefits you provide for all employees under the plan go to key employees. However, a plan you maintain under a collective bargaining agreement does not favor key employees.

A key employee during 2014 is generally an employee who is either of the following.

1. An officer having annual pay of more than \$170,000.
2. An employee who for 2014 is either of the following.
 - a. A 5% owner of your business.
 - b. A 1% owner of your business whose annual pay was more than \$150,000.

Simple Cafeteria Plans

Eligible employers meeting contribution requirements and eligibility and participation requirements can establish a simple cafeteria plan. Simple cafeteria plans are treated as meeting the nondiscrimination requirements of a cafeteria plan and certain benefits under a cafeteria plan.

Eligible employer. You are an eligible employer if you employ an average of 100 or fewer employees during either of the 2 preceding years. If your business was not in existence throughout the preceding year, you are eligible if you reasonably expect to employ an average of 100 or fewer employees in the current year. If you establish a simple cafeteria plan in a year that you employ an average of 100 or fewer employees, you are considered an eligible employer for any subsequent year as long as you do not employ an average of 200 or more employees in a subsequent year.

Eligibility and participation requirements. These requirements are met if all employees who had at least 1,000 hours of service for the preceding plan year are eligible to participate and each employee eligible to participate in the plan may elect any benefit available under the plan. You may elect to exclude from the plan employees who:

1. Are under age 21 before the close of the plan year,
2. Have less than 1 year of service with you as of any day during the plan year,
3. Are covered under a collective bargaining agreement, or
4. Are nonresident aliens working outside the United States whose income did not come from a U.S. source.

Contribution requirements. You must make a contribution to provide qualified benefits on behalf of each qualified employee in an amount equal to:

1. A uniform percentage (not less than 2%) of the employee's compensation for the plan year, or
2. An amount which is at least 6% of the employee's compensation for the plan year or twice the amount of

the salary reduction contributions of each qualified employee, whichever is less.

If the contribution requirements are met using option (2), the rate of contribution to any salary reduction contribution of a highly compensated or key employee can not be greater than the rate of contribution to any other employee.

More information. For more information about cafeteria plans, see section 125 of the Internal Revenue Code and its regulations.

2. Fringe Benefit Exclusion Rules

This section discusses the exclusion rules that apply to fringe benefits. These rules exclude all or part of the value of certain benefits from the recipient's pay.

The excluded benefits are not subject to federal income tax withholding. Also, in most cases, they are not subject to social security, Medicare, or federal unemployment (FUTA) tax and are not reported on Form W-2.

This section discusses the exclusion rules for the following fringe benefits.

- Accident and health benefits.
- Achievement awards.
- Adoption assistance.
- Athletic facilities.
- *De minimis* (minimal) benefits.
- Dependent care assistance.
- Educational assistance.
- Employee discounts.
- Employee stock options.
- Employer-provided cell phones.
- Group-term life insurance coverage.
- Health savings accounts (HSAs).
- Lodging on your business premises.
- Meals.
- Moving expense reimbursements.
- No-additional-cost services.
- Retirement planning services.
- Transportation (commuting) benefits.
- Tuition reduction.
- Working condition benefits.

See Table 2-1, later, for an overview of the employment tax treatment of these benefits.

Accident and Health Benefits

This exclusion applies to contributions you make to an accident or health plan for an employee, including the following.

- Contributions to the cost of accident or health insurance including qualified long-term care insurance.
- Contributions to a separate trust or fund that directly or through insurance provides accident or health benefits.
- Contributions to Archer MSAs or health savings accounts (discussed in Publication 969, Health Savings Accounts and Other Tax-Favored Health Plans).

This exclusion also applies to payments you directly or indirectly make to an employee under an accident or health plan for employees that are either of the following.

- Payments or reimbursements of medical expenses.
- Payments for specific injuries or illnesses (such as the loss of the use of an arm or leg). The payments must be figured without regard to any period of absence from work.

Accident or health plan. This is an arrangement that provides benefits for your employees, their spouses, their dependents, and their children (under age 27) in the event of personal injury or sickness. The plan may be insured or noninsured and does not need to be in writing.

Employee. For this exclusion, treat the following individuals as employees.

- A current common-law employee.
- A full-time life insurance agent who is a current statutory employee.
- A retired employee.
- A former employee you maintain coverage for based on the employment relationship.
- A widow or widower of an individual who died while an employee.
- A widow or widower of a retired employee.
- For the exclusion of contributions to an accident or health plan, a leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.

Special rule for certain government plans. For certain government accident and health plans, payments to a deceased plan participant's beneficiary may qualify for the exclusion from gross income if the other requirements for exclusion are met. See section 105(j) for details.

Table 2-1. Special Rules for Various Types of Fringe Benefits
(For more information, see the full discussion in this section.)

Treatment Under Employment Taxes			
Type of Fringe Benefit	Income Tax Withholding	Social Security and Medicare (including Additional Medicare Tax when wages are paid in excess of \$200,000)	Federal Unemployment (FUTA)
Accident and health benefits	Exempt ^{1,2} , except for long-term care benefits provided through a flexible spending or similar arrangement.	Exempt, except for certain payments to S corporation employees who are 2% shareholders.	Exempt
Achievement awards	Exempt ¹ up to \$1,600 for qualified plan awards (\$400 for nonqualified awards).		
Adoption assistance	Exempt ^{1,3}	Taxable	Taxable
Athletic facilities	Exempt if substantially all use during the calendar year is by employees, their spouses, and their dependent children and the facility is operated by the employer on premises owned or leased by the employer.		
<i>De minimis</i> (minimal) benefits	Exempt	Exempt	Exempt
Dependent care assistance	Exempt ³ up to certain limits, \$5,000 (\$2,500 for married employee filing separate return).		
Educational assistance	Exempt up to \$5,250 of benefits each year. (See Educational Assistance , later in this section.)		
Employee discounts	Exempt ³ up to certain limits. (See Employee Discounts , later in this section.)		
Employee stock options	See Employee Stock Options , later in this section.		
Employer-provided cell phones	Exempt if provided primarily for noncompensatory business purposes.		
Group-term life insurance coverage	Exempt	Exempt ^{1,4,7} up to cost of \$50,000 of coverage. (Special rules apply to former employees.)	Exempt
Health savings accounts (HSAs)	Exempt for qualified individuals up to the HSA contribution limits. (See Health Savings Accounts , later in this section.)		
Lodging on your business premises	Exempt ¹ if furnished for your convenience as a condition of employment.		
Meals	Exempt if furnished on your business premises for your convenience. Exempt if <i>de minimis</i> .		
Moving expense reimbursements	Exempt ¹ if expenses would be deductible if the employee had paid them.		
No-additional-cost services	Exempt ³	Exempt ³	Exempt ³
Retirement planning services	Exempt ⁵	Exempt ⁵	Exempt ⁵
Transportation (commuting) benefits	Exempt ¹ up to certain limits if for rides in a commuter highway vehicle and/or transit passes (\$130), qualified parking (\$250), or qualified bicycle commuting reimbursement ⁶ (\$20). (See Transportation (Commuting) Benefits , later in this section.) Exempt if <i>de minimis</i> .		
Tuition reduction	Exempt ³ if for undergraduate education (or graduate education if the employee performs teaching or research activities).		
Working condition benefits	Exempt	Exempt	Exempt

¹ Exemption does not apply to S corporation employees who are 2% shareholders.
² Exemption does not apply to certain highly compensated employees under a self-insured plan that favors those employees.
³ Exemption does not apply to certain highly compensated employees under a program that favors those employees.
⁴ Exemption does not apply to certain key employees under a plan that favors those employees.
⁵ Exemption does not apply to services for tax preparation, accounting, legal, or brokerage services.
⁶ If the employee receives a qualified bicycle commuting reimbursement in a qualified bicycle commuting month, the employee cannot receive commuter highway vehicle, transit pass, or qualified parking benefits in that same month.
⁷ You must include in your employee's wages the cost of group-term life insurance beyond \$50,000 worth of coverage, reduced by the amount the employee paid toward the insurance. Report it as wages in boxes 1, 3, and 5 of the employee's Form W-2. Also, show it in box 12 with code "C." The amount is subject to social security and Medicare taxes, and you may, at your option, withhold federal income tax.

Exception for S corporation shareholders. Do not treat a 2% shareholder of an S corporation as an employee of the corporation for this purpose. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Exclusion from wages. You can generally exclude the value of accident or health benefits you provide to an employee from the employee's wages.

Exception for certain long-term care benefits. You cannot exclude contributions to the cost of long-term care

insurance from an employee's wages subject to federal income tax withholding if the coverage is provided through a flexible spending or similar arrangement. This is a benefit program that reimburses specified expenses up to a maximum amount that is reasonably available to the employee and is less than five times the total cost of the insurance. However, you can exclude these contributions from the employee's wages subject to social security, Medicare, and federal unemployment (FUTA) taxes.

S corporation shareholders. Because you cannot treat a 2% shareholder of an S corporation as an employee for this exclusion, you must include the value of accident or health benefits you provide to the employee in the employee's wages subject to federal income tax withholding. However, you can exclude the value of these

benefits (other than payments for specific injuries or illnesses) from the employee's wages subject to social security, Medicare, and FUTA taxes.

Exception for highly compensated employees. If your plan is a self-insured medical reimbursement plan that favors highly compensated employees, you must include all or part of the amounts you pay to these employees in their wages subject to federal income tax withholding. However, you can exclude these amounts (other than payments for specific injuries or illnesses) from the employee's wages subject to social security, Medicare, and FUTA taxes.

A self-insured plan is a plan that reimburses your employees for medical expenses not covered by an accident or health insurance policy.

A highly compensated employee for this exception is any of the following individuals.

- One of the five highest paid officers.
- An employee who owns (directly or indirectly) more than 10% in value of the employer's stock.
- An employee who is among the highest paid 25% of all employees (other than those who can be excluded from the plan).

For more information on this exception, see section 105(h) of the Internal Revenue Code and its regulations.

COBRA premiums. The exclusion for accident and health benefits applies to amounts you pay to maintain medical coverage for a current or former employee under the Combined Omnibus Budget Reconciliation Act of 1986 (COBRA). The exclusion applies regardless of the length of employment, whether you directly pay the premiums or reimburse the former employee for premiums paid, and whether the employee's separation is permanent or temporary.

Achievement Awards

This exclusion applies to the value of any tangible personal property you give to an employee as an award for either length of service or safety achievement. The exclusion does not apply to awards of cash, cash equivalents, gift certificates, or other intangible property such as vacations, meals, lodging, tickets to theater or sporting events, stocks, bonds, and other securities. The award must meet the requirements for employee achievement awards discussed in chapter 2 of Publication 535, Business Expenses.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A former common-law employee you maintain coverage for in consideration of or based on an agreement relating to prior service as an employee.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if

the services are performed under your primary direction or control.

Exception for S corporation shareholders. Do not treat a 2% shareholder of an S corporation as an employee of the corporation for this purpose. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Exclusion from wages. You can generally exclude the value of achievement awards you give to an employee from the employee's wages if their cost is not more than the amount you can deduct as a business expense for the year. The excludable annual amount is \$1,600 (\$400 for awards that are not "qualified plan awards"). See chapter 2 of Publication 535 for more information about the limit on deductions for employee achievement awards.



To determine for 2014 whether an achievement award is a "qualified plan award" under the deduction rules described in Publication 535, treat any employee who received more than \$115,000 in pay for 2013 as a highly compensated employee.

If the cost of awards given to an employee is more than your allowable deduction, include in the employee's wages the larger of the following amounts.

- The part of the cost that is more than your allowable deduction (up to the value of the awards).
- The amount by which the value of the awards exceeds your allowable deduction.

Exclude the remaining value of the awards from the employee's wages.

Adoption Assistance

An adoption assistance program is a separate written plan of an employer that meets all of the following requirements.

1. It benefits employees who qualify under rules set up by you, which do not favor highly compensated employees or their dependents. To determine whether your plan meets this test, do not consider employees excluded from your plan who are covered by a collective bargaining agreement, if there is evidence that adoption assistance was a subject of good-faith bargaining.
2. It does not pay more than 5% of its payments during the year for shareholders or owners (or their spouses or dependents). A shareholder or owner is someone who owns (on any day of the year) more than 5% of the stock or of the capital or profits interest of your business.
3. You give reasonable notice of the plan to eligible employees.

4. Employees provide reasonable substantiation that payments or reimbursements are for qualifying expenses.

For this exclusion, a highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

You must exclude all payments or reimbursements you make under an adoption assistance program for an employee's qualified adoption expenses from the employee's wages subject to federal income tax withholding. However, you cannot exclude these payments from wages subject to social security, Medicare, and federal unemployment (FUTA) taxes. For more information, see the Instructions for Form 8839, Qualified Adoption Expenses.

You must report all qualifying adoption expenses you paid or reimbursed under your adoption assistance program for each employee for the year in box 12 of the employee's Form W-2. Use code "T" to identify this amount.

Exception for S corporation shareholders. For this exclusion, do not treat a 2% shareholder of an S corporation as an employee of the corporation. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, including using the benefit as a reduction in distributions to the 2% shareholder.

Athletic Facilities

You can exclude the value of an employee's use of an on-premises gym or other athletic facility you operate from an employee's wages if substantially all use of the facility during the calendar year is by your employees, their spouses, and their dependent children. For this purpose, an employee's dependent child is a child or stepchild who is the employee's dependent or who, if both parents are deceased, has not attained the age of 25.

On-premises facility. The athletic facility must be located on premises you own or lease. It does not have to be located on your business premises. However, the exclusion does not apply to an athletic facility for residential use, such as athletic facilities that are part of a resort.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A former employee who retired or left on disability.

- A widow or widower of an individual who died while an employee.
- A widow or widower of a former employee who retired or left on disability.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.
- A partner who performs services for a partnership.

De Minimis (Minimal) Benefits

You can exclude the value of a *de minimis* benefit you provide to an employee from the employee's wages. A *de minimis* benefit is any property or service you provide to an employee that has so little value (taking into account how frequently you provide similar benefits to your employees) that accounting for it would be unreasonable or administratively impracticable. Cash and cash equivalent fringe benefits (for example, use of gift card, charge card, or credit card), no matter how little, are never excludable as a *de minimis* benefit, except for occasional meal money or transportation fare.

Examples of *de minimis* benefits include the following.

- Personal use of an employer-provided cell phone provided primarily for noncompensatory business purposes. See [Employer-Provided Cell Phones](#), later in this section, for details.
- Occasional personal use of a company copying machine if you sufficiently control its use so that at least 85% of its use is for business purposes.
- Holiday gifts, other than cash, with a low fair market value.
- Group-term life insurance payable on the death of an employee's spouse or dependent if the face amount is not more than \$2,000.
- Meals. See [Meals](#), later in this section, for details.
- Occasional parties or picnics for employees and their guests.
- Occasional tickets for theater or sporting events.
- Transportation fare. See [Transportation \(Commuting\) Benefits](#), later in this section, for details.

Employee. For this exclusion, treat any recipient of a *de minimis* benefit as an employee.

Dependent Care Assistance

This exclusion applies to household and dependent care services you directly or indirectly pay for or provide to an employee under a dependent care assistance program that covers only your employees. The services must be for a qualifying person's care and must be provided to allow the employee to work. These requirements are basically the same as the tests the employee would have to meet to

claim the dependent care credit if the employee paid for the services. For more information, see *Qualifying Person Test* and *Work-Related Expense Test* in Publication 503, Child and Dependent Care Expenses.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.
- Yourself (if you are a sole proprietor).
- A partner who performs services for a partnership.

Exclusion from wages. You can exclude the value of benefits you provide to an employee under a dependent care assistance program from the employee's wages if you reasonably believe that the employee can exclude the benefits from gross income.

An employee can generally exclude from gross income up to \$5,000 of benefits received under a dependent care assistance program each year. This limit is reduced to \$2,500 for married employees filing separate returns.

However, the exclusion cannot be more than the smaller of the earned income of either the employee or employee's spouse. Special rules apply to determine the earned income of a spouse who is either a student or not able to care for himself or herself. For more information on the earned income limit, see Publication 503.

Exception for highly compensated employees.

You cannot exclude dependent care assistance from the wages of a highly compensated employee unless the benefits provided under the program do not favor highly compensated employees and the program meets the requirements described in section 129(d) of the Internal Revenue Code.

For this exclusion, a highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Form W-2. Report the value of all dependent care assistance you provide to an employee under a dependent care assistance program in box 10 of the employee's Form W-2. Include any amounts you cannot exclude from the employee's wages in boxes 1, 3, and 5. Report both the nontaxable portion of assistance (up to \$5,000) and any assistance above the amount that is non-taxable to the employee.

Example. Company A provides a dependent care assistance flexible spending arrangement to its employees through a cafeteria plan. In addition, it provides occasional on-site dependent care to its employees at no cost. Emily, an employee of company A, had \$4,500 deducted from her pay for the dependent care flexible spending arrangement. In addition, Emily used the on-site dependent care several times. The fair market value of the on-site care was \$700. Emily's Form W-2 should report \$5,200 of dependent care assistance in box 10 (\$4,500 flexible spending arrangement plus \$700 on-site dependent care). Boxes 1, 3, and 5 should include \$200 (the amount in excess of the nontaxable assistance), and applicable taxes should be withheld on that amount.

Educational Assistance

This exclusion applies to educational assistance you provide to employees under an educational assistance program. The exclusion also applies to graduate level courses.

Educational assistance means amounts you pay or incur for your employees' education expenses. These expenses generally include the cost of books, equipment, fees, supplies, and tuition. However, these expenses do not include the cost of a course or other education involving sports, games, or hobbies, unless the education:

- Has a reasonable relationship to your business, or
- Is required as part of a degree program.

Education expenses do not include the cost of tools or supplies (other than textbooks) your employee is allowed to keep at the end of the course. Nor do they include the cost of lodging, meals, or transportation.

Educational assistance program. An educational assistance program is a separate written plan that provides educational assistance only to your employees. The program qualifies only if all of the following tests are met.

- The program benefits employees who qualify under rules set up by you that do not favor highly compensated employees. To determine whether your program meets this test, do not consider employees excluded from your program who are covered by a collective bargaining agreement if there is evidence that educational assistance was a subject of good-faith bargaining.
- The program does not provide more than 5% of its benefits during the year for shareholders or owners. A shareholder or owner is someone who owns (on any day of the year) more than 5% of the stock or of the capital or profits interest of your business.
- The program does not allow employees to choose to receive cash or other benefits that must be included in gross income instead of educational assistance.
- You give reasonable notice of the program to eligible employees.

Your program can cover former employees if their employment is the reason for the coverage.

For this exclusion, a highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A former employee who retired, left on disability, or was laid off.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.
- Yourself (if you are a sole proprietor).
- A partner who performs services for a partnership.

Exclusion from wages. You can exclude up to \$5,250 of educational assistance you provide to an employee under an educational assistance program from the employee's wages each year.

Assistance over \$5,250. If you do not have an educational assistance plan, or you provide an employee with assistance exceeding \$5,250, you must include the value of these benefits as wages, unless the benefits are working condition benefits. Working condition benefits may be excluded from wages. Property or a service provided is a working condition benefit to the extent that if the employee paid for it, the amount paid would have been deductible as a business or depreciation expense. See [Working Condition Benefits](#), later, in this section.

Employee Discounts

This exclusion applies to a price reduction you give an employee on property or services you offer to customers in the ordinary course of the line of business in which the employee performs substantial services. However, it does not apply to discounts on real property or discounts on personal property of a kind commonly held for investment (such as stocks or bonds).

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A former employee who retired or left on disability.

- A widow or widower of an individual who died while an employee.
- A widow or widower of an employee who retired or left on disability.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.
- A partner who performs services for a partnership.

Exclusion from wages. You can generally exclude the value of an employee discount you provide an employee from the employee's wages, up to the following limits.

- For a discount on services, 20% of the price you charge nonemployee customers for the service.
- For a discount on merchandise or other property, your gross profit percentage times the price you charge nonemployee customers for the property.

Determine your gross profit percentage in the line of business based on all property you offer to customers (including employee customers) and your experience during the tax year immediately before the tax year in which the discount is available. To figure your gross profit percentage, subtract the total cost of the property from the total sales price of the property and divide the result by the total sales price of the property.

Exception for highly compensated employees.

You cannot exclude from the wages of a highly compensated employee any part of the value of a discount that is not available on the same terms to one of the following groups.

- All of your employees.
- A group of employees defined under a reasonable classification you set up that does not favor highly compensated employees.

For this exclusion, a highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Employee Stock Options

There are three kinds of stock options—incentive stock options, employee stock purchase plan options, and non-statutory (nonqualified) stock options.

Wages for social security, Medicare, and federal unemployment (FUTA) taxes do not include remuneration resulting from the exercise, after October 22, 2004, of an

incentive stock option or under an employee stock purchase plan option, or from any disposition of stock acquired by exercising such an option. The IRS will not apply these taxes to an exercise before October 23, 2004, of an incentive stock option or an employee stock purchase plan option or to a disposition of stock acquired by such exercise.

Additionally, federal income tax withholding is not required on the income resulting from a disqualifying disposition of stock acquired by the exercise after October 22, 2004, of an incentive stock option or under an employee stock purchase plan option, or on income equal to the discount portion of stock acquired by the exercise, after October 22, 2004, of an employee stock purchase plan option resulting from any disposition of the stock. The IRS will not apply federal income tax withholding upon the disposition of stock acquired by the exercise, before October 23, 2004, of an incentive stock option or an employee stock purchase plan option. However, the employer must report as income in box 1 of Form W-2, (a) the discount portion of stock acquired by the exercise of an employee stock purchase plan option upon disposition of the stock, and (b) the spread (between the exercise price and the fair market value of the stock at the time of exercise) upon a disqualifying disposition of stock acquired by the exercise of an incentive stock option or an employee stock purchase plan option.

An employer must report the excess of the fair market value of stock received upon exercise of a nonstatutory stock option over the amount paid for the stock option on Form W-2 in boxes 1, 3 (up to the social security wage base), 5, and in box 12 using the code "V." See Regulations section 1.83-7.

An employee who transfers his or her interest in nonstatutory stock options to the employee's former spouse incident to a divorce is not required to include an amount in gross income upon the transfer. The former spouse, rather than the employee, is required to include an amount in gross income when the former spouse exercises the stock options. See Revenue Ruling 2002-22 and Revenue Ruling 2004-60 for details. You can find Revenue Ruling 2002-22 on page 849 of Internal Revenue Bulletin 2002-19 at www.irs.gov/pub/irs-irbs/irb02-19.pdf. See Revenue Ruling 2004-60, 2004-24 I.R.B. 1051, available at www.irs.gov/irb/2004-24_IRB/ar13.html.

For more information about employee stock options, see sections 421, 422, and 423 of the Internal Revenue Code and their related regulations.

Employer-Provided Cell Phones

The value of an employer-provided cell phone, provided primarily for noncompensatory business reasons, is excludable from an employee's income as a working condition fringe benefit. Personal use of an employer-provided cell phone, provided primarily for noncompensatory business reasons, is excludable from an employee's income as a *de minimis* fringe benefit. For the rules relating to these types of benefits, see [De Minimis \(Minimal\)](#)

[Benefits](#), earlier in this section, and [Working Condition Benefits](#), later in this section.

Noncompensatory business purposes. You provide a cell phone primarily for noncompensatory business purposes if there are substantial business reasons for providing the cell phone. Examples of substantial business reasons include the employer's:

- Need to contact the employee at all times for work-related emergencies,
- Requirement that the employee be available to speak with clients at times when the employee is away from the office, and
- Need to speak with clients located in other time zones at times outside the employee's normal workday.

Cell phones provided to promote goodwill, boost morale, or attract prospective employees. You cannot exclude from an employee's wages the value of a cell phone provided to promote goodwill of an employee, to attract a prospective employee, or as a means of providing additional compensation to an employee.

Additional information. For additional information on the tax treatment of employer-provided cell phones, see Notice 2011-72, 2011-38 I.R.B. 407, available at www.irs.gov/irb/2011-38_IRB/ar07.html.

Group-Term Life Insurance Coverage

This exclusion applies to life insurance coverage that meets all the following conditions.

- It provides a general death benefit that is not included in income.
- You provide it to a group of employees. See [The 10-employee rule](#), later.
- It provides an amount of insurance to each employee based on a formula that prevents individual selection. This formula must use factors such as the employee's age, years of service, pay, or position.
- You provide it under a policy you directly or indirectly carry. Even if you do not pay any of the policy's cost, you are considered to carry it if you arrange for payment of its cost by your employees and charge at least one employee less than, and at least one other employee more than, the cost of his or her insurance. Determine the cost of the insurance, for this purpose, as explained under [Coverage over the limit](#), later.

Group-term life insurance does not include the following insurance.

- Insurance that does not provide general death benefits, such as travel insurance or a policy providing only accidental death benefits.
- Life insurance on the life of your employee's spouse or dependent. However, you may be able to exclude the cost of this insurance from the employee's wages as a *de minimis* benefit. See [De Minimis \(Minimal\) Benefits](#), earlier in this section.

- Insurance provided under a policy that provides a permanent benefit (an economic value that extends beyond 1 policy year, such as paid-up or cash surrender value), unless certain requirements are met. See Regulations section 1.79-1 for details.

Employee. For this exclusion, treat the following individuals as employees.

1. A current common-law employee.
2. A full-time life insurance agent who is a current statutory employee.
3. An individual who was formerly your employee under (1) or (2).
4. A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction and control.

Exception for S corporation shareholders. Do not treat a 2% shareholder of an S corporation as an employee of the corporation for this purpose. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

The 10-employee rule. Generally, life insurance is not group-term life insurance unless you provide it to at least 10 full-time employees at some time during the year.

For this rule, count employees who choose not to receive the insurance unless, to receive it, they must contribute to the cost of benefits other than the group-term life insurance. For example, count an employee who could receive insurance by paying part of the cost, even if that employee chooses not to receive it. However, do not count an employee who must pay part or all of the cost of permanent benefits to get insurance, unless that employee chooses to receive it. A permanent benefit is an economic value extending beyond one policy year (for example, a paid-up or cash-surrender value) that is provided under a life insurance policy.

Exceptions. Even if you do not meet the 10-employee rule, two exceptions allow you to treat insurance as group-term life insurance.

Under the first exception, you do not have to meet the 10-employee rule if all the following conditions are met.

1. If evidence that the employee is insurable is required, it is limited to a medical questionnaire (completed by the employee) that does not require a physical.
2. You provide the insurance to all your full-time employees or, if the insurer requires the evidence mentioned in (1), to all full-time employees who provide evidence the insurer accepts.
3. You figure the coverage based on either a uniform percentage of pay or the insurer's coverage brackets

that meet certain requirements. See Regulations section 1.79-1 for details.

Under the second exception, you do not have to meet the 10-employee rule if all the following conditions are met.

- You provide the insurance under a common plan covering your employees and the employees of at least one other employer who is not related to you.
- The insurance is restricted to, but mandatory for, all your employees who belong to, or are represented by, an organization (such as a union) that carries on substantial activities besides obtaining insurance.
- Evidence of whether an employee is insurable does not affect an employee's eligibility for insurance or the amount of insurance that employee gets.

To apply either exception, do not consider employees who were denied insurance for any of the following reasons.

- They were 65 or older.
- They customarily work 20 hours or less a week or 5 months or less in a calendar year.
- They have not been employed for the waiting period given in the policy. This waiting period cannot be more than 6 months.

Exclusion from wages. You can generally exclude the cost of up to \$50,000 of group-term life insurance from the wages of an insured employee. You can exclude the same amount from the employee's wages when figuring social security and Medicare taxes. In addition, you do not have to withhold federal income tax or pay FUTA tax on any group-term life insurance you provide to an employee.

Coverage over the limit. You must include in your employee's wages the cost of group-term life insurance beyond \$50,000 worth of coverage, reduced by the amount the employee paid toward the insurance. Report it as wages in boxes 1, 3, and 5 of the employee's Form W-2. Also, show it in box 12 with code "C." The amount is subject to social security and Medicare taxes, and you may, at your option, withhold federal income tax.

Figure the monthly cost of the insurance to include in the employee's wages by multiplying the number of thousands of dollars of all insurance coverage over \$50,000 (figured to the nearest \$100) by the cost shown in Table 2-2. For all coverage provided within the calendar year, use the employee's age on the last day of the employee's tax year. You must prorate the cost from the table if less than a full month of coverage is involved.

Table 2-2. Cost Per \$1,000 of Protection For 1 Month

Age	Cost
Under 25	\$.05
25 through 29	.06
30 through 34	.08
35 through 39	.09
40 through 44	.10
45 through 49	.15
50 through 54	.23
55 through 59	.43
60 through 64	.66
65 through 69	1.27
70 and older	2.06

You figure the total cost to include in the employee's wages by multiplying the monthly cost by the number of full months' coverage at that cost.

Example. Tom's employer provides him with group-term life insurance coverage of \$200,000. Tom is 45 years old, is not a key employee, and pays \$100 per year toward the cost of the insurance. Tom's employer must include \$170 in his wages. The \$200,000 of insurance coverage is reduced by \$50,000. The yearly cost of \$150,000 of coverage is \$270 ($\$.15 \times 150 \times 12$), and is reduced by the \$100 Tom pays for the insurance. The employer includes \$170 in boxes 1, 3, and 5 of Tom's Form W-2. The employer also enters \$170 in box 12 with code "C."

Coverage for dependents. Group-term life insurance coverage paid by the employer for the spouse or dependents of an employee may be excludable from income as a *de minimis* fringe benefit if the face amount is not more than \$2,000. If the face amount is greater than \$2,000, the entire cost of the dependent coverage must be included in income unless the amount over \$2,000 is purchased with employee contributions on an after-tax basis. The cost of the insurance is determined by using Table 2-2.

Former employees. When group-term life insurance over \$50,000 is provided to an employee (including retirees) after his or her termination, the employee share of social security and Medicare taxes on that period of coverage is paid by the former employee with his or her tax return and is not collected by the employer. You are not required to collect those taxes. Use the table above to determine the amount of social security and Medicare taxes owed by the former employee for coverage provided after separation from service. Report those uncollected amounts separately in box 12 of Form W-2 using codes "M" and "N." See the General Instructions for Forms W-2 and W-3 and the Instructions for Form 941.

Exception for key employees. Generally, if your group-term life insurance plan favors key employees as to participation or benefits, you must include the entire cost of the insurance in your key employees' wages. This exception generally does not apply to church plans. When figuring social security and Medicare taxes, you must also include the entire cost in the employees' wages. Include the cost in boxes 1, 3, and 5 of Form W-2. However, you

do not have to withhold federal income tax or pay FUTA tax on the cost of any group-term life insurance you provide to an employee.

For this purpose, the cost of the insurance is the greater of the following amounts.

- The premiums you pay for the employee's insurance. See Regulations section 1.79-4T(Q&A 6) for more information.
- The cost you figure using Table 2-2.

For this exclusion, a key employee during 2014 is an employee or former employee who is one of the following individuals. See section 416(i) of the Internal Revenue Code for more information.

1. An officer having annual pay of more than \$170,000.
2. An individual who for 2014 was either of the following.
 - a. A 5% owner of your business.
 - b. A 1% owner of your business whose annual pay was more than \$150,000.

A former employee who was a key employee upon retirement or separation from service is also a key employee.

Your plan does not favor key employees as to participation if at least one of the following is true.

- It benefits at least 70% of your employees.
- At least 85% of the participating employees are not key employees.
- It benefits employees who qualify under a set of rules you set up that do not favor key employees.

Your plan meets this participation test if it is part of a cafeteria plan (discussed in section 1) and it meets the participation test for those plans.

When applying this test, do not consider employees who:

- Have not completed 3 years of service,
- Are part-time or seasonal,
- Are nonresident aliens who receive no U.S. source earned income from you, or
- Are not included in the plan but are in a unit of employees covered by a collective bargaining agreement, if the benefits provided under the plan were the subject of good-faith bargaining between you and employee representatives.

Your plan does not favor key employees as to benefits if all benefits available to participating key employees are also available to all other participating employees. Your plan does not favor key employees just because the amount of insurance you provide to your employees is uniformly related to their pay.

S corporation shareholders. Because you cannot treat a 2% shareholder of an S corporation as an employee for this exclusion, you must include the cost of all group-term life insurance coverage you provide the 2%

shareholder in his or her wages. When figuring social security and Medicare taxes, you must also include the cost of this coverage in the 2% shareholder's wages. Include the cost in boxes 1, 3, and 5 of Form W-2. However, you do not have to withhold federal income tax or pay federal unemployment tax on the cost of any group-term life insurance coverage you provide to the 2% shareholder.

Health Savings Accounts

A Health Savings Account (HSA) is an account owned by a qualified individual who is generally your employee or former employee. Any contributions that you make to an HSA become the employee's property and cannot be withdrawn by you. Contributions to the account are used to pay current or future medical expenses of the account owner, his or her spouse, and any qualified dependent. The medical expenses must not be reimbursable by insurance or other sources and their payment from HSA funds (distribution) will not give rise to a medical expense deduction on the individual's federal income tax return. For more information about HSAs, visit the Department of Treasury's website at www.treasury.gov and enter "HSA" in the search box.

Eligibility. A qualified individual must be covered by a High Deductible Health Plan (HDHP) and not be covered by other health insurance except for permitted insurance listed under section 223(c)(3) or insurance for accidents, disability, dental care, vision care, or long-term care. For calendar year 2014, a qualifying HDHP must have a deductible of at least \$1,250 for self-only coverage or \$2,500 for family coverage and must limit annual out-of-pocket expenses of the beneficiary to \$6,350 for self-only coverage and \$12,700 for family coverage.

There are no income limits that restrict an individual's eligibility to contribute to an HSA nor is there a requirement that the account owner have earned income to make a contribution.

Exceptions. An individual is not a qualified individual if he or she can be claimed as a dependent on another person's tax return. Also, an employee's participation in a health flexible spending arrangement (FSA) or health reimbursement arrangement (HRA) generally disqualifies the individual (and employer) from making contributions to his or her HSA. However, an individual may qualify to participate in an HSA if he or she is participating in only a limited-purpose FSA or HRA or a post-deductible FSA. For more information, see *Other employee health plans* in Publication 969.

Employer contributions. Up to specified dollar limits, cash contributions to the HSA of a qualified individual (determined monthly) are exempt from federal income tax withholding, social security tax, Medicare tax, and FUTA tax. For 2014, you can contribute up to \$3,300 for self-only coverage or \$6,550 for family coverage to a qualified individual's HSA.

The contribution amounts listed above are increased by \$1,000 for a qualified individual who is age 55 or older at any time during the year. For two qualified individuals who

are married to each other and who each are age 55 or older at any time during the year, each spouse's contribution limit is increased by \$1,000 provided each spouse has a separate HSA. No contributions can be made to an individual's HSA after he or she becomes enrolled in Medicare Part A or Part B.

Nondiscrimination rules. Your contribution amount to an employee's HSA must be comparable for all employees who have comparable coverage during the same period. Otherwise, there will be an excise tax equal to 35% of the amount you contributed to all employees' HSAs.

For guidance on employer comparable contributions to HSAs under section 4980G in instances where an employee has not established an HSA by December 31 and in instances where an employer accelerates contributions for the calendar year for employees who have incurred qualified medical expenses, see Regulations section 54.4980G-4.

Exception. The Tax Relief and Health Care Act of 2006 allows employers to make larger HSA contributions for a nonhighly compensated employee than for a highly compensated employee. A highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Partnerships and S corporations. Partners and 2% shareholders of an S corporation are not eligible for salary reduction (pre-tax) contributions to an HSA. Employer contributions to the HSA of a bona fide partner or 2% shareholder are treated as distributions or guaranteed payments as determined by the facts and circumstances.

Cafeteria plans. You may contribute to an employee's HSA using a cafeteria plan and your contributions are not subject to the statutory comparability rules. However, cafeteria plan nondiscrimination rules still apply. For example, contributions under a cafeteria plan to employee HSAs cannot be greater for higher-paid employees than they are for lower-paid employees. Contributions that favor lower-paid employees are not prohibited.

Reporting requirements. You must report your contributions to an employee's HSA in box 12 of Form W-2 using code "W." The trustee or custodian of the HSA, generally a bank or insurance company, reports distributions from the HSA using Form 1099-SA, Distributions From an HSA, Archer MSA, or Medicare Advantage MSA.

Lodging on Your Business Premises

You can exclude the value of lodging you furnish to an employee from the employee's wages if it meets the following tests.

- It is furnished on your business premises.
- It is furnished for your convenience.
- The employee must accept it as a condition of employment.

Different tests may apply to lodging furnished by educational institutions. See section 119(d) of the Internal Revenue Code for details.

The exclusion does not apply if you allow your employee to choose to receive additional pay instead of lodging.

On your business premises. For this exclusion, your business premises is generally your employee's place of work. For special rules that apply to lodging furnished in a camp located in a foreign country, see section 119(c) of the Internal Revenue Code and its regulations.

For your convenience. Whether or not you furnish lodging for your convenience as an employer depends on all the facts and circumstances. You furnish the lodging to your employee for your convenience if you do this for a substantial business reason other than to provide the employee with additional pay. This is true even if a law or an employment contract provides that the lodging is furnished as pay. However, a written statement that the lodging is furnished for your convenience is not sufficient.

Condition of employment. Lodging meets this test if you require your employees to accept the lodging because they need to live on your business premises to be able to properly perform their duties. Examples include employees who must be available at all times and employees who could not perform their required duties without being furnished the lodging.

It does not matter whether you must furnish the lodging as pay under the terms of an employment contract or a law fixing the terms of employment.

Example. A hospital gives Joan, an employee of the hospital, the choice of living at the hospital free of charge or living elsewhere and receiving a cash allowance in addition to her regular salary. If Joan chooses to live at the hospital, the hospital cannot exclude the value of the lodging from her wages because she is not required to live at the hospital to properly perform the duties of her employment.

S corporation shareholders. For this exclusion, do not treat a 2% shareholder of an S corporation as an employee of the corporation. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe

benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Meals


This section discusses the exclusion rules that apply to *de minimis* meals and meals on your business premises.

De Minimis Meals

You can exclude any occasional meal or meal money you provide to an employee if it has so little value (taking into account how frequently you provide meals to your employees) that accounting for it would be unreasonable or administratively impracticable. The exclusion applies, for example, to the following items.

- Coffee, doughnuts, or soft drinks.
- Occasional meals or meal money provided to enable an employee to work overtime. However, the exclusion does not apply to meal money figured on the basis of hours worked.
- Occasional parties or picnics for employees and their guests.

This exclusion also applies to meals you provide at an employer-operated eating facility for employees if the annual revenue from the facility equals or exceeds the direct costs of the facility. For this purpose, your revenue from providing a meal is considered equal to the facility's direct operating costs to provide that meal if its value can be excluded from an employee's wages as explained under [Meals on Your Business Premises](#), later.

 *If food or beverages you furnish to employees qualify as a de minimis benefit, you can deduct their full cost. The 50% limit on deductions for the cost of meals does not apply. The deduction limit on meals is discussed in chapter 2 of Publication 535.*

Employee. For this exclusion, treat any recipient of a *de minimis* meal as an employee.

Employer-operated eating facility for employees. An employer-operated eating facility for employees is an eating facility that meets all the following conditions.

- You own or lease the facility.
- You operate the facility. You are considered to operate the eating facility if you have a contract with another to operate it.
- The facility is on or near your business premises.
- You provide meals (food, drinks, and related services) at the facility during, or immediately before or after, the employee's workday.

Exclusion from wages. You can generally exclude the value of *de minimis* meals you provide to an employee from the employee's wages.

Exception for highly compensated employees.

You cannot exclude from the wages of a highly compensated employee the value of a meal provided at an employer-operated eating facility that is not available on the same terms to one of the following groups.

- All of your employees.
- A group of employees defined under a reasonable classification you set up that does not favor highly compensated employees.

For this exclusion, a highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Meals on Your Business Premises

You can exclude the value of meals you furnish to an employee from the employee's wages if they meet the following tests.

- They are furnished on your business premises.
- They are furnished for your convenience.

This exclusion does not apply if you allow your employee to choose to receive additional pay instead of meals.

On your business premises. Generally, for this exclusion, the employee's place of work is your business premises.

For your convenience. Whether you furnish meals for your convenience as an employer depends on all the facts and circumstances. You furnish the meals to your employee for your convenience if you do this for a substantial business reason other than to provide the employee with additional pay. This is true even if a law or an employment contract provides that the meals are furnished as pay. However, a written statement that the meals are furnished for your convenience is not sufficient.

Meals excluded for all employees if excluded for more than half. If more than half of your employees who are furnished meals on your business premises are furnished the meals for your convenience, you can treat all meals you furnish to employees on your business premises as furnished for your convenience.

Food service employees. Meals you furnish to a restaurant or other food service employee during, or immediately before or after, the employee's working hours are furnished for your convenience. For example, if a waitress works through the breakfast and lunch periods, you can

exclude from her wages the value of the breakfast and lunch you furnish in your restaurant for each day she works.

Example. You operate a restaurant business. You furnish your employee, Carol, who is a waitress working 7:00 a.m. to 4:00 p.m., two meals during each workday. You encourage but do not require Carol to have her breakfast on the business premises before starting work. She must have her lunch on the premises. Since Carol is a food service employee and works during the normal breakfast and lunch periods, you can exclude from her wages the value of her breakfast and lunch.

If you also allow Carol to have meals on your business premises without charge on her days off, you cannot exclude the value of those meals from her wages.

Employees available for emergency calls. Meals you furnish during working hours so an employee will be available for emergency calls during the meal period are furnished for your convenience. You must be able to show these emergency calls have occurred or can reasonably be expected to occur.

Example. A hospital maintains a cafeteria on its premises where all of its 230 employees may get meals at no charge during their working hours. The hospital must have 120 of its employees available for emergencies. Each of these 120 employees is, at times, called upon to perform services during the meal period. Although the hospital does not require these employees to remain on the premises, they rarely leave the hospital during their meal period. Since the hospital furnishes meals on its premises to its employees so that more than half of them are available for emergency calls during meal periods, the hospital can exclude the value of these meals from the wages of all of its employees.

Short meal periods. Meals you furnish during working hours are furnished for your convenience if the nature of your business restricts an employee to a short meal period (such as 30 or 45 minutes) and the employee cannot be expected to eat elsewhere in such a short time. For example, meals can qualify for this treatment if your peak work-load occurs during the normal lunch hour. However, they do not qualify if the reason for the short meal period is to allow the employee to leave earlier in the day.

Example. Frank is a bank teller who works from 9 a.m. to 5 p.m. The bank furnishes his lunch without charge in a cafeteria the bank maintains on its premises. The bank furnishes these meals to Frank to limit his lunch period to 30 minutes, since the bank's peak workload occurs during the normal lunch period. If Frank got his lunch elsewhere, it would take him much longer than 30 minutes and the bank strictly enforces the time limit. The bank can exclude the value of these meals from Frank's wages.

Proper meals not otherwise available. Meals you furnish during working hours are furnished for your convenience if the employee could not otherwise eat proper meals within a reasonable period of time. For example,

meals can qualify for this treatment if there are insufficient eating facilities near the place of employment.

Meals after work hours. Meals you furnish to an employee immediately after working hours are furnished for your convenience if you would have furnished them during working hours for a substantial nonpay business reason but, because of the work duties, they were not eaten during working hours.

Meals you furnish to promote goodwill, boost morale, or attract prospective employees. Meals you furnish to promote goodwill, boost morale, or attract prospective employees are not considered furnished for your convenience. However, you may be able to exclude their value as discussed under [De Minimis Meals](#), earlier.

Meals furnished on nonworkdays or with lodging. You generally cannot exclude from an employee's wages the value of meals you furnish on a day when the employee is not working. However, you can exclude these meals if they are furnished with lodging that is excluded from the employee's wages as discussed under [Lodging on Your Business Premises](#), earlier in this section.

Meals with a charge. The fact that you charge for the meals and that your employees may accept or decline the meals is not taken into account in determining whether or not meals are furnished for your convenience.

S corporation shareholder-employee. For this exclusion, do not treat a 2% shareholder of an S corporation as an employee of the corporation. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Moving Expense Reimbursements

This exclusion applies to any amount you directly or indirectly give to an employee, (including services furnished in kind) as payment for, or reimbursement of, moving expenses. You must make the reimbursement under rules similar to those described in chapter 11 of Publication 535 for reimbursement of expenses for travel, meals, and entertainment under accountable plans.

The exclusion applies only to reimbursement of moving expenses that the employee could deduct if he or she had paid or incurred them without reimbursement. However, it does not apply if the employee actually deducted the expenses in a previous year.

Deductible moving expenses. Deductible moving expenses include only the reasonable expenses of:

- Moving household goods and personal effects from the former home to the new home, and
- Traveling (including lodging) from the former home to the new home.

Deductible moving expenses do not include any expenses for meals and must meet both the distance test and the time test. The distance test is met if the new job location is at least 50 miles farther from the employee's old home than the old job location was. The time test is met if the employee works at least 39 weeks during the first 12 months after arriving in the general area of the new job location.

For more information on deductible moving expenses, see Publication 521, Moving Expenses.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.

Exception for S corporation shareholders. Do not treat a 2% shareholder of an S corporation as an employee of the corporation for this purpose. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Exclusion from wages. Generally, you can exclude qualifying moving expense reimbursement you provide to an employee from the employee's wages. If you paid the reimbursement directly to the employee, report the amount in box 12 of Form W-2 with the code "P." Do not report payments to a third party for the employee's moving expenses or the value of moving services you provided in kind.

No-Additional-Cost Services

This exclusion applies to a service you provide to an employee if it does not cause you to incur any substantial additional costs. The service must be offered to customers in the ordinary course of the line of business in which the employee performs substantial services.

Generally, no-additional-cost services are excess capacity services, such as airline, bus, or train tickets; hotel rooms; or telephone services provided free or at a reduced price to employees working in those lines of business.

Substantial additional costs. To determine whether you incur substantial additional costs to provide a service to an employee, count any lost revenue as a cost. Do not reduce the costs you incur by any amount the employee pays for the service. You are considered to incur substantial additional costs if you or your employees spend a substantial amount of time in providing the service, even if the

time spent would otherwise be idle or if the services are provided outside normal business hours.

Reciprocal agreements. A no-additional-cost service provided to your employee by an unrelated employer may qualify as a no-additional-cost service if all the following tests are met.

- The service is the same type of service generally provided to customers in both the line of business in which the employee works and the line of business in which the service is provided.
- You and the employer providing the service have a written reciprocal agreement under which a group of employees of each employer, all of whom perform substantial services in the same line of business, may receive no-additional-cost services from the other employer.
- Neither you nor the other employer incurs any substantial additional cost either in providing the service or because of the written agreement.

Employee. For this exclusion, treat the following individuals as employees.

1. A current employee.
2. A former employee who retired or left on disability.
3. A widow or widower of an individual who died while an employee.
4. A widow or widower of a former employee who retired or left on disability.
5. A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.
6. A partner who performs services for a partnership.

Treat services you provide to the spouse or dependent child of an employee as provided to the employee. For this fringe benefit, dependent child means any son, stepson, daughter, or stepdaughter who is a dependent of the employee, or both of whose parents have died and who has not reached age 25. Treat a child of divorced parents as a dependent of both parents.

Treat any use of air transportation by the parent of an employee as use by the employee. This rule does not apply to use by the parent of a person considered an employee because of item (3) or (4) above.

Exclusion from wages. You can generally exclude the value of a no-additional-cost service you provide to an employee from the employee's wages.

Exception for highly compensated employees. You cannot exclude from the wages of a highly compensated employee the value of a no-additional-cost service that is not available on the same terms to one of the following groups.

- All of your employees.

- A group of employees defined under a reasonable classification you set up that does not favor highly compensated employees.

For this exclusion, a highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Retirement Planning Services

You may exclude from an employee's wages the value of any retirement planning advice or information you provide to your employee or his or her spouse if you maintain a qualified retirement plan as defined in section 219(g)(5) of the Internal Revenue Code. In addition to employer plan advice and information, the services provided may include general advice and information on retirement. However, the exclusion does not apply to services for tax preparation, accounting, legal, or brokerage services. You cannot exclude from the wages of a highly compensated employee retirement planning services that are not available on the same terms to each member of a group of employees normally provided education and information about the employer's qualified retirement plan.

Transportation (Commuting) Benefits

This section discusses exclusion rules that apply to benefits you provide to your employees for their personal transportation, such as commuting to and from work. These rules apply to the following transportation benefits.

- *De minimis* transportation benefits.
- Qualified transportation benefits.

Special rules that apply to demonstrator cars and qualified nonpersonal use vehicles are discussed under [Working Condition Benefits](#), later in this section.

De Minimis Transportation Benefits

You can exclude the value of any *de minimis* transportation benefit you provide to an employee from the employee's wages. A *de minimis* transportation benefit is any local transportation benefit you provide to an employee if it has so little value (taking into account how frequently you provide transportation to your employees) that accounting for it would be unreasonable or administratively impracticable. For example, it applies to occasional transportation fare you give an employee because the employee is working overtime if the benefit is reasonable and is not based on hours worked.

Employee. For this exclusion, treat any recipient of a *de minimis* transportation benefit as an employee.

Qualified Transportation Benefits

This exclusion applies to the following benefits.

- A ride in a commuter highway vehicle between the employee's home and work place.
- A transit pass.
- Qualified parking.
- Qualified bicycle commuting reimbursement.

The exclusion applies whether you provide only one or a combination of these benefits to your employees.

Qualified transportation benefits can be provided directly by you or through a bona fide reimbursement arrangement. However, cash reimbursements for transit passes qualify only if a voucher or a similar item that the employee can exchange only for a transit pass is not readily available for direct distribution by you to your employee. A voucher is readily available for direct distribution only if an employee can obtain it from a voucher provider that does not impose fare media charges or other restrictions that effectively prevent the employer from obtaining vouchers. See Regulations section 1.132-9(b)(Q&A 16–19) for more information.

Generally, you can exclude qualified transportation fringe benefits from an employee's wages even if you provide them in place of pay. However, qualified bicycle commuting reimbursements cannot be excluded if the reimbursements are provided in place of pay. For information about providing qualified transportation fringe benefits under a compensation reduction agreement, see Regulations section 1.132-9(b)(Q&A 11–15).

Commuter highway vehicle. A commuter highway vehicle is any highway vehicle that seats at least 6 adults (not including the driver). In addition, you must reasonably expect that at least 80% of the vehicle mileage will be for transporting employees between their homes and work place with employees occupying at least one-half the vehicle's seats (not including the driver's).

Transit pass. A transit pass is any pass, token, farecard, voucher, or similar item entitling a person to ride, free of charge or at a reduced rate, on one of the following.

- On mass transit.
- In a vehicle that seats at least 6 adults (not including the driver) if a person in the business of transporting persons for pay or hire operates it.

Mass transit may be publicly or privately operated and includes bus, rail, or ferry. For guidance on the use of smart cards and debit cards to provide qualified transportation fringes, see Revenue Ruling 2006-57, 2006-47 I.R.B. 911, available at www.irs.gov/irb/2006-47_IRB/ar05.html and Notice 2010-94, 2010-52 I.R.B. 927, available at www.irs.gov/irb/2010-52_IRB/ar18.html.

Qualified parking. Qualified parking is parking you provide to your employees on or near your business premises. It includes parking on or near the location from which your employees commute to work using mass transit, commuter highway vehicles, or carpools. It does not include parking at or near your employee's home.

Qualified bicycle commuting reimbursement. For any calendar year, the exclusion for qualified bicycle commuting reimbursement includes any employer reimbursement during the 15-month period beginning with the first day of the calendar year for reasonable expenses incurred by the employee during the calendar year.

Reasonable expenses include:

- The purchase of a bicycle, and
- Bicycle improvements, repair, and storage.

These are considered reasonable expenses as long as the bicycle is regularly used for travel between the employee's residence and place of employment.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A leased employee who has provided services to you on a substantially full-time basis for at least a year if the services are performed under your primary direction or control.

A self-employed individual is not an employee for qualified transportation benefit purposes.

Exception for S corporation shareholders. Do not treat a 2% shareholder of an S corporation as an employee of the corporation for this purpose. A 2% shareholder is someone who directly or indirectly owns (at any time during the year) more than 2% of the corporation's stock or stock with more than 2% of the voting power. Treat a 2% shareholder as you would a partner in a partnership for fringe benefit purposes, but do not treat the benefit as a reduction in distributions to the 2% shareholder.

Relation to other fringe benefits. You cannot exclude a qualified transportation benefit you provide to an employee under the *de minimis* or working condition benefit rules. However, if you provide a local transportation benefit other than by transit pass or commuter highway vehicle, or to a person other than an employee, you may be able to exclude all or part of the benefit under other fringe benefit rules (*de minimis*, working condition, etc.).

Exclusion from wages. You can generally exclude the value of transportation benefits that you provide to an employee during 2014 from the employee's wages up to the following limits.

- \$130 per month for combined commuter highway vehicle transportation and transit passes.
- \$250 per month for qualified parking.

- For a calendar year, \$20 multiplied by the number of qualified bicycle commuting months during that year for qualified bicycle commuting reimbursement of expenses incurred during the year.

Qualified bicycle commuting month. For any employee, a qualified bicycle commuting month is any month the employee:

1. Regularly uses the bicycle for a substantial portion of the travel between the employee's residence and place of employment and
2. Does not receive:
 - a. Transportation in a commuter highway vehicle,
 - b. Any transit pass, or
 - c. Qualified parking benefits.

Benefits more than the limit. If the value of a benefit for any month is more than its limit, include in the employee's wages the amount over the limit minus any amount the employee paid for the benefit. You cannot exclude the excess from the employee's wages as a *de minimis* transportation benefit.

More information. For more information on qualified transportation benefits, including van pools, and how to determine the value of parking, see Regulations section 1.132-9.

Tuition Reduction

An educational organization can exclude the value of a qualified tuition reduction it provides to an employee from the employee's wages.

A tuition reduction for undergraduate education generally qualifies for this exclusion if it is for the education of one of the following individuals.

1. A current employee.
2. A former employee who retired or left on disability.
3. A widow or widower of an individual who died while an employee.
4. A widow or widower of a former employee who retired or left on disability.
5. A dependent child or spouse of any individual listed in (1) through (4) above.

A tuition reduction for graduate education qualifies for this exclusion only if it is for the education of a graduate student who performs teaching or research activities for the educational organization.

For more information on this exclusion, see Publication 970.

Working Condition Benefits

This exclusion applies to property and services you provide to an employee so that the employee can perform his

or her job. It applies to the extent the employee could deduct the cost of the property or services as a business expense or depreciation expense if he or she had paid for it. The employee must meet any substantiation requirements that apply to the deduction. Examples of working condition benefits include an employee's use of a company car for business, an employer-provided cell phone provided primarily for noncompensatory business purposes, and job-related education provided to an employee.

This exclusion also applies to a cash payment you provide for an employee's expenses for a specific or prearranged business activity for which a deduction is otherwise allowable to the employee. You must require the employee to verify that the payment is actually used for those expenses and to return any unused part of the payment.

For information on deductible employee business expenses, see *Unreimbursed Employee Expenses* in Publication 529, Miscellaneous Deductions.

The exclusion does not apply to the following items.

- A service or property provided under a flexible spending account in which you agree to provide the employee, over a time period, a certain level of unspecified noncash benefits with a predetermined cash value.
- A physical examination program you provide, even if mandatory.
- Any item to the extent the employee could deduct its cost as an expense for a trade or business other than your trade or business.

Employee. For this exclusion, treat the following individuals as employees.

- A current employee.
- A partner who performs services for a partnership.
- A director of your company.
- An independent contractor who performs services for you.

Vehicle allocation rules. If you provide a car for an employee's use, the amount you can exclude as a working condition benefit is the amount that would be allowable as a deductible business expense if the employee paid for its use. If the employee uses the car for both business and personal use, the value of the working condition benefit is the part determined to be for business use of the vehicle. See *Business use of your car* under *Personal versus Business Expenses* in chapter 1 of Publication 535. Also, see the special rules for certain demonstrator cars and qualified nonpersonal use vehicles discussed later.

However, instead of excluding the value of the working condition benefit, you can include the entire annual lease value of the car in the employee's wages. The employee can then claim any deductible business expense for the car as an itemized deduction on his or her personal income tax return. This option is available only if you use the

lease value rule (discussed in section 3) to value the benefit.

Demonstrator cars. Generally, all of the use of a demonstrator car by your full-time auto salesperson qualifies as a working condition benefit if the use is primarily to facilitate the services the salesperson provides for you and there are substantial restrictions on personal use. For more information and the definition of “full-time auto salesperson,” see Regulations section 1.132-5(o). For optional, simplified methods used to determine if full, partial, or no exclusion of income to the employee for personal use of a demonstrator car applies, see Revenue Procedure 2001-56. You can find Revenue Procedure 2001-56 on page 590 of Internal Revenue Bulletin 2001-51 at www.irs.gov/pub/irs-irbs/irb01-51.pdf.

Qualified nonpersonal use vehicles. All of an employee's use of a qualified nonpersonal use vehicle is a working condition benefit. A qualified nonpersonal use vehicle is any vehicle the employee is not likely to use more than minimally for personal purposes because of its design. Qualified nonpersonal use vehicles generally include all of the following vehicles.

- Clearly marked, through painted insignia or words, police, fire, and public safety vehicles.
- Unmarked vehicles used by law enforcement officers if the use is officially authorized.
- An ambulance or hearse used for its specific purpose.
- Any vehicle designed to carry cargo with a loaded gross vehicle weight over 14,000 pounds.
- Delivery trucks with seating for the driver only, or the driver plus a folding jump seat.
- A passenger bus with a capacity of at least 20 passengers used for its specific purpose.
- School buses.
- Tractors and other special-purpose farm vehicles.
- Bucket trucks, cement mixers, combines, cranes and derricks, dump trucks (including garbage trucks), flat-bed trucks, forklifts, qualified moving vans, qualified specialized utility repair trucks, and refrigerated trucks.

See Regulations section 1.274-5(k) for the definition of qualified moving van and qualified specialized utility repair truck.

Pickup trucks. A pickup truck with a loaded gross vehicle weight of 14,000 pounds or less is a qualified nonpersonal use vehicle if it has been specially modified so it is not likely to be used more than minimally for personal purposes. For example, a pickup truck qualifies if it is clearly marked with permanently affixed decals, special painting, or other advertising associated with your trade, business, or function and meets either of the following requirements.

1. It is equipped with at least one of the following items.

- a. A hydraulic lift gate.
 - b. Permanent tanks or drums.
 - c. Permanent side boards or panels that materially raise the level of the sides of the truck bed.
 - d. Other heavy equipment (such as an electric generator, welder, boom, or crane used to tow automobiles and other vehicles).
2. It is used primarily to transport a particular type of load (other than over the public highways) in a construction, manufacturing, processing, farming, mining, drilling, timbering, or other similar operation for which it was specially designed or significantly modified.

Vans. A van with a loaded gross vehicle weight of 14,000 pounds or less is a qualified nonpersonal use vehicle if it has been specially modified so it is not likely to be used more than minimally for personal purposes. For example, a van qualifies if it is clearly marked with permanently affixed decals, special painting, or other advertising associated with your trade, business, or function and has a seat for the driver only (or the driver and one other person) and either of the following items.

- Permanent shelving that fills most of the cargo area.
- An open cargo area and the van always carries merchandise, material, or equipment used in your trade, business, or function.

Education. Certain job-related education you provide to an employee may qualify for exclusion as a working condition benefit. To qualify, the education must meet the same requirements that would apply for determining whether the employee could deduct the expenses had the employee paid the expenses. Degree programs as a whole do not necessarily qualify as a working condition benefit. Each course in the program must be evaluated individually for qualification as a working condition benefit. The education must meet at least one of the following tests.

- The education is required by the employer or by law for the employee to keep his or her present salary, status, or job. The required education must serve a bona fide business purpose of the employer.
- The education maintains or improves skills needed in the job.

However, even if the education meets one or both of the above tests, it is not qualifying education if it:

- Is needed to meet the minimum educational requirements of the employee's present trade or business, or
- Is part of a program of study that will qualify the employee for a new trade or business.

Outplacement services. An employee's use of outplacement services qualifies as a working condition benefit if you provide the services to the employee on the basis of need, you get a substantial business benefit from the services distinct from the benefit you would get from the payment of additional wages, and the employee is seeking employment in the same trade or business of the

employer. Substantial business benefits include promoting a positive business image, maintaining employee morale, and avoiding wrongful termination suits.

Outplacement services do not qualify as a working condition benefit if the employee can choose to receive cash or taxable benefits in place of the services. If you maintain a severance plan and permit employees to get outplacement services with reduced severance pay, include in the employee's wages the difference between the unreduced severance and the reduced severance payments.

Exclusion from wages. You can generally exclude the value of a working condition benefit you provide to an employee from the employee's wages.

Exception for independent contractors. You cannot exclude the value of parking (unless *de minimis*), transit passes (if their monthly value exceeds \$130 per month), or the use of consumer goods you provide in a product testing program from the compensation you pay to an independent contractor who performs services for you.

Exception for company directors. You cannot exclude the value of the use of consumer goods you provide in a product testing program from the compensation you pay to a director.

3. Fringe Benefit Valuation Rules

This section discusses the rules you must use to determine the value of a fringe benefit you provide to an employee. You must determine the value of any benefit you cannot exclude under the rules in section 2 or for which the amount you can exclude is limited. See [Including taxable benefits in pay](#) in section 1.

In most cases, you must use the general valuation rule to value a fringe benefit. However, you may be able to use a special valuation rule to determine the value of certain benefits.

This section does not discuss the special valuation rule used to value meals provided at an employer-operated eating facility for employees. For that rule, see Regulations section 1.61-21(j). This section also does not discuss the special valuation rules used to value the use of aircraft. For those rules, see Regulations sections 1.61-21(g) and (h). The fringe benefit valuation formulas are published in the Internal Revenue Bulletin as Revenue Rulings twice during the year. The formula applicable for the first half of the year is usually available at the end of March. The formula applicable for the second half of the year is usually available at the end of September.

General Valuation Rule

You must use the general valuation rule to determine the value of most fringe benefits. Under this rule, the value of a fringe benefit is its fair market value.

Fair market value. The fair market value (FMV) of a fringe benefit is the amount an employee would have to pay a third party in an arm's-length transaction to buy or lease the benefit. Determine this amount on the basis of all the facts and circumstances.

Neither the amount the employee considers to be the value of the fringe benefit nor the cost you incur to provide the benefit determines its FMV.

Employer-provided vehicles. In general, the FMV of an employer-provided vehicle is the amount the employee would have to pay a third party to lease the same or similar vehicle on the same or comparable terms in the geographic area where the employee uses the vehicle. A comparable lease term would be the amount of time the vehicle is available for the employee's use, such as a 1-year period.

Do not determine the FMV by multiplying a cents-per-mile rate times the number of miles driven unless the employee can prove the vehicle could have been leased on a cents-per-mile basis.

Cents-Per-Mile Rule

Under this rule, you determine the value of a vehicle you provide to an employee for personal use by multiplying the standard mileage rate by the total miles the employee drives the vehicle for personal purposes. Personal use is any use of the vehicle other than use in your trade or business. This amount must be included in the employee's wages or reimbursed by the employee. For 2014, the standard mileage rate is 56 cents per mile.

You can use the cents-per-mile rule if either of the following requirements is met.

- You reasonably expect the vehicle to be regularly used in your trade or business throughout the calendar year (or for a shorter period during which you own or lease it).
- The vehicle meets the mileage test.



Maximum automobile value. You cannot use the cents-per-mile rule for an automobile (any four-wheeled vehicle, such as a car, pickup truck, or van) if its value when you first make it available to any employee for personal use is more than an amount determined by the IRS as the maximum automobile value for the year. For example, you cannot use the cents-per-mile rule for an automobile that you first made available to an employee in 2013 if its value at that time exceeded \$16,000 for a passenger automobile or \$17,000 for a truck or van. The maximum automobile value for 2014 will be published in a notice in the Internal Revenue Bulletin early in 2014. If you and the employee own or lease the automobile together, see Regulations section 1.61-21(e)(1)(iii)(B).

Vehicle. For the cents-per-mile rule, a vehicle is any motorized wheeled vehicle, including an automobile, manufactured primarily for use on public streets, roads, and highways.

Regular use in your trade or business. A vehicle is regularly used in your trade or business if at least one of the following conditions is met.

- At least 50% of the vehicle's total annual mileage is for your trade or business.
- You sponsor a commuting pool that generally uses the vehicle each workday to drive at least three employees to and from work.
- The vehicle is regularly used in your trade or business on the basis of all of the facts and circumstances. Infrequent business use of the vehicle, such as for occasional trips to the airport or between your multiple business premises, is not regular use of the vehicle in your trade or business.

Mileage test. A vehicle meets the mileage test for a calendar year if both of the following requirements are met.

- The vehicle is actually driven at least 10,000 miles during the year. If you own or lease the vehicle only part of the year, reduce the 10,000 mile requirement proportionately.
- The vehicle is used during the year primarily by employees. Consider the vehicle used primarily by employees if they use it consistently for commuting. Do not treat the use of the vehicle by another individual whose use would be taxed to the employee as use by the employee.

For example, if only one employee uses a vehicle during the calendar year and that employee drives the vehicle at least 10,000 miles in that year, the vehicle meets the mileage test even if all miles driven by the employee are personal.

Consistency requirements. If you use the cents-per-mile rule, the following requirements apply.

- You must begin using the cents-per-mile rule on the first day you make the vehicle available to any employee for personal use. However, if you use the commuting rule (discussed later) when you first make the vehicle available to any employee for personal use, you can change to the cents-per-mile rule on the first day for which you do not use the commuting rule.
- You must use the cents-per-mile rule for all later years in which you make the vehicle available to any employee and the vehicle qualifies, except that you can use the commuting rule for any year during which use of the vehicle qualifies under the commuting rules. However, if the vehicle does not qualify for the cents-per-mile rule during a later year, you can use for that year and thereafter any other rule for which the vehicle then qualifies.
- You must continue to use the cents-per-mile rule if you provide a replacement vehicle to the employee (and the vehicle qualifies for the use of this rule) and your primary reason for the replacement is to reduce federal taxes.

Items included in cents-per-mile rate. The cents-per-mile rate includes the value of maintenance and insurance for the vehicle. Do not reduce the rate by the value of any service included in the rate that you did not provide. You can take into account the services actually provided for the vehicle by using the [General Valuation Rule](#), earlier.

For miles driven in the United States, its territories and possessions, Canada, and Mexico, the cents-per-mile rate includes the value of fuel you provide. If you do not provide fuel, you can reduce the rate by no more than 5.5 cents.

For special rules that apply to fuel you provide for miles driven outside the United States, Canada, and Mexico, see Regulations section 1.61-21(e)(3)(ii)(B).

The value of any other service you provide for a vehicle is not included in the cents-per-mile rate. Use the general valuation rule to value these services.

Commuting Rule

Under this rule, you determine the value of a vehicle you provide to an employee for commuting use by multiplying each one-way commute (that is, from home to work or from work to home) by \$1.50. If more than one employee commutes in the vehicle, this value applies to each employee. This amount must be included in the employee's wages or reimbursed by the employer.

You can use the commuting rule if all the following requirements are met.

- You provide the vehicle to an employee for use in your trade or business and, for bona fide noncompensatory business reasons, you require the employee to commute in the vehicle. You will be treated as if you had met this requirement if the vehicle is generally used each workday to carry at least three employees to and from work in an employer sponsored commuting pool.
- You establish a written policy under which you do not allow the employee to use the vehicle for personal purposes other than for commuting or *de minimis* personal use (such as a stop for a personal errand on the way between a business delivery and the employee's home). Personal use of a vehicle is all use that is not for your trade or business.
- The employee does not use the vehicle for personal purposes other than commuting and *de minimis* personal use.
- If this vehicle is an automobile (any four-wheeled vehicle, such as a car, pickup truck, or van), the employee who uses it for commuting is not a control employee. See [Control employee](#), later.

Vehicle. For this rule, a vehicle is any motorized wheeled vehicle, including an automobile manufactured primarily for use on public streets, roads, and highways.

Control employee. A control employee of a nongovernment employer for 2014 is generally any of the following employees.

- A board or shareholder-appointed, confirmed, or elected officer whose pay is \$105,000 or more.
- A director.
- An employee whose pay is \$210,000 or more.
- An employee who owns a 1% or more equity, capital, or profits interest in your business.

A control employee for a government employer for 2014 is either of the following.

- A government employee whose compensation is equal to or exceeds Federal Government Executive Level V. See the Office of Personnel Management website at www.opm.gov/policy-data-oversight/pay-leave/salaries-wages/ for 2014 compensation information.
- An elected official.

Highly compensated employee alternative. Instead of using the preceding definition, you can choose to define a control employee as any highly compensated employee. A highly compensated employee for 2014 is an employee who meets either of the following tests.

1. The employee was a 5% owner at any time during the year or the preceding year.
2. The employee received more than \$115,000 in pay for the preceding year.

You can choose to ignore test (2) if the employee was not also in the top 20% of employees when ranked by pay for the preceding year.

Lease Value Rule

Under this rule, you determine the value of an automobile you provide to an employee by using its annual lease value. For an automobile provided only part of the year, use either its prorated annual lease value or its daily lease value.

If the automobile is used by the employee in your business, you generally reduce the lease value by the amount that is excluded from the employee's wages as a working condition benefit. In order to do this, the employee must account to the employer for the business use. This is done by substantiating the usage (mileage, for example), the time and place of the travel, and the business purpose of the travel. Written records made at the time of each business use are the best evidence. Any use of a company-provided vehicle that is not substantiated as business use is included in income. The working condition benefit is the amount that would be an allowable business expense deduction for the employee if the employee paid for the use of the vehicle. However, you can choose to include the entire lease value in the employee's wages. See [Vehicle allocation rules](#), under *Working Condition Benefit* in section 2.

Automobile. For this rule, an automobile is any four-wheeled vehicle (such as a car, pickup truck, or van) manufactured primarily for use on public streets, roads, and highways.

Consistency requirements. If you use the lease value rule, the following requirements apply.

1. You must begin using this rule on the first day you make the automobile available to any employee for personal use. However, the following exceptions apply.
 - a. If you use the commuting rule (discussed earlier in this section) when you first make the automobile available to any employee for personal use, you can change to the lease value rule on the first day for which you do not use the commuting rule.
 - b. If you use the cents-per-mile rule (discussed earlier in this section) when you first make the automobile available to any employee for personal use, you can change to the lease value rule on the first day on which the automobile no longer qualifies for the cents-per-mile rule.
2. You must use this rule for all later years in which you make the automobile available to any employee, except that you can use the commuting rule for any year during which use of the automobile qualifies.
3. You must continue to use this rule if you provide a replacement automobile to the employee and your primary reason for the replacement is to reduce federal taxes.

Annual Lease Value

Generally, you figure the annual lease value of an automobile as follows.

1. Determine the fair market value (FMV) of the automobile on the first date it is available to any employee for personal use.
2. Using *Table 3-1. Annual Lease Value Table*, read down column (1) until you come to the dollar range within which the FMV of the automobile falls. Then read across to column (2) to find the annual lease value.
3. Multiply the annual lease value by the percentage of personal miles out of total miles driven by the employee.

Table 3-1. Annual Lease Value Table

(1) Automobile FMV	(2) Annual Lease
\$ 0 to 999	\$ 600
1,000 to 1,999	850
2,000 to 2,999	1,100
3,000 to 3,999	1,350
4,000 to 4,999	1,600
5,000 to 5,999	1,850
6,000 to 6,999	2,100
7,000 to 7,999	2,350
8,000 to 8,999	2,600
9,000 to 9,999	2,850
10,000 to 10,999	3,100
11,000 to 11,999	3,350
12,000 to 12,999	3,600
13,000 to 13,999	3,850
14,000 to 14,999	4,100
15,000 to 15,999	4,350
16,000 to 16,999	4,600
17,000 to 17,999	4,850
18,000 to 18,999	5,100
19,000 to 19,999	5,350
20,000 to 20,999	5,600
21,000 to 21,999	5,850
22,000 to 22,999	6,100
23,000 to 23,999	6,350
24,000 to 24,999	6,600
25,000 to 25,999	6,850
26,000 to 27,999	7,250
28,000 to 29,999	7,750
30,000 to 31,999	8,250
32,000 to 33,999	8,750
34,000 to 35,999	9,250
36,000 to 37,999	9,750
38,000 to 39,999	10,250
40,000 to 41,999	10,750
42,000 to 43,999	11,250
44,000 to 45,999	11,750
46,000 to 47,999	12,250
48,000 to 49,999	12,750
50,000 to 51,999	13,250
52,000 to 53,999	13,750
54,000 to 55,999	14,250
56,000 to 57,999	14,750
58,000 to 59,999	15,250

For automobiles with a FMV of more than \$59,999, the annual lease value equals (.25 × the FMV of the automobile) + \$500.

FMV. The FMV of an automobile is the amount a person would pay to buy it from a third party in an arm's-length transaction in the area in which the automobile is bought or leased. That amount includes all purchase expenses, such as sales tax and title fees.

If you have 20 or more automobiles, see Regulations section 1.61-21(d)(5)(v). If you and the employee own or lease the automobile together, see Regulations section 1.61-21(d)(2)(ii).

You do not have to include the value of a telephone or any specialized equipment added to, or carried in, the automobile if the equipment is necessary for your business. However, include the value of specialized equipment if the employee to whom the automobile is available uses the

specialized equipment in a trade or business other than yours.

Neither the amount the employee considers to be the value of the benefit nor your cost for either buying or leasing the automobile determines its FMV. However, see *Safe-harbor value*, next.

Safe-harbor value. You may be able to use a safe-harbor value as the FMV.

For an automobile you bought at arm's length, the safe-harbor value is your cost, including sales tax, title, and other purchase expenses. You cannot have been the manufacturer of the automobile.

For an automobile you lease, you can use any of the following as the safe-harbor value.

- The manufacturer's invoice price (including options) plus 4%.
- The manufacturer's suggested retail price minus 8% (including sales tax, title, and other expenses of purchase).
- The retail value of the automobile reported by a nationally recognized pricing source if that retail value is reasonable for the automobile.

Items included in annual lease value table. Each annual lease value in the table includes the value of maintenance and insurance for the automobile. Do not reduce the annual lease value by the value of any of these services that you did not provide. For example, do not reduce the annual lease value by the value of a maintenance service contract or insurance you did not provide. You can take into account the services actually provided for the automobile by using the general valuation rule discussed earlier.

Items not included. The annual lease value does not include the value of fuel you provide to an employee for personal use, regardless of whether you provide it, reimburse its cost, or have it charged to you. You must include the value of the fuel separately in the employee's wages. You can value fuel you provided at FMV or at 5.5 cents per mile for all miles driven by the employee. However, you cannot value at 5.5 cents per mile fuel you provide for miles driven outside the United States (including its possessions and territories), Canada, and Mexico.

If you reimburse an employee for the cost of fuel, or have it charged to you, you generally value the fuel at the amount you reimburse, or the amount charged to you if it was bought at arm's length.

If you have 20 or more automobiles, see Regulations section 1.61-21(d)(3)(ii)(D).

If you provide any service other than maintenance and insurance for an automobile, you must add the FMV of that service to the annual lease value of the automobile to figure the value of the benefit.

4-year lease term. The annual lease values in the table are based on a 4-year lease term. These values will generally stay the same for the period that begins with the first

date you use this rule for the automobile and ends on December 31 of the fourth full calendar year following that date.

Figure the annual lease value for each later 4-year period by determining the FMV of the automobile on January 1 of the first year of the later 4-year period and selecting the amount in column (2) of the table that corresponds to the appropriate dollar range in column (1).

Using the special accounting rule. If you use the special accounting rule for fringe benefits discussed in section 4, you can figure the annual lease value for each later 4-year period at the beginning of the special accounting period that starts immediately before the January 1 date described in the previous paragraph.

For example, assume that you use the special accounting rule and that, beginning on November 1, 2013, the special accounting period is November 1 to October 31. You elected to use the lease value rule as of January 1, 2014. You can refigure the annual lease value on November 1, 2017, rather than on January 1, 2018.

Transferring an automobile from one employee to another. Unless the primary purpose of the transfer is to reduce federal taxes, you can refigure the annual lease value based on the FMV of the automobile on January 1 of the calendar year of transfer.

However, if you use the special accounting rule for fringe benefits discussed in section 4, you can refigure the annual lease value (based on the FMV of the automobile) at the beginning of the special accounting period in which the transfer occurs.

Prorated Annual Lease Value

If you provide an automobile to an employee for a continuous period of 30 or more days but less than an entire calendar year, you can prorate the annual lease value. Figure the prorated annual lease value by multiplying the annual lease value by a fraction, using the number of days of availability as the numerator and 365 as the denominator.

If you provide an automobile continuously for at least 30 days, but the period covers 2 calendar years (or 2 special accounting periods if you are using the special accounting rule for fringe benefits discussed in section 4), you can use the prorated annual lease value or the daily lease value.

If you have 20 or more automobiles, see Regulations section 1.61-21(d)(6).

If an automobile is unavailable to the employee because of his or her personal reasons (for example, if the employee is on vacation), you cannot take into account the periods of unavailability when you use a prorated annual lease value.



You cannot use a prorated annual lease value if the reduction of federal tax is the main reason the automobile is unavailable.

Daily Lease Value

If you provide an automobile to an employee for a continuous period of less than 30 days, use the daily lease value to figure its value. Figure the daily lease value by multiplying the annual lease value by a fraction, using four times the number of days of availability as the numerator and 365 as the denominator.

However, you can apply a prorated annual lease value for a period of continuous availability of less than 30 days by treating the automobile as if it had been available for 30 days. Use a prorated annual lease value if it would result in a lower valuation than applying the daily lease value to the shorter period of availability.

Unsafe Conditions Commuting Rule

Under this rule, the value of commuting transportation you provide to a qualified employee solely because of unsafe conditions is \$1.50 for a one-way commute (that is, from home to work or from work to home). This amount must be included in the employee's wages or reimbursed by the employee.

You can use the unsafe conditions commuting rule for qualified employees if all of the following requirements are met.

- The employee would ordinarily walk or use public transportation for commuting.
- You have a written policy under which you do not provide the transportation for personal purposes other than commuting because of unsafe conditions.
- The employee does not use the transportation for personal purposes other than commuting because of unsafe conditions.

These requirements must be met on a trip-by-trip basis.

Commuting transportation. This is transportation to or from work using any motorized wheeled vehicle (including an automobile) manufactured for use on public streets, roads, and highways. You or the employee must buy the transportation from a party that is not related to you. If the employee buys it, you must reimburse the employee for its cost (for example, cab fare) under a bona fide reimbursement arrangement.

Qualified employee. A qualified employee for 2014 is one who:

- Performs services during the year;
- Is paid on an hourly basis;
- Is not claimed under section 213(a)(1) of the Fair Labor Standards Act (FLSA) of 1938 (as amended) to be exempt from the minimum wage and maximum hour provisions;
- Is within a classification for which you actually pay, or have specified in writing that you will pay, overtime pay of at least one and one-half times the regular rate provided in section 207 of FLSA; and

- Received pay of not more than \$115,000 during 2013.

However, an employee is not considered a qualified employee if you do not comply with the recordkeeping requirements concerning the employee's wages, hours, and other conditions and practices of employment under section 211(c) of FLSA and the related regulations.

Unsafe conditions. Unsafe conditions exist if, under the facts and circumstances, a reasonable person would consider it unsafe for the employee to walk or use public transportation at the time of day the employee must commute. One factor indicating whether it is unsafe is the history of crime in the geographic area surrounding the employee's workplace or home at the time of day the employee commutes.

4. Rules for Withholding, Depositing, and Reporting

Use the following guidelines for withholding, depositing, and reporting taxable noncash fringe benefits. For additional information on how to withhold on fringe benefits, see section 5 in Publication 15 (Circular E).

Valuation of fringe benefits. Generally, you must determine the value of noncash fringe benefits no later than January 31 of the next year. Before January 31, you may reasonably estimate the value of the fringe benefits for purposes of withholding and depositing on time.

Choice of period for withholding, depositing, and reporting. For employment tax and withholding purposes, you can treat noncash fringe benefits (including personal use of employer-provided highway motor vehicles) as paid on a pay period, quarter, semiannual, annual, or other basis. But the benefits must be treated as paid no less frequently than annually. You do not have to choose the same period for all employees. You can withhold more frequently for some employees than for others.

You can change the period as often as you like as long as you treat all of the benefits provided in a calendar year as paid no later than December 31 of the calendar year.

You can also treat the value of a single fringe benefit as paid on one or more dates in the same calendar year, even if the employee receives the entire benefit at one time. For example, if your employee receives a fringe benefit valued at \$1,000 in one pay period during 2014, you can treat it as made in four payments of \$250, each in a different pay period of 2014. You do not have to notify the IRS of the use of the periods discussed above.

Transfer of property. The above choice for reporting and withholding does not apply to a cash fringe benefit or a fringe benefit that is a transfer of tangible or intangible personal property of a kind normally held for investment or a transfer of real property. For these kinds of fringe benefits, you must use the actual date the property was transferred to the employee.

Withholding and depositing taxes. You can add the value of fringe benefits to regular wages for a payroll period and figure income tax withholding on the total. Or you can withhold federal income tax on the value of fringe benefits at the flat 25% rate that applies to supplemental wages. See section 7 in Publication 15 (Circular E) for the flat rate (39.6%) when supplemental wage payments to an individual exceed \$1 million during the year.

You must withhold the applicable income, social security, and Medicare taxes on the date or dates you chose to treat the benefits as paid. Deposit the amounts withheld as discussed in section 11 of Publication 15 (Circular E).

Additional Medicare Tax withholding. In addition to withholding Medicare tax at 1.45%, you must withhold a 0.9% Additional Medicare Tax from wages you pay to an employee in excess of \$200,000 in a calendar year. You are required to begin withholding Additional Medicare Tax in the pay period in which you pay wages in excess of \$200,000 to an employee and continue to withhold it each pay period until the end of the calendar year. Additional Medicare Tax is only imposed on the employee. There is no employer share of Additional Medicare Tax. All wages that are subject to Medicare tax are subject to Additional Medicare Tax withholding if paid in excess of the \$200,000 withholding threshold.

For more information on what wages are subject to Medicare tax, see Table 2-1, earlier, and the chart, *Special Rules for Various Types of Services and Payments*, in section 15 of Publication 15, (Circular E). For more information on Additional Medicare Tax, visit IRS.gov and enter "Additional Medicare Tax" in the search box.

Amount of deposit. To estimate the amount of income tax withholding and employment taxes and to deposit them on time, make a reasonable estimate of the value of the fringe benefits provided on the date or dates you chose to treat the benefits as paid. Determine the estimated deposit by figuring the amount you would have had to deposit if you had paid cash wages equal to the estimated value of the fringe benefits and withheld taxes from those cash wages. Even if you do not know which employee will receive the fringe benefit on the date the deposit is due, you should follow this procedure.

If you underestimate the value of the fringe benefits and deposit less than the amount you would have had to deposit if the applicable taxes had been withheld, you may be subject to a penalty.

If you overestimate the value of the fringe benefit and overdeposit, you can either claim a refund or have the overpayment applied to your next Form 941, Employer's QUARTERLY Federal Tax Return. See the Instructions for Form 941.

If you paid the required amount of taxes but withheld a lesser amount from the employee, you can recover from the employee the social security, Medicare, or income taxes you deposited on the employee's behalf and included on the employee's Form W-2. However, you must recover the income taxes before April 1 of the following year.

Paying your employee's share of social security and Medicare taxes. If you choose to pay your employee's social security and Medicare taxes on taxable fringe benefits without deducting them from his or her pay, you must include the amount of the payments in the employee's income. Also, if your employee leaves your employment and you have unpaid and uncollected taxes for noncash benefits, you are still liable for those taxes. You must add the uncollected employee share of social security and Medicare tax to the employee's wages. Follow the procedure discussed under *Employee's Portion of Taxes Paid by Employer* in section 7 of Publication 15-A. Do not use withheld federal income tax to pay the social security and Medicare tax.

Special accounting rule. You can treat the value of taxable noncash benefits as paid on a pay period, quarterly, semi-annually, annually, or on another basis, provided that the benefits are treated as paid no less frequently than annually. You can treat the value of taxable noncash fringe benefits provided during the last two months of the calendar year, or any shorter period within the last two months, as paid in the next year. Thus, the value of taxable noncash benefits actually provided in the last two months of 2013 could be treated as provided in 2014 together with the value of benefits provided in the first 10 months of 2014. This does not mean that all benefits treated as paid during the last two months of a calendar year can be deferred until the next year. Only the value of benefits actually provided during the last two months of the calendar year can be treated as paid in the next calendar year.

Limitation. The special accounting rule cannot be used, however, for a fringe benefit that is a transfer of tangible or intangible personal property of a kind normally held for investment or a transfer of real property.

Conformity rules. Use of the special accounting rule is optional. You can use the rule for some fringe benefits but not others. The period of use need not be the same for each fringe benefit. However, if you use the rule for a particular fringe benefit, you must use it for all employees who receive that benefit.

If you use the special accounting rule, your employee also must use it for the same period you use it. But your employee cannot use the special accounting rule unless you do.

You do not have to notify the IRS if you use the special accounting rule. You may also, for appropriate reasons, change the period for which you use the rule without notifying the IRS. But you must report the income and deposit the withheld taxes as required for the changed period.

Special rules for highway motor vehicles. If an employee uses the employer's vehicle for personal purposes, the value of that use must be determined by the employer and included in the employee's wages. The value of the personal use must be based on fair market value or determined by using one of the following three special valuation rules previously discussed in section 3.

- The lease value rule.

- The cents-per-mile rule.
- The commuting rule (for commuting use only).

Election not to withhold income tax. You can choose not to withhold income tax on the value of an employee's personal use of a highway motor vehicle you provided. You do not have to make this choice for all employees. You can withhold income tax from the wages of some employees but not others. You must, however, withhold the applicable social security and Medicare taxes on such benefits.

You can choose not to withhold income tax on an employee's personal use of a highway motor vehicle by:

- Notifying the employee as described below that you choose not to withhold, and
- Including the value of the benefits in boxes 1, 3, 5, and 14 on a timely furnished Form W-2. For use of a separate statement in lieu of using box 14, see the General Instructions for Forms W-2 and W-3.

The notice must be in writing and must be provided to the employee by January 31 of the election year or within 30 days after a vehicle is first provided to the employee, whichever is later. This notice must be provided in a manner reasonably expected to come to the attention of the affected employee. For example, the notice may be mailed to the employee, included with a paycheck, or posted where the employee could reasonably be expected to see it. You can also change your election not to withhold at any time by notifying the employee in the same manner.

Amount to report on Forms 941 (or Form 944) and W-2. The actual value of fringe benefits provided during a calendar year (or other period as explained under [Special accounting rule](#), earlier in this section) must be determined by January 31 of the following year. You must report the actual value on Forms 941 (or Form 944) and W-2. If you choose, you can use a separate Form W-2 for fringe benefits and any other benefit information.

Include the value of the fringe benefit in box 1 of Form W-2. Also include it in boxes 3 and 5, if applicable. You may show the total value of the fringe benefits provided in the calendar year or other period in box 14 of Form W-2. However, if you provided your employee with the use of a highway motor vehicle and included 100% of its annual lease value in the employee's income, you must also report it separately in box 14 or provide it in a separate statement to the employee so that the employee can compute the value of any business use of the vehicle.

If you use the special accounting rule, you must notify the affected employees of the period in which you used it. You must give this notice at or near the date you give the Form W-2, but not earlier than with the employee's last paycheck of the calendar year.

How To Get Tax Help

Whether it's help with a tax issue or a need for a free publication or form, get the help you need the way you want it:

online, use a smart phone, call or walk in to an IRS office or volunteer site near you.

Internet. IRS.gov and **IRS2Go** are ready when you are—24 hours a day, 7 days a week to.

- Download the free IRS2Go app from the iTunes app store or from Google Play. Use it to watch the IRS YouTube channel, get IRS news as soon as it's released to the public, subscribe to filing season updates or daily tax tips, and follow the IRS Twitter news feed, @IRSnews, to get the latest federal tax news, including information about tax law changes and important IRS programs.
- Use [Tax Trails](#), one of the Tax Topics on IRS.gov which contain general individual and business tax information or by searching the [IRS Tax Map](#), which includes an **international subject index**. You can use the **IRS Tax Map**, to search publications and instructions by topic or keyword. The IRS Tax Map integrates forms and publications into one research tool and provides single-point access to tax law information by subject. When the user searches the IRS Tax Map, they will be provided with links to related content in existing IRS publications, forms and instructions, questions and answers, and Tax Topics.
- Visit [Understanding Your IRS Notice or Letter](#) to get answers to questions about a notice or letter you received from the IRS.
- Make a payment using one of several safe and convenient electronic payment options available on IRS.gov. Select the Payment tab on the front page of IRS.gov for more information.
- Request an **Electronic Filing PIN** by going to IRS.gov and entering *Electronic Filing PIN* in the search box.
- Download forms, instructions and publications, including accessible versions for people with disabilities.
- Locate the nearest **Taxpayer Assistance Center (TAC)** using the [Office Locator](#) tool on IRS.gov, or choose the *Contact Us* option on the IRS2Go app and search *Local Offices*. An employee can answer questions about your tax account or help you set up a payment plan. Before you visit, check the *Office Locator* on IRS.gov, or *Local Offices* under Contact Us on IRS2Go to confirm the address, phone number, days and hours of operation, and the services provided. If you have a special need, such as a disability, you can request an appointment. Call the local number listed in the Office Locator, or look in the phone book under United States Government, Internal Revenue Service.
- Apply for an **Employer Identification Number (EIN)**. Go to IRS.gov and enter *Apply for an EIN* in the search box.
- Read the Internal Revenue Code, regulations, or other official guidance.
- Read Internal Revenue Bulletins.

- Sign up to receive local and national tax news and more by email. Just click on “subscriptions” above the search box on IRS.gov and choose from a variety of options.

Phone. You can call the IRS, or you can carry it in your pocket with the IRS2Go app on your smart phone or tablet. Download the free IRS2Go app from the iTunes app store or from Google Play.

- Call 1-800-TAX-FORM (1-800-829-3676) to order current-year forms, instructions, publications, and prior-year forms and instructions (limited to 5 years). You should receive your order within 10 business days.
- Call **TeleTax**, 1-800-829-4477 to listen to pre-recorded messages covering general and business tax information.
- Call the IRS Business and Specialty Tax Line with your employment tax questions at 1-800-829-4933.
- Call using TDD/TTY equipment, 1-800-829-4059 to ask tax questions or order forms and publications. The TDD/TTY telephone number is for people who are deaf, hard of hearing, or have a speech disability. These individuals can also contact the IRS through relay services such as the [Federal Relay Service](#).

Walk-in. You can find a selection of forms, publications and services — in-person.

- **Products.** You can walk in to some post offices, libraries, and IRS offices to pick up certain forms, instructions, and publications. Some IRS offices, libraries, and city and county government offices have a collection of products available to photocopy from reproducible proofs.
- **Services.** You can walk in to your local TAC for face-to-face tax help. An employee can answer questions about your tax account or help you set up a payment plan. Before visiting, use the *Office Locator* tool on IRS.gov, or choose the *Contact Us* option on the IRS2Go app and search *Local Offices* for days and hours of operation, and services provided.

Mail. You can send your order for forms, instructions, and publications to the address below. You should receive a response within 10 business days after your request is received.

Internal Revenue Service
1201 N. Mitsubishi Motorway
Bloomington, IL 61705-6613

The Taxpayer Advocate Service Is Here to Help You. **The Taxpayer Advocate Service (TAS)** is your voice at the IRS. Our job is to ensure that every taxpayer is treated fairly and that you know and understand your rights.

What can TAS do for you? We can offer you free help with IRS problems that you can't resolve on your own. We

know this process can be confusing, but the worst thing you can do is nothing at all! TAS can help if you can't resolve your tax problem and:

- Your problem is causing financial difficulties for you, your family, or your business.
- You face (or your business is facing) an immediate threat of adverse action.
- You've tried repeatedly to contact the IRS but no one has responded, or the IRS hasn't responded by the date promised.

If you qualify for our help, you'll be assigned to one advocate who'll be with you at every turn and will do everything possible to resolve your problem. Here's why we can help:

- TAS is an independent organization within the IRS.

- Our advocates know how to work with the IRS.
- Our services are free and tailored to meet your needs.
- We have offices in every state, the District of Columbia, and Puerto Rico.

How can you reach us? If you think TAS can help you, call your local advocate, whose number is in your local directory and at [Taxpayer Advocate](#), or call us toll-free at 1-877-777-4778.

How else does TAS help taxpayers?

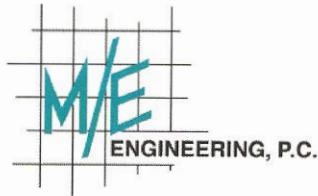
TAS also works to resolve large-scale, systemic problems that affect many taxpayers. If you know of one of these broad issues, please report it to us through our [Systemic Advocacy Management System](#).



<p>A Accident benefits 5 Achievement awards 7 Additional Medicare Tax 2, 27 Adoption assistance 7 Annual lease value 24 Annual lease value table 25 Assistance (See Tax help) Athletic facilities 8 Automobile (See Vehicles) Awards, achievement 7</p> <hr/> <p>B Bicycle commuting reimbursement, qualified 19</p> <hr/> <p>C Cafeteria plans 3 Cents-per-mile rule 1, 22 COBRA premiums 7 Comments on publication 2 Commuter highway vehicle 19 Commuting rule 23 Copying machine use 8</p> <hr/> <p>D Daily lease value 26 De minimis (minimal) benefits: In general 8 Meals 15 Transportation 18 Demonstrator cars 21 Dependent care assistance 8 Deposit rules 27 Discounts for employees 10</p> <hr/> <p>E Educational assistance 9 Employee benefit programs: Accident and health benefits 5 Cafeteria plans 3 Dependent care assistance 8 Educational assistance 9 Group-term life insurance 11 Employee discounts 10 Employee stock options 10 Employer-operated eating facility 15 Employer-provided cell phones 11 Exclusion rules 5</p> <hr/> <p>F Fair market value 22 Fringe benefit overview 2 Fringe benefits: Special accounting rule 28</p>	<p style="text-align: right;">Valuation rules 22</p> <hr/> <p>G General valuation rule 22 Group-term life insurance 11</p> <hr/> <p>H Health benefits 5 Health Savings Accounts 14 Holiday gifts 8</p> <hr/> <p>I Insurance: Accident and health 5 Group-term life 11 Long-term care 6</p> <hr/> <p>L Lease value rule 24 Length of service awards 7 Life insurance: Group-term 11 Spouse or dependent 8 Lodging 15 Long-term care insurance 6</p> <hr/> <p>M Meals: De minimis 15 On your business premises 16 Medical reimbursement plans 5 Minimal benefits 8 Moving expense reimbursements 17</p> <hr/> <p>N No-additional-cost services 17 Nonpersonal use vehicles, qualified 21</p> <hr/> <p>O Options on stock 10 Outplacement services 21</p> <hr/> <p>P Parking, qualified 19 Parties 8 Performance of services 2 Pickup trucks 21 Picnics 8 Prorated annual lease value 26 Provider defined 2 Publications (See Tax help)</p>	<p>Q Qualified transportation benefits 19</p> <hr/> <p>R Recipient defined 3 Reimbursements, moving expense 17 Reporting rules 27 Retirement planning services 18</p> <hr/> <p>S Safety achievement awards 7 Self insurance (medical reimbursement plans) 5 Services, no-additional-cost 17 Simple Cafeteria Plans 4 Special accounting rule 28 Stock options, employee 10 Suggestions for publication 2</p> <hr/> <p>T Taxable benefits 3 Tax help 28 Tickets for theater or sporting events 8 Transit pass 19 Transportation benefits: De minimis 18 Qualified 19 TTY/TDD information 28 Tuition reduction 20</p> <hr/> <p>U Unsafe conditions commuting rule 26</p> <hr/> <p>V Valuation rules 22 Vans 21 Vehicles: Business use of (See Working condition benefits) Commuter highway 19 Qualified nonpersonal use 21 Valuation of 22</p> <hr/> <p>W Withholding rules 27 Working condition benefits 20</p>
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APPENDIX F

**LETTER OF RECOMMENDATION FOR BNMC MOBILITY HUB AND
BICYCLE PARKING FACILITY ACCESS CONTROL SYSTEM**



May 12, 2014

**Mechanical/Electrical
Engineering Consultants**

**BNMC SMART CARD FEASIBILITY
STUDY AND DEMONSTRATION
PROJECT**
M/E Reference 131231.00

BUFFALO NIAGARA MEDICAL CAMPUS
640 Ellicott Street
Buffalo, NY 14203

Attention: Mr. Jamie Hamann-Burney

Dear Jamie:

We are writing in order to provide a recommendation for the preferred systems for the BNMC Mobility Hub and Bicycle Parking Facility Access Control Systems.

The RFP requested that preferred systems, based on compatibility with the proposed Smart Card, be identified prior to completion of the final report due to construction and operation schedules.

BNMC Mobility Hub Access Control System:

Description:

The Mobility Hub is an existing residential building, undergoing renovations. When completed, the Mobility Hub shall be used as office space, retail space and a secure bicycle parking complex. The secure bicycle entrance of the Mobility Hub shall be outfitted with an access control system.

The access control system shall be as compliant as reasonable, with technologies being reviewed in the Smart Card Feasibility study. The access control system being recommended requires 120 VAC power and a LAN / WAN data network to operate. The required power and data services shall be provided at this facility with arrangements made by BNMC.

Recommendation:

The access control system at the Mobility Hub Facility shall be an extension of the existing access controller, currently located at the Innovation Center. The existing system provider, Johnson Controls, needs to be engaged for the inclusion of the Mobility Hub Facility access entrance(s), into the programming of the existing controller at the Innovation Center.

- Interface to ADA Motorized Door Opener - (Product model will depend on manufacture of ADA door operator.)
- Door Electric Strike / Lock - HES No. 9600 (Door Hardware is not defined; this lock will work with typical ADA door hardware.)
- Access Card Reader - Allegion No. MTMSK15
- Door Contact - Sentrol No. 2505
- Lock Power Supply with Battery Backup - Altronics No. AL176ULX

Estimated Material Cost:	\$1,500.00 - \$2,000.00
Estimated Installation Cost:	\$2,000.00 - \$2,500.00
Estimated Programming Cost (Johnson Controls):	<u>\$2,000.00 - \$2,500.00</u>
Total Estimate:	\$5,500.00 - \$7,000.00

BNMC Bike Storage Access Control System:

Description:

The Bicycle Storage Facility is basically a renovated shipping container, with an access ramp. Bicycle Storage Facility shall serve as a secure bicycle parking area. The bicycle storage entrance shall be outfitted with an access control system.

The access control system shall be as compliant as reasonable, with technologies being reviewed in the Smart Card Feasibility study. No AC power or LAN / WAN services exist to the Bicycle Storage Facility. The access control system being recommended shall operate on batteries, and shall link wirelessly to a transceiver located on the Innovation Center Building.

Recommendation:

The access control system at the Bike Storage Facility shall be an extension of the existing access controller, currently located at the Innovation Center. The existing system provider, Johnson Controls, needs to be engaged for the inclusion of the Bike Storage Facility access entrance into the programming of the existing controller at the Innovation Center.

- Lock Controller - Allegion No. AD400-993
- Exit Device -Vonduprin No. 99-EO
- Request to Exit Switch - Vonduprin No. RX-LC 050281
- Door Contact -Sentrol No. 2505
- Wireless Remote Antennas - Allegion No. ANT400-REM

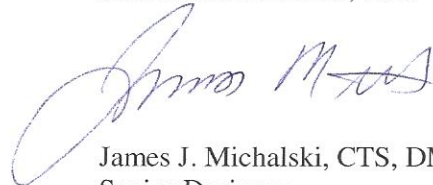
Estimated Material Cost:	\$3,500.00 - \$4,000.00
Estimated Installation Cost:	\$1,000.00 - \$1,500.00
Estimated Programming Cost (Johnson Controls):	<u>\$2,000.00 - \$2,500.00</u>
Total Estimate:	\$6,500.00 - \$8,000.00

The equipment recommendations above have been made to provide for the inter-compatibility with the development of the Smart Card initiative.

The recommended card readers have the ability to work with multiple technologies including those being considered for the planned Smart Cards.

Sincerely,

M/E ENGINEERING, P.C.



James J. Michalski, CTS, DMC-D
Senior Designer

JJM:dls

cc: Mr. William Smith - BNMC
Mr. Tim Natalino - U&S Services, Inc.
Mr. Anthony V. Thomas, P.E., LEED AP - M/E Engineering, P.C.
File

APPENDIX G

MIFARE DESFIRE EV1 INFORMATION



NXP IC solution for contactless multi-application, high-speed and secure smart cards

MIFARE DESFire EV1

MIFARE DESFire EV1 is ideal for solution developers and providers wanting to combine and support multiple applications on one contactless smart card. It fully complies with the requirements for fast and secure data transmission, flexible memory organization, and interoperability with existing infrastructure.

Key applications

- ▶ Advanced public transportation
- ▶ Access management
- ▶ E-Government incl. social services
- ▶ Closed loop micro-payment
- ▶ Loyalty programs

Key features

- ▶ Fully ISO / IEC 14443 A 1-4 compliant
- ▶ 2/4/8-Kbyte EEPROM with fast programming
- ▶ Secure, high-speed command set
- ▶ High data rates according to ISO / IEC 14443-4: up to 848 Kbit/s
- ▶ Flexible file structure
- ▶ Choice of open DES/2K3DES/3K3DES/AES crypto algorithm in hardware
- ▶ Anti-collision
- ▶ Privacy protection
- ▶ Unique 7-byte serial number (ISO cascade level 2)
- ▶ Data integrity: CRC and bit counting on physical layer
- ▶ Available in MOA4 modules or 8" sawn bumped wafer
- ▶ Common Criteria certification: EAL4+ for IC HW and SW

MIFARE DESFire EV1 is based on open global standards for both air interfaces and cryptographic methods. It is compliant to all four levels of ISO / IEC 14443 A and uses optional ISO / IEC 7816-4 commands.

Featuring an on-chip backup management system and the mutual three pass authentication, a MIFARE DESFire EV1 card can hold up to 28 different applications and 32 files per application. The size and access conditions of each file are defined at the moment of its creation, making MIFARE DESFire EV1 a truly flexible and convenient product.

Additionally, an automatic anti-tear mechanism is available for all file types, which guarantees transaction oriented data integrity. With MIFARE DESFire EV1, data transfer rates up to 848 Kbit/s can be achieved, making fast data processing possible. The chip's main characteristics are denoted by its name DESFire EV1, the first evolution of MIFARE DESFire: DES indicates the commitment for high levels of security - MIFARE DESFire EV1 uses a DES, 2K3DES, 3K3DES and AES hardware cryptographic engine for securing transmission data. Fire reflects its outstanding position as a Fast, Innovative, Reliable and Enhanced IC in the contactless proximity transaction market.



Contactless convenience

MIFARE DESFire EV1 brings many benefits to end users. Cardholders can experience convenient contactless ticketing while also having the possibility to use the same device for applications such as closed-loop payment at vending machines, access management, loyalty or social services. In other words, the MIFARE DESFire EV1 silicon solution offers enhanced, consumer- friendly system design, in combination with security and reliability. The 70 pF option enables read range optimizations of small antenna form factors.

MIFARE DESFire EV1 delivers the perfect balance of speed, performance, and cost efficiency. Its open concept allows future seamless integration of other media such as smart paper tickets, key fobs, and mobile ticketing based on Near Field Communication (NFC) technology. It is also fully compatible with the existing MIFARE reader hardware platform.

About MIFARE

MIFARE is NXP's well-known brand for a wide range of contactless IC products used in more than 40 different applications worldwide. With more than 150 million reader core components and 5 billion smart card ICs sold, MIFARE products are proven and reliable more than any other interface technology in the market.

MIFARE products comply with the international standard ISO/IEC 14443 and are backwards compatible within the product families. This ensures that the existing infrastructure can be smoothly upgraded to higher security and feature levels such as payment systems, ticketing solutions, loyalty programs, access management and parking. To further extend the reach of MIFARE products, the MIFARE4Mobile Industry Group brings MIFARE applications into NFC enabled mobile devices.

Product Features	MIFARE DESFire EV1 2 K	MIFARE DESFire EV1 4 K	MIFARE DESFire EV1 8 K
	MF3 IC D21	MF3 IC D41	MF3 IC D81
Memory			
EEPROM Size [byte]	2048	4096	8192
Write Endurance [cycles]	500 000	500 000	500 000
Data Retention [yrs]	10	10	10
Organization	flexible file system	flexible file system	flexible file system
RF-Interface			
Acc. to ISO 14443 A	yes - up to layer 4	yes - up to layer 4	yes - up to layer 4
Frequency [MHz]	13.56	13.56	13.56
Baudrate [kbit/s]	106 ... 848	106 ... 848	106 ... 848
Anticollision	bit-wise	bit-wise	bit-wise
Operating Distance [mm]	up to 100	up to 100	up to 100
Security			
Unique Serial Number [byte]	7, cascaded	7, cascaded	7, cascaded
Random Number Generator	yes	yes	yes
Access Keys	14 keys per application	14 keys per application	14 keys per application
Access Conditions	per file	per file	per file
DES & 3DES Security	MACing / Encipherment	MACing / Encipherment	MACing / Encipherment
AES Security	MACing / Encipherment	MACing / Encipherment	MACing / Encipherment
Anti-tear supported by chip	yes	yes	yes
Special Features			
Multi-application	28 applications, MAD3	28 applications, MAD3	28 applications, MAD3
Purse Functionality	value file	value file	value file
Transaction Logging Capability	record file	record file	record file
Secure Transport Transaction example	512 byte read 128 byte write	512 byte read 128 byte write	512 byte read 128 byte write
Related Transaction Time [ms]	89	89	89
Packaging			
17 pF			
Sawn Wafer Type Description	MF3ICD2101DUD/05	MF3ICD4101DUD/05	MF3ICD8101DUD/05
MOA4 Module Type Description	MF3MOD2101DA4/05	MF3MOD4101DA4/05	MF3MOD8101DA4/05
MOA8 Module Type Description	MF3MOD2101DA8/05	MF3MOD4101DA8/05	MF3MOD8101DA8/05
70 pF			
Sawn Wafer Type description	MF3ICDH2101DUD/05	MF3ICDH4101DUD/05	MF3ICDH8101DUD/05
MOA4 Module Type Description	MF3MODH2101DA4/05	MF3MODH4101DA4/05	MF3MODH8101DA4/05
MOA8 Module Type Description	MF3MODH2101DA8/05	MF3MODH4101DA8/05	MF3MODH8101DA8/05



www.MIFARE.net

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www.nxp.com

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Date of release: September 2013

APPENDIX H

PROPOSED NFTA CARD READER



Fast Fare™ revolutionary farebox



Fast Fare integrates mobile payment along with e-Fare™ an innovative, web based fare system.





Fast Fare transforms passenger fare payment to the next level. By combining traditional fare media with emerging technology, Genfare delivers a flexible solution to expand as new technology becomes available.

We are in the business of helping people use and manage public transportation systems. We have and will continue to deliver the technology leadership and product innovation you would expect from the company that helped create the industry.



Fast Fare was designed from the ground up to work with new fare system requirements. The innovative design leverages 30 years of proven transit experience in security, durability, passenger interface and usability. Improved ergonomics provide maximum clarity and customer convenience.

Fast Fare integrates seamlessly with legacy media, data acquisition, reporting and security systems. This allows for mixed fleets of *Fast Fare* and legacy Genfare fareboxes insuring a smooth transition.

EQUIPMENT HIGHLIGHTS

- Greatly increased program memory and data storage, allowing significant increase in event record transaction and list capacity
- Well thought out placement and spacing of fare media insertion points
- Lighted passenger interface and full color customizable display
- Audio response including multilingual voice messages
- Fast boot up, controller circuit designed to overcome bus power fluctuation.
- Enhanced cashbox ID does not require batteries
- Durable stainless steel construction
- Ease of maintenance requiring no special tools to perform module replacement, minimizing repair time and maximizing availability

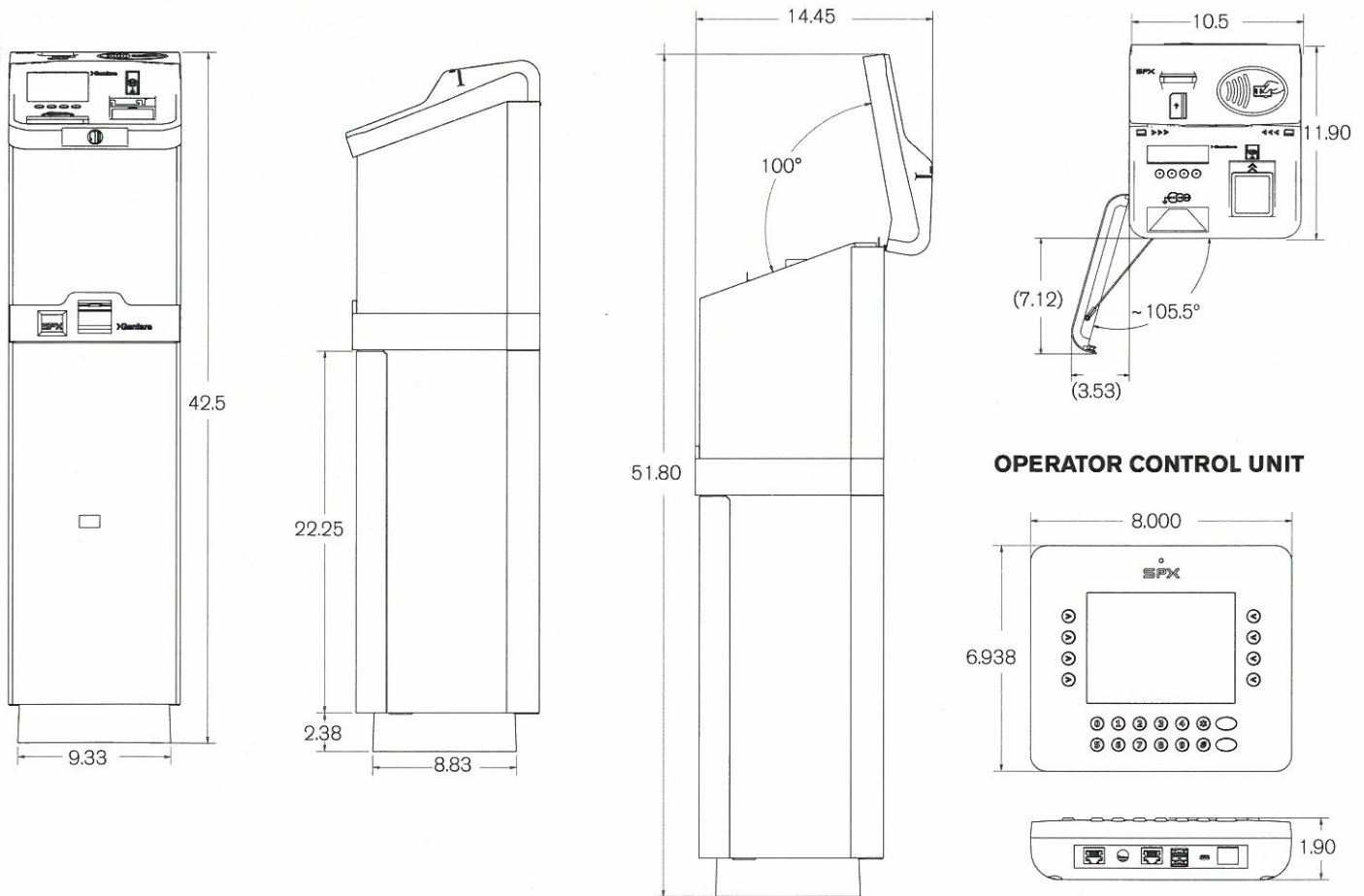
Responding to Rider and Agency Needs

WHY FAST FARE?

- Seamless integration with e-Fare™ web based fare system and mobile ticketing
- Combines traditional fare media with emerging technology
- Innovative new design improves passenger interface and usability while providing a state-of-the-art bus fleet image
- Reliability and ease of maintenance minimizes repair time and maximizes up time



Dimensions at a glance





Fast Fare Product Features

FARE MEDIA ACCEPTANCE

Mobile payment

- NFC phone applications
- 2D high density barcode: QR, Data Matrix and other popular formats

Smart cards

- Smart cards available in various forms: Tags, key chains, fobs, stickers, watches and NFC phones
- All smart cards are ISO 14443 compliant
- Electronic purse and multiple fare products implemented on enhanced security DESFire EV1™ cards
- Thin Ultralight™ or Ultralight C™ thermal coated cards for short term usage

HID iClass

- Existing building access cards
- University student and faculty IDs

Open payment flexible and convenient credit card processing

Magnetics

- Durable 30 mil cards for Period Pass and University ID program
- Limited use 7 to 15 mil thermal coated cards re-encoded and printed upon usage

Bills, coins and tokens

- Faster processing for improved boarding speed
- Software configurable
- Electronically validates and accepts up to 32 types of coins and tokens

FARE MEDIA ISSUANCE

- Mobile ticketing
- Low cost barcode printing
- Limited-use smart card dispenser
- Magnetic ticket reader and issuer

DATA TRANSFER

- Wireless probing for data download and list updates
- Take advantage of existing transit authority WiFi infrastructure or have one provided
- Infrared probing restricts door opening and cashbox removal to areas under surveillance

INTERFACE TO THIRD-PARTY SYSTEMS

- J1708/1587 interface to third-party CAD/AVL system for single point logon, geo-tagging of fare transaction and reporting farebox alarms
- Provision for 4G modem
- Ethernet connection to existing mobile broadband devices
- RS232 connection with other on-board systems
- J1939 interfaces with other on-board devices

FARE PROGRAMS SUPPORTED

- Flat fare or zone-based, peak and off-peak
- Route or class of service (local, express, shuttle, etc.)
- Electronic purse, multiple products and automatic replenish
- Automatic switching from active to pending fare tables simplifies fare changes



751 Pratt Boulevard
Elk Grove Village, IL 60007
TEL: 847 593 8855
www.genfare.com

APPENDIX I

CONVADIS HARDWARE

Convadis Platform

CBox Micro Features

The Convadis In-Vehicle Technology Platform (CBox Micro) comes pre-built with many features. Below is a short summary of them:



User Interface

- Display is visible and readable from the inside and outside of the vehicle. It displays all necessary information and guides the customer through all of the reservation scenarios. Additionally the customer is informed of exceptions and alarms (e.g. "card invalid", "show card again", "no reservation").
- The keyboard permits changing and extending reservations directly. The four soft-keys can be configured in a flexible manner for current and future requirements.
- SmartCard Multi-Reader reads Hitag, Mifare, Legic advant, Kaba, and all card-types with standards ISO 14443 or ISO 15693
- Fuel Card PINS are displayed only for verified users with active reservations. Both mechanical and RFID chip technology is used to verify card presence and identification. Missing cards can be tracked to a single user.

Telemetry

- CANBUS: CBox-Micro has 3 CAN-Controllers: Hi speed, fault tolerant, 1 Wire (+ 1 LIN-BUS).
- GPS: The vehicle can be located at any time.
- Mileage: The distance of the vehicle is always reported.
- Time: Accurate times for trip starting, ending and other events is reported.

- Battery Level: Event is produced for batteries with low charge.
- Fuel Level: Event is produced for vehicles with low fuel levels.

CCom/CConfig

CCom/CConfig is a comprehensive middleware tool for configuration and communications to the CBox Micro units in the fleet. It tightly integrates with Autovera, providing a seamless interface for reservations, call center, billing and administrative functions. It's features includes:

- Bi-directional vehicle onboard system messaging
- Device management / inventory
- Object management (on board systems, SIM cards, gas cards)
- Remote configuration (automatically initiated by vehicle system, manually initiated by web UI)
- Remote control (door functions, immobilizer functions)
- Remote configuration and firmware update (< 5 minutes per car)
- Remote system analysis

Third Party Hardware Tools and Supplies

Smartcards

For startup operators, standard Mifare 1K double-sided offset 4-color (CMYK) printed are recommended. These cards are serialized (each card has a unique serial number), and coded for your organization.

Smartcard Keyboard Reading Device

A simple Smartcard reading device can be attached through USB to any computer. Cards can be associated with new members during Enrollment through a simple scan of the card on the reading device rather than an error-prone hand data entry.

Communications Modem

For non-USA implementations, a modem is required to communicate to the vehicle. To avoid international communications charges this modem must be housed in your location. Two are required, one is for backup purposes.

Communications Port Replicator

For non-USA implementations, a port replicator is used to attach the modem to our servers located in Toronto. This important communications hardware requires physical

connectivity to the modem and to a fixed IP address network connection that is accessible from Toronto. Two are required, one is for backup purposes.

Vehicle Installation

The installation time is very dependent on the car make and model. A typical installation can be completed between 1.5 to 2.5 hours.

Supported Vehicle Types

The following vehicles have known CBox-Micro configurations:

- Alfa
- BMW
- Citroen
- Fiat
- Ford
- General Motors
- Honda
- Hyundai
- Mazda
- Mercedes
- Mini
- Mitsubishi
- Peugeot
- Renault
- Smart
- Suzuki
- Toyota
- VW

New Vehicle Types

CBox is optimized to adapt to different car models/types on the market providing the operator with the flexibility to choose and expand their vehicle fleet. Analysis and engineering of new vehicle types will provide multiple connection options, either through physical wiring or utilization of the CANBUS.

Convadis Platform Rates and Prices

Purchase Order Items

The following items are available for purchase from Metavera, or from a direct supplier as the case may be. Please note that all prices listed are exclusive of shipping, taxes and duties. Prices may change at any time. Please request an formal Quotation before placing an order.

CBox Micro Units

The CBox Micro Unit pricing has volume order discounts and are available directly from Metavera.

- 1-49 units: **\$1175** each
- 50-99 units: **\$1140** each
- 100-249 units: **\$1100** each
- >250 units: **\$1050** each

Smartcards

Mifare 1K, double-sided, serialized, four color (CMYK) printed Smartcards are available through Metavera. Quotes for lower or higher volumes can be arranged.

COST: \$3.50 per SmartCard for orders of 1000.

Smartcard Keyboard Reading Device

This item may be purchased directly from the Manufacturer or through Metavera for a cost of about **\$200** each.

Communications Modem

This item may be purchased directly from the Manufacturer or through Metavera for a cost of about **\$200** each.

Communications Port Replicator

This item may be purchased directly from the Manufacturer or through Metavera for a cost of about **\$100** each.

One-Time Costs

Installation Training

It is recommended that a two-day onsite visit with our contracted installation training engineer be planned, whereby appropriate training of your staff and local installation crew can be fulfilled. Travel expenses are additional

COST: \$2000 + travel costs

Vehicle Type Installation Engineering (optional)

Some late model vehicle types can pose challenges for installation. Problem vehicles are sometimes those with new native keyless entry features, or those with sophisticated onboard computers. In these cases, the wiring may require expert analysis, or reverse engineering of a CANBUS so that the protocol can be programmed in the CBox Micro (example: mileage can only be obtained through a CANBUS read of the odometer value). Sophisticated installation shops can perform these services as can our contracted installation engineering crew.

COST: \$125/hour

Recurring Fees

Monthly Communications Software Access Fees

Metavera provides access to CCom/CConfig under a variable cost monthly fee structure, which decreases with higher volumes. The variable is the number of vehicles on the road, and the pricing structure is as follows:

First 100 vehicles:	\$10/vehicle/month
Next 100 vehicles:	\$7/vehicle/month
Thereafter:	\$5/vehicle/month

Monthly access fees provide the following

- License to use CCom/CConfig
- Subscription to Platform Upgrades
- Secure, scaled, highly available web application hosting services
- 24-7 Emergency Support services
- Regular Maintenance Services (backups, tuning, etc)

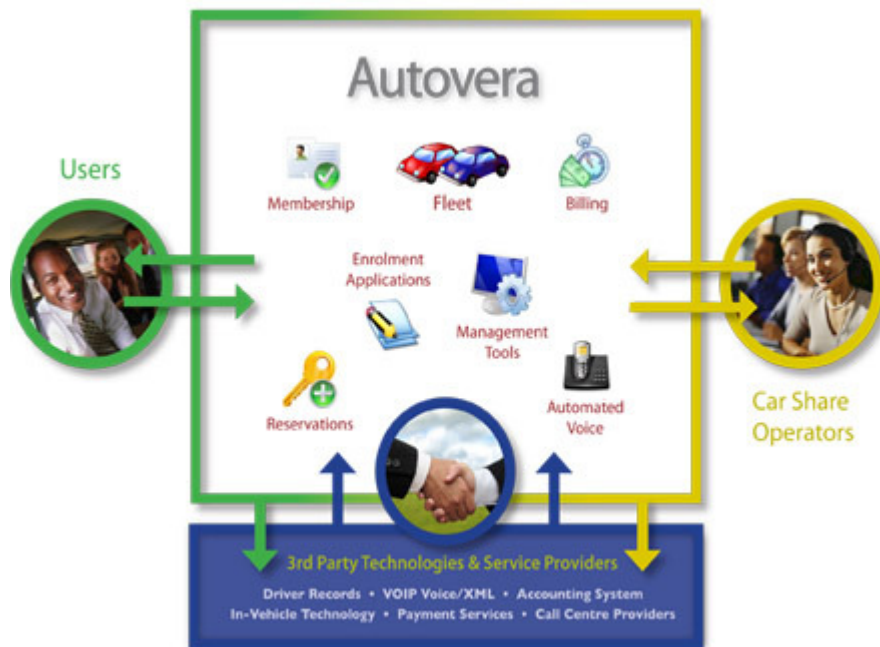
APPENDIX J

AUTOVERA SOFTWARE

Autovera Platform

Autovera Features

The Autovera Platform comes pre-built with many features. Below is a short summary of them:



Complete Enrollment Management

- Online enrollment forms
- Automated approval work flow
- Driver eligibility review
- Driver records request and approval (With First Advantage ADR)
- Enrollment status notifications

Complete Membership Management

- member history, information, status
- member can self-manage profile information/credit cards etc
- member documents repository (driver records, etc)
- member relationship management

- accounts receivable management
- annual driver deductible program

Complete Fleet Management

- manage locations
- manage vehicles (new, old, re-located, out of service)
- maintenance management
- recurring maintenance for large fleets
- interface with commercial 3rd party in-vehicle technology equipment

Reservation System

- nearest location searching
- online google maps
- online reservation cost-estimates
- sophisticated Call Center application with Operational Decision Support (late users, vehicle replacements, etc)
- virtual fleet, exclusive fleet for dedicating capacity to certain customers
- Automated Phone System (predictive touch tone system)
- Mobile Phone WAP System (dedicated iPhone, BlackBerry web apps)

Billing System

- sophisticated trip costing rate plan engine
- online trip log data collection tool (for manual reporting of trip data)
- automated trip log data reconciliation with 3rd party in-vehicle technology providers
- automated daily or monthly online customer billing
- online payment collections
- variety of "PrePayment" models: Pay As You Drive (AutoShare), Pay As You Reserve (PhillyCarShare), Committed Plans (Zipcar/Hertz)
- automated fee collections (Plan Fees, Cancellations, LATE/EARLY penalties, etc)

Management Tools

- standard reports including utilization, revenue, cash flow, accounts receivable
- member audit trails
- staff security and audit trail
- data exports

Vehicle Technology Integration

- Complete integration for reservation support, billing, fleet management and member service
- Partners include: Convadis, OpenCar, INVERS

Third-Party Service Referrals (optional)

Trained 24/7 Call Center Services (optional)

- Fully trained 24/7 Call Center
- Manage reservation Transactions and Conflicts
- Handle Emergency Response (road repairs, out of service)

Driver Record Abstracts (optional)

- North American Provider of Driver Abstracts
- Direct interface through Autovera
- Conversion of the abstract to PDF

Further Information Available

- Detailed Features Sheets
- Online Videos of Autovera in action
- Live Demonstration Site for your review

Autovera Rate Schedule

One Time Setup/Configuration Fees

Out-the-Box Activation Fees

Our out of the box configuration will provide:

Branding

- Custom 4-Color Template + Logo
- Customization of Invoice
- Contact Information (for emails, website, etc)
- Mini-Login (ability to login to Autovera from corporate website)

Enrollment Configuration

- 4 Application Types (residential, business, additional driver, corporate driver)
- Standard Click Through Enrollment Workflow
- Enrollment Form Content Customization
- Customized Enrollment Emails
- Membership Fees
- Application Fees

Reservation Configuration

- Reservation Increments
- Reservation Permissions (book in the past, etc)

Billing Configuration

- Up to 3 Rate Plan Configurations (example: Basic, Standard, Advantage)
- Two Payment Term Models: Daily Billing, End of Month Billing
- Automated Billing Policy Configuration (LATE, EARLY, CANCELLED TIME, etc)
- Fee Type Configuration (for manual and automated fees)
- Taxation Configuration

Fleet Configuration

- Initial Vehicle Type Setup
- First Location/Vehicle Setup

Member Services Configuration

- Problem Report Configuration
- Customized Member Services Emails

Training

- 5 hours of training

COST: \$3000

Automated Phone Activation Fees (Optional)

To turn on and configure the Automated Phone System.

COST: \$500

Mobile Reservation Activation Fees (Optional)

To turn on and configure the Mobile Phone System.

COST: \$600

Other Options

This document is meant as an introduction to the Autovera Platform. There are a variety of other optional features that can be activated upon request during Implementation. Our detailed implementation plan identifies these available add-on features as well as any additional costs.

COST: upon request of additional features

Recurring Fees

Monthly Software Access Fees

Metavera employs a variable cost monthly fee structure, which decreases with higher volumes. The variable is the number of vehicles on the road, and the pricing structure is as follows:

First 50 vehicles:	\$60/vehicle/month
Next 50 vehicles:	\$55/vehicle/month
Next 100 vehicles:	\$50/vehicle/month
Thereafter:	\$45/vehicle/month

Monthly access fees provide the following

- License to use our complete software platform
- Subscription to Platform Upgrades
- Secure, scaled, highly available web application hosting services
- 24-7 Emergency Support services
- Regular Maintenance Services (backups, tuning, etc)

Monthly Mobile Reservation Fees (Optional)

Reservations:	\$0.35/transaction
---------------	---------------------------

Reservation transactions include new reservations, cancellations and any changes to existing reservations made over the mobile reservation interface. Looking up existing reservations and browsing availability is free.

Monthly Automated Telephone Fees (Optional)

Automated telephony fees are based on connect time (i.e. when the a caller is interacting with the Automated Telephone system). Transfer fees depend on the mode of transfer.

Connect Time:	\$0.25/minute
Transfers:	\$0.06/minute (telco in USA, subject to change)

Billing increments are 10 seconds, with a minimum call length of 60 seconds.

SSL Certificates (Optional)

Through our Hosting Partner we can offer you Secure Encryption Certificates at below retail value. These certificates are required to provide a secure connection to your membership and are purchased on an annual basis.

SSL Certificate:	\$130/year (for .com, .net, or .org domains)
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Autovera Special Startup Offer

For small startups, Metavera offers a very cost-effective means of getting on to the Autovera Platform. This offer is good for CarShares up to and including 10 vehicles only (beyond 10 vehicles, the rates fall back to the standard rates), for a maximum period of 6 months.

The one-time fees are \$3000 and include the features, configuration, customizations, branding and training as the "out-of-the-box" Activation.

Within the 6 month period and while the CarShare operator is operating with 10 vehicles or less the following pricing will apply.

Monthly Software Access Fees Monthly

All vehicles: **\$40/vehicle/month**

Monthly Mobile Reservation Fees (Optional)

Reservation Transactions: **free**

After 6 months of implementation the monthly fees above revert to the standard rate schedule.

Popular add-ons available for additional costs include:

Driving Record Integration:	\$500
Dual Memberships:	\$500
Automated Phone:	\$500
Mobile Phone:	free (\$600 value)

Appendix D: Description of Relevant CBORD Systems

Benefits

- Provide 24/7 online and mobile support
- Expand your use of CS Gold®
- Offer a wide variety of online and mobile solutions for students and staff
- Improve student service and efficiency

For Colleges and Universities

Introduction

CS Gold® WebManager™ software makes it easy to expand your use of CS Gold without requiring a GUI. This solution provides the back-end components necessary to implement many of CBORD's online and mobile solutions for CS Gold in a simple, unified approach.

Some features are available with WebManager alone, while others are offered for users of WebManager and our GET™ commerce solution. No matter the configuration, CS Gold WebManager allows you to offer the latest online and mobile services to your students and staff.

* Requires GET



CS Gold WebManager

The core components of CS Gold WebManager offer several patron-facing functions that give your cardholders 24/7 self-service.

Some components of CS Gold WebManager require CBORD's GET commerce platform, offering account management, ordering, and more through an online or mobile interface. Customers with CS Gold WebManager and GET can choose from a long list of combined features. A shared login is supported for both solutions so users can move from one site to the other. Please refer to separate GET documentation to learn about many other patron-facing options available when GET (CBORD hosted) is coupled with WebManager (customer hosted).

- **Notification Preferences:** Specify how and when to receive notifications and account alerts (email, text message, or both).
- **Roll Call:** Display and track patrons expected for an event, and view those not yet checked in.
- **Set or Change PIN:** Set or change PIN.
- **Report Lost/Found Card:** Report a card lost or found.
- **Report Lost Phone:** Report a phone or any other mobile device lost.
- **Use Mobile Apps:** View an overview of CBORD mobile apps, links to download the apps, and options for configuring the apps.
- **Transfer Funds*:** Transfer funds from one Stored Value & Credit account to another.
- **Add and Drop Meal Plans*:** Add and drop (remove) meal plans.

Comprehensive Solutions. Innovative Products. Dedicated Service.

The CBORD Group, Inc.
61 Brown Road, Ithaca, NY 14850
607.257.2410 • FAX: 607.257.1902
www.cbord.com

CS Gold® WebManager™ Software

The following are **administrator-facing** components of CS Gold WebManager:

- **Active Alarm Map:** Show active alarms on a map using the geographic positions that are assigned to the alarm locations.
- **Issue Card:** Issue pre-encoded cards to patrons (e.g., when the card office is closed).
- **Location Finder:** Search for locations in a range or location group on a map.
- **Patron Finder:** Display current and former patron locations on a map using recorded geolocation positions.
- **Patron Management:** Add new patrons, or search for patrons by name, meal plan, Stored Value & Credit plan, or patron group.
- **Priv Editor:** Control users' access to menu items and features in CS Gold WebManager.
- **Quick Tran:** Perform charge, refund, balance inquiry, meal, meal refund, and activity transactions.
- **Reader Status:** View reader information including status, location, reader name, time and date of status change, IP address, MGR, and firmware versions.
- **Reporting:** Manually or automatically run ad-hoc or stored reports.
- **TPS Dashboard:** Start, stop, bounce, reload configuration, change debug levels, and start or stop Windows services on the TPS.

Additional Modules

CS Gold WebManager also powers many of CBORD's other mobile solutions. Please refer to separate documentation to learn more about:

- CS WebManager Access Module
- CBORD Mobile ID™
- Pathlight®
- Laundry status monitoring
- Sports lottery
- Attendance Monitor
- CS Gold® Mobile Reader™
- CS Notify™

Comprehensive Solutions

CBORD provides campus card systems, integrated security solutions, housing management, food and nutrition management, catering solutions, and commerce programs to more than 6,000 organizations. Our focus is on comprehensive solutions that increase revenue, reduce costs, enhance campus safety, improve student satisfaction, and integrate systems seamlessly.

Innovative Products

Our innovation is customer driven. Working in partnership with users, we listen to the industry's evolving needs and develop solutions to keep you a step ahead.

Dedicated Service

The quality of our products is made greater by the caliber of our employees. Through open dialogue with you, our customers, CBORD strives to not only meet, but exceed your expectations; we are committed to providing superior service in all aspects of our customer relationships. You can reach us twenty-four hours a day, seven days a week, and know you have a team dedicated to your satisfaction and success.

CBORD, CS Gold, and Pathlight are registered trademarks, and CS Gold WebManager Software, GET, CBORD Mobile ID, CS Gold Mobile Reader, and CS Notify are trademarks, of The CBORD Group, Inc. All other brand and product names are believed to be trademarks, registered trademarks, or service marks of their respective owners.



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Benefits of CBORD Off-Campus Programs

- Offer new and expanded student services
- Drive incremental revenue
- Improve town/gown relations
- Assure parents that campus card funds are being spent responsibly

For Colleges and Universities

Introduction

Today's colleges and universities are not defined by geographic boundaries, and student life doesn't stop at the front gate; they are integral parts of their surrounding communities. That's why so many universities are taking their campus card programs off campus.

Powered by the industry-leading UGryd® central server technology, CBORD off-campus programs are praised by merchants nationwide thanks to daily ACH settlement and flexible online reporting.

Take your campus card program to the next level with a customizable off-campus program from CBORD.

Go Your Own Way

CBORD off-campus programs are fully customizable to meet the needs of each institution. Whether you desire a fully outsourced off-campus program or just need some help managing your own program, CBORD can help. Solutions are easily tailored for new and existing programs, large or small.



What is UGryd?

UGryd is a leading central server solution from CBORD that facilitates communication between universities and merchants. No need for modem banks or open IP connections between university networks and merchants—UGryd handles all merchant transaction requests. Its scalable and redundant communication architecture handles peak transaction traffic without bogging down. Plus, UGryd communicates with Odyssey PCS™ and CS Gold® campus card systems through a secure IP tunnel for real-time authorization of funds and settlements.

Daily ACH Settlement

CBORD has built an industry-standard ACH settlement flow to settle with merchants handling payments, commissions, credits, adjustments, and disputes. UGryd settles daily with merchants and supplies real-time views of daily settlements, as well as monthly merchant statements.

Add Value with Student Advantage®

Your students will love the convenience of using their campus cards off campus. Take the value one step further by offering exclusive discounts at their favorite businesses with Student Advantage. When the program is integrated onto your existing campus card, memberships can be easily sold through CS Gold or Odyssey PCS at the time of card creation. Additionally, you can opt to sell cards separately.

UGRYD®



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www.cbord.com

CBORD® Off-Campus Programs

Merchant Support Services

CBORD has built a support organization to meet the diverse needs of its merchant community. UGryd handles all merchant transactions, whether processed via dial-up, IP, or national network processors. CBORD's Merchant Services Group is a sole-source provider for all support calls with access to common support tools used for Odyssey PCS and CS Gold systems. The dedicated team allows schools to outsource all support functions to attract merchants, implement programs, and provide ongoing support to ensure that merchants are meeting students' needs.

Comprehensive Solutions

CBORD provides campus card systems, integrated security solutions, housing management, food and nutrition management, catering solutions, and off-campus programs to more than 6,000 organizations. Our focus is on comprehensive solutions that increase revenue, reduce costs, enhance campus safety, improve student satisfaction, and integrate systems seamlessly.

Innovative Products

Our innovation is customer driven. Working in partnership with users, we listen to the industry's evolving needs and develop solutions to keep you a step ahead.

Dedicated Service

The quality of our products is made greater by the caliber of our employees. Through open dialogue with you, our customers, CBORD strives to not only meet, but exceed your expectations; we are committed to providing superior service in all aspects of our customer relationships. You can reach us twenty-four hours a day, seven days a week, and know you have a team dedicated to your satisfaction and success.

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Benefits of GET™

- Hosted, secure commerce management
- A singular mobile app experience for all card-and-account-related activity
- Mobile Credential for payment
- MICROS® order posting
- CBORD® campus card integration



For Colleges & Universities

The Platform

Account management. Mobile ordering. Mobile payment. Program marketing. GET has it all. You gotta get GET!

GET My Card™ Mobile Payment

Pull out your phone, launch the app, pay for your meal. It's that simple. Using a 2D bar code scanner*, any POS can accept the GET app for payment.

GET Funds™ Account Management

With GET Funds, students can manage their campus card accounts any time. Features include:

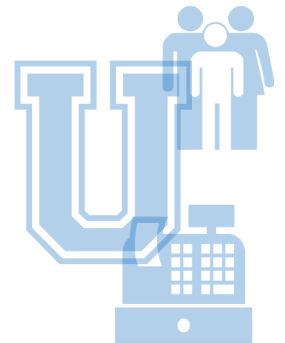
- Secure credit card deposits
- Options to bill deposits to student account
- Account balances
- Transaction histories
- Lost card reporting
- ID photo uploads

GET Food™ Online Ordering

With GET Food, online and mobile ordering has never been easier. Students simply:



- View menus from participating merchants
- Order through a simple and intuitive process
- Pay via campus card or credit card
- Route orders through your MICROS system or send directly to a kitchen printer



GET is a secure, convenient way to expand your students' dining options while driving new sales and avoiding additional overhead.

GET Places™ Easy Searching

Market the value of your campus card program by improving visibility for your card-accepting locations, on campus or off.

GET Places gives students a list of locations including addresses and GPS-enabled maps, and it can display special offers (e.g., "Two for Tuesday" at New York Pizzeria – Buy one large pizza, get one free!").

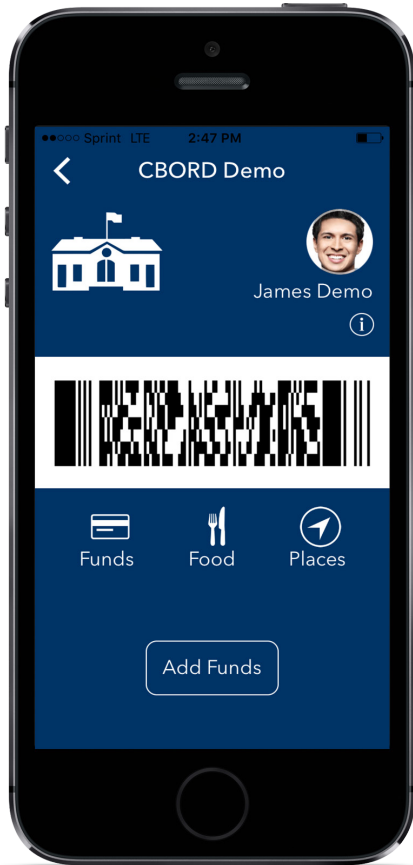
*Motorola® DS9208 is the only supported reader for GET My Card

A Complete, Cloud-Based Solution

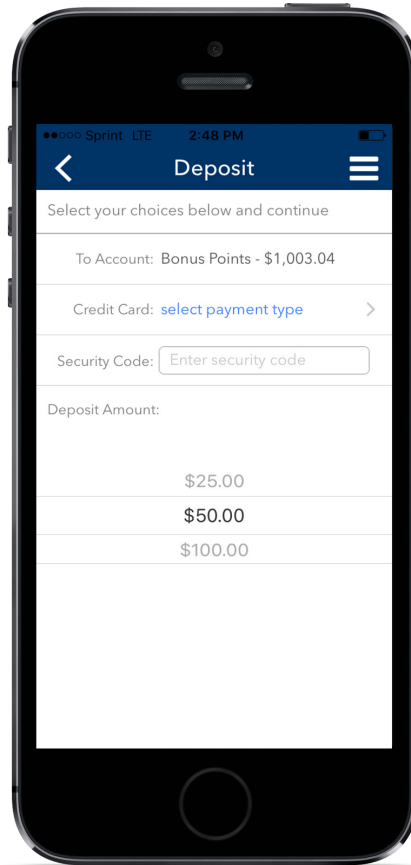
GET is a cloud-based solution from CBORD that expands the reach of your campus card efficiently and securely. A hosted solution brings many benefits, including:

- No hardware to maintain
- PCI-compliant transactions processed by CBORD
- New features added automatically; no need to upgrade
- Easy to expand to new locations

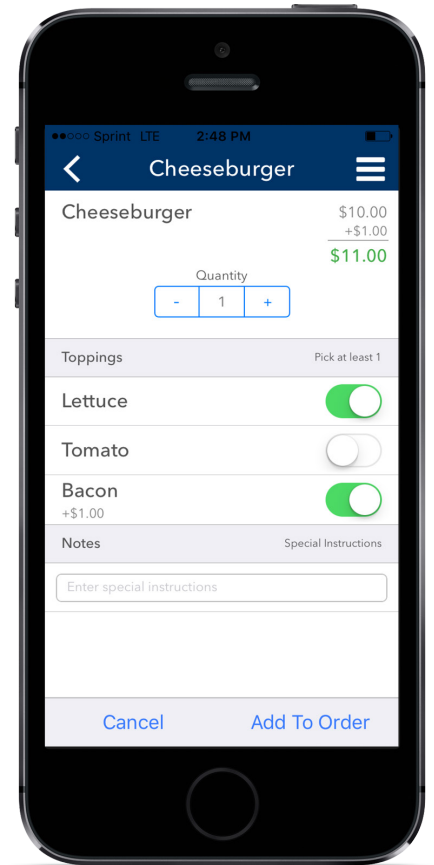
From account management to spending and more, GET improves student satisfaction, increases campus card usage, and simplifies system management.



Check out our five-minute YouTube® video on GET My Card.



Check out our one-minute YouTube video on GET: How to Deposit.



Check out our one-minute YouTube video on GET: How to Order.



CS CardLink Features

- Supports multiple badge formats, card designs, and numbering schemes
- Increments lost card code automatically
- Provides tracking statistics on card issuance



For Colleges and Universities

CS CardLink™ is a software module integrating the Datacard® IDWorks® badging system for card production with the patron accounts within CS Gold®. This module provides an online, real-time integration between the Datacard system and the CS Gold system which enhances the capabilities of both.



Data-entry reduction

CS CardLink saves time and reduces errors during the production of ID cards by eliminating the need to re-key data from multiple databases. The information required to produce ID cards can be gathered from any Open Database Connectivity (ODBC)-compliant database.

A system user at a campus network-based PC running the software can extract basic cardholder information from the CS Gold database, along with information residing in any other campus network database. CS CardLink combines this data with the cardholder's digitized photo maintained within the database.

Simple Operation

A simple drop-down menu on the patron screen initiates the data-gathering process for CS Gold. Following validation rules established by the campus and other card issuance participants (such as banking institutions), CS CardLink coordinates the information and launches the card production process. CS CardLink can also coordinate and assign a specific ISO number to the cardholder's ID card when needed.

Configuration Wizard

Users have the ability to directly access the configuration tools for card production or use a step-by-step wizard to set up and complete card production. Options available within the wizard include creating a card from scratch, copying from another location, or modifying an existing card. The wizard contains validity checks and help buttons, as well as reporting on missing data.

Card Designs

CS CardLink enables administrators to design multiple cards (staff, student, guest, etc.), program rules for card qualification, and automatically print the appropriate card on pre-printed or blank card stock.

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MIFARE® DESFire® EV1 Credentials

MIFARE DESFire EV1 Card • 1450, 1456

MIFARE DESFire EV1 / HID Prox Combo Card • 1451, 1457

- ▶ **High Security** - Mutual authentication, AES 128, DES and triple-DES data encryption and unique 56-bit serial number.
- ▶ **Read/Write Functionality** - Perfect for multi-functional memory applications.
- ▶ **Transition Solution** - Add smart card applications to existing HID proximity technology access control systems.
- ▶ **True Credit Card Thickness** - Use with all direct image and thermal transfer printers.



ACCESS interoperability.

HID MIFARE® DESFire® EV1 cards are designed for diverse applications that demand the highest levels of security, including access control and biometric identification, cashless vending, public transportation, ticketing and customer loyalty cards. Available in PVC and Composite PET/PVC card construction, the HID MIFARE DESFire EV1 card is exceptionally durable and can accept an embeddable contact chip for logical access and biometric ID systems.

HID MIFARE DESFire EV1 credentials have 8 Kbytes of dynamic memory arranged in easy-to-define application folders and data files. MIFARE DESFire EV1 data can be encrypted with the highly secure Advanced Encryption Standard (AES 128) algorithm assuring that data in the card is secure before, during and after the transaction, as well as between folders and files within the credential itself.

13.56 MHz MIFARE DESFire EV1 read/write technology combined with 125 kHz HID Prox technology can be integrated into a single ISO standard thickness card (custom programming with Indala formats is also available). This converged card is suitable for adding MIFARE DESFire EV1 applications to an existing HID Prox-based access control system.

When security and performance count most, HID's MIFARE DESFire EV1 cards can be produced with visual security and anti-counterfeiting features such as holograms, ultra-violet fluorescent inks, micro-printing or a custom logo to quickly and easily identify genuine cards.

Key Features of MIFARE DESFire EV1 Technology

- ▶ **Proven, Reliable Technology** - MIFARE DESFire EV1 is based on open global standards for security, and is interoperable with existing MIFARE infrastructures.*
- ▶ **Fast Processing and Data Communication** - Transaction times are less than 100 milliseconds for a typical secure ticketing transaction.
- ▶ **Standards Compliant** - MIFARE DESFire EV1 is fully compliant with ISO 14443A 1-4, and has been awarded CC EAL 4+ for card security.

*MIFARE DESFire EV1 is not compatible with the PIV read application used with a DESFire 0.6 card

Features

Long Life

Passive, no-battery design allows for an infinite number of reads.

Durability

Strong, flexible and resistant to damage.

Photo ID Compatible

Print directly to the card with a direct image or thermal transfer printer.

PVC Card Surface

Card is optimized for dye sublimation printing.

Customizable

Specify your own text or graphics artwork.

Thin

0.030" (0.076 cm) card can be carried with credit cards in a wallet or purse. Use with a badge holder and strap clip or lanyards for an attractive photo ID badge.

Many Ordering Options

Including magnetic stripe, external card numbering, custom artwork and contact smart chip module.

MIFARE® DESFire® EV1

MIFARE® DESFire® EV1 with HID PROX

Base Part Number	PVC - 1450 PET/PVC - 1456	PVC - 1451 PET/PVC - 1457
Operating Frequency	13.56 MHz	13.56 MHz (MIFARE DESFire EV1) 125 kHz (HID PROX)
RF Interface	ISO 14443 A, Parts 1-4 (DESFire EV1)	
Typical Maximum Read Range	DESFire: Up to 4" (10 cm)	DESFire: Up to 4" (10 cm) Prox: 2" - 4.5" (5.0 - 11.4 cm)
Transaction Time	< 100 ms	
Baud Rate	Activation at 106 kbps; Data transfer up to 848 kbps	
Memory Type	EEPROM 8 Kbytes	
Memory Structure	Up to 28 applications, with up to 32 files per application	
Operating Temperature	Model 1450/1451 PVC Cards: -40 to 122°F (-40 to 50°C) Model 1456/1457 Composite Cards: -40 to 158°F (-40 to 70°C)	
Operating Humidity	5% - 95% Non-Condensing	
Write Endurance	100,000 cycles min.	
Data Retention	10 years min	
Materials and Finish	Gloss white/white PVC or PVC/Polyester Composite	
Weight	0.20 oz (6.0 g)	0.24 oz (6.8 g)
Programming	Factory or Field	
Card Marking	Inkjet standard, Laser Engraving optional	
Custom Graphics	Optional	
Magnetic Stripe	Optional	
Printable	Yes (white/white card)	
Slot Punch	Not Available (MIFARE DESFire EV1 cards do not allow a slot punch)	
Visual Security Options	Optional	
Additional Security Options	Corporate 1000	
Warranty	Lifetime - see Sales Policy for complete details	

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State of New York

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New York State Energy Research and Development Authority

Richard L. Kauffman, Chair | John B. Rhodes, President and CEO

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Matthew J. Driscoll, Commissioner