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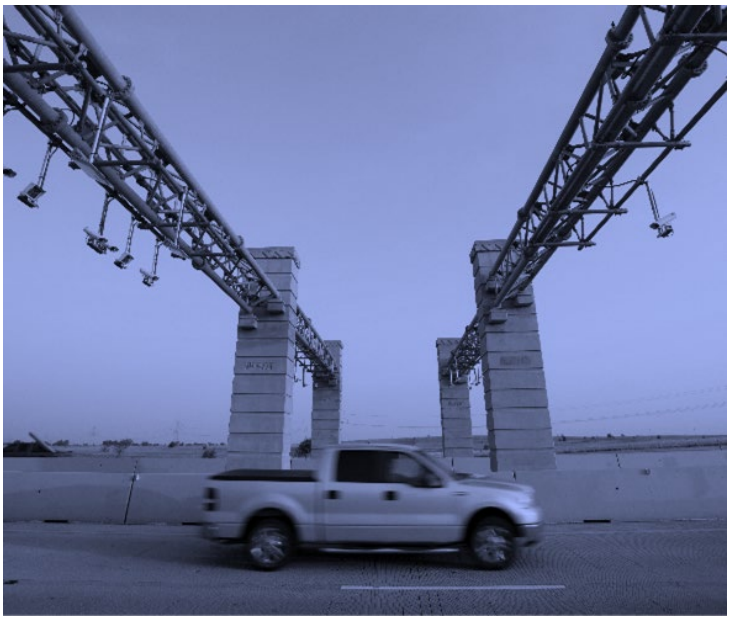


Michigan Statewide Tolling Strategic Implementation Plan Appendix A. Concept of Operations Report

IN ACCORDANCE WITH
PUBLIC ACT 140 OF 2020
AND PUBLIC ACT 73 OF 2022

MDOT

HNTB

CDM Smith

December 21, 2022

Contents

1. Introduction

1.1. Purpose of the Concept of Operations

This document establishes a framework for how the new Michigan Toll Authority would operate and maintain a potential statewide toll program. Developing this Concept of Operations (ConOps) is an important part of the strategic planning process because it helps communicate how a Michigan toll program may look and feel to the traveling public. It also provides a basis for estimating the initial and ongoing costs associated with implementing a statewide toll program.

If the State of Michigan decides that tolling is the best means of funding major limited access highway improvements, MDOT and the new Michigan Toll Authority will revise this document over time and provide more details as operational and maintenance standards are advanced and finalized. This document will identify program goals and specify various operational and functional requirements regarding infrastructure, equipment, and personnel that will influence the program's design, implementation, and operations and maintenance (O&M) support efforts.

The elements presented in this document are intended to be flexible and serve as a basis for continued discussions throughout the planning and potential implementation processes.

1.2 Acronyms

Table 1-1: Acronyms

Acronym	Definition
AET	All-Electronic Tolling
ACD	Automatic Call Distribution
ACH	Automated Clearing House
ADT	Average Daily Traffic
AVDC	Automatic Vehicle Detection and Classification
AVI	Automatic Vehicle Identification
BOS	Back-Office System
ConOps	Concept of Operations
CSC	Customer Service Center
CSR	Customer Service Representative
DMS	Dynamic Message Sign
DMV	Department of Motor Vehicles
DR	Disaster Recovery
DOS	Department of State
DVAS	Digital Video Audit System
ETCS	Electronic Toll Collection System
IAG	E-ZPass Inter-Agency Group
ITR	Indiana Toll Road
ITS	Intelligent Transportation Systems

Acronym	Definition
IOP	Interoperability
IVR	Interactive Voice Response
KPI	Key Performance Indicator
LAN	Local Area Network
LoS	Level of Service
MDOT	Michigan Department of Transportation
MOT	Maintenance of Traffic
OCR	Optical Character Recognition
O&M	Operations & Maintenance
PCI-DSS	Payment Card Industry – Data Security Standard
PTZ	Pan-Tilt-Zoom
RFID	Radio-Frequency Identification
SLA	Service Level Agreement
TSP	Toll Services Provider
TMC	Traffic Management Center
U.S.	United States
VPN	Virtual Private Network
WAN	Wide Area Network

2. All-Electronic Tolling

The toll system would be an All-Electronic Tolling (AET) system that allows tolls to be collected without vehicles stopping or even slowing down. The AET system would be based on state-of-the-art technology which would detect, identify, and classify vehicles through integrated roadside and lane devices installed at various locations (Toll Zones) along the tolled facility (see Figure 2-1). These devices would work in combination with a Back-Office System (BOS) and Customer Service Center (CSC) that would process toll transactions and images from the Toll Zones, administer customer accounts, and manage customer payments.

Figure 2-1: Example of an All-Electronic Tolling System Toll Zone

The AET system's method of vehicle identification would be based on two technologies:

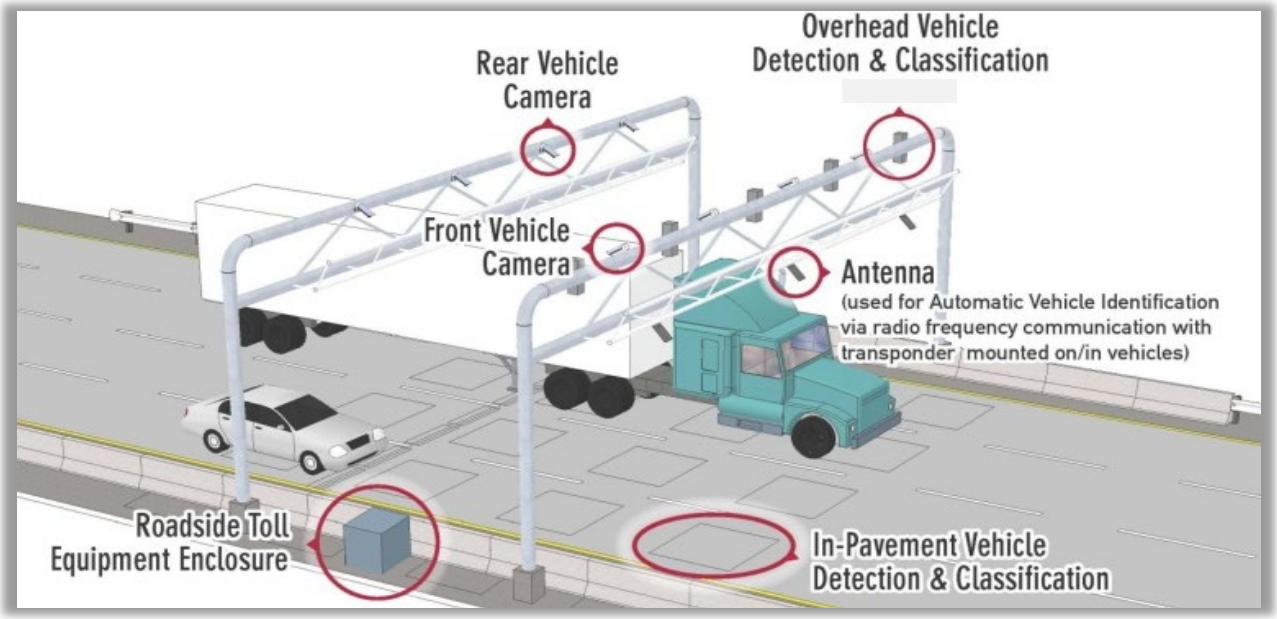
- Radio Frequency Identification (RFID) transponders and
- Images of vehicle license plates from digital cameras.

See the next page for more information and details on the AET transponders and cameras.

2.1 Electronic Toll Collection System

The roadside and lane devices installed and integrated at the various Toll Zones are collectively referred to as the Electronic Toll Collection System (ETCS). At the Toll Zone level, the ETCS consists of devices mounted on overhead gantry structures, installed in the pavement and enclosures along the roadside. Figure 2-2 depicts a typical dual-gantry Toll Zone.

Figure 2-2: Typical Dual-Gantry Toll Zone



The Toll Zones interface with a central server-based ETCS facility host that aggregates data and images from the Toll Zone devices and forwards them to the BOS for processing. For each vehicle that travels through the Toll Zone, the ETCS would generate a toll transaction data record, capture vehicle images, and transmit this information to the BOS.

Due to the importance of accurately and consistently capturing, storing, and processing data and images at the Toll Zone, the ETCS equipment would be designed to be redundant (either fully or functionally), with high availability (e.g., hardened design, with low rate of component failures, etc.), and easily maintained.

2.1.1. Toll gantries

Toll gantries are the structures spanning the roadway on which the ETCS lane equipment is mounted. At each Toll Zone, dual gantries would be installed and provide toll system design and equipment mounting flexibility (see Figure 2-3).

Figure 2-3: Toll Gantries (Ohio River Bridges)

2.1.2. Automated Vehicle Identification readers

Automated Vehicle Identification (AVI) RFID readers and associated antennae would be installed at the Toll Zones and integrated into the ETCS. This equipment is required so that the AET system can use RFID transponders as a means of toll payment.

The transponder readers on the market today are able to communicate using different protocols simultaneously. These readers, commonly referred to as multi-protocol readers, support tolling interoperability throughout the United States (U.S.), as required in the MAP 21 federal authorization legislation. Because of the geographic location of the toll corridors being studied, and because several toll bridges and tunnels are already operating within the state, multiprotocol readers capable of communicating in the following protocols would be used:

- PS111 / TDM / IAG E-ZPass Group (E-ZPass),
- ISOC / ISO 18000-63/6C (6C), and
- ISOB_80K / SeGo – 6B (SeGo)

AVI equipment would be installed in every travel lane and shoulders that are wide enough to carry traffic. This approach would prohibit a vehicle from avoiding tolls by traveling in the shoulder.

2.1.3. Automatic Vehicle Detection and Classification

It is recommended that THE NEW MICHIGAN TOLL AUTHORITY's vehicle classification scheme be based on axle count. The ETCS equipment at the Toll Zones would include devices that automatically detect and classify vehicles accordingly.

Axle-based Automatic Vehicle Detection and Classification (AVDC) devices in a Toll Zone typically consist of in-pavement inductive loops complemented by overhead sensors. The loops determine the number of axles per vehicle, while the overhead sensors support vehicle detection and separation, camera triggering, and functional redundancy.

Benefits of an axle-based classification scheme include:

- The technology is fair, proven, and accurate;
- The approach is easy to explain to customers;
- The lifecycle equipment costs are lower than those for other classification schemes; and
- The equipment is not affected by weather

Figure 2-4 shows an example of a two-lane layout design for an in-pavement inductive loop array that is used for axle-based classification.

Figure 2-4: Example of an Axle-Based Automatic Vehicle Detection and Classification Loop Layout Design

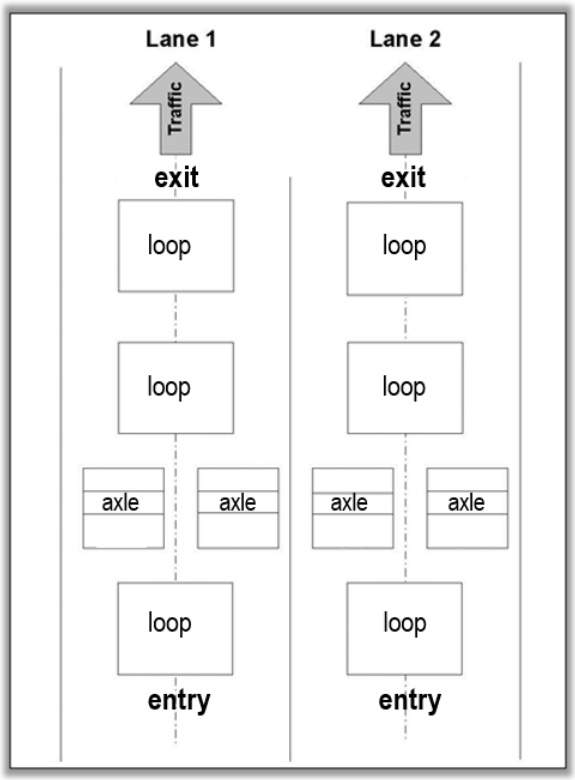
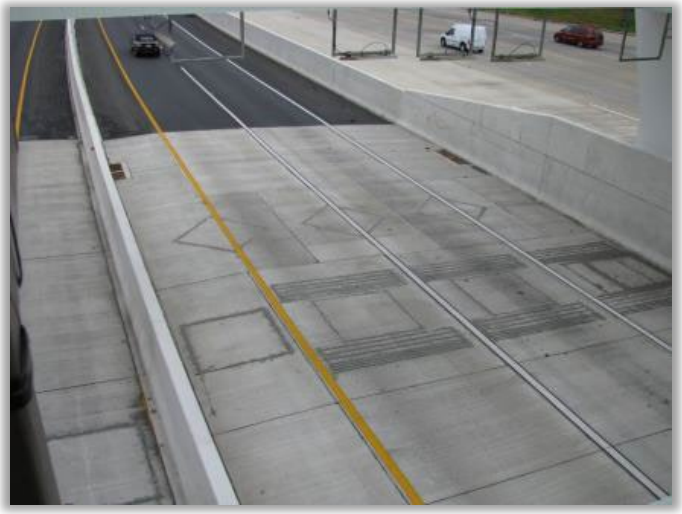


Figure 2-5 depicts an example toll rate signage used at an axle-based classification toll facility.

Figure 2-5: Example of Axle-Based Signage

Figure 2-6 shows an in-pavement inductive loop array installation in a Toll Zone that uses axle-based classification.

Figure 2-6: Example of an Axle-Based Automatic Vehicle Detection and Classification Loop Layout Installation



The AVDC devices would provide the ETCS with the ability to accurately detect and classify vehicles and would meet industry standard performance requirements. The ETCS would use the AVDC data to determine the proper toll rate amount to charge a customer.

2.1.4. Image capture

The ETCS equipment would include devices that capture and store front and rear images of every vehicle traveling in the Toll Zone. These devices would include digital high-resolution cameras, supplemental lighting, triggers, and sensors. They would capture readable images of vehicle license plates in a variety of typical lighting conditions as a means of vehicle identification for the purposes of toll payment.

The image capture devices would provide the ETCS with the ability to capture images of vehicles accurately and meet industry standard performance requirements. Figure 2-7 shows example images generated from ETCS cameras in a Toll Zone lane.

Michigan only requires rear license plates for passenger cars, so many vehicle images in Michigan would only include rear license plates. Front and rear plates, such as shown in Figure 2-7, are preferred for toll collection systems to provide more image redundancy but are not necessary. Other states that have all-electronic tolling systems, for example Pennsylvania, do not have front license plates. For commercial vehicles front plates are required in Michigan. For large commercial vehicles with trailers, the front tractor license plate would be used for video toll processing, if applicable, rather than the rear trailer license plate.

Figure 2-7: Example Images Captured by Toll Zone Electronic Toll Collection System Cameras

2.1.5. Digital Video Audit System

The ETCS equipment would include devices that capture and store continuous video of vehicular activity in the Toll Zone. These Digital Video Audit System (DVAS) devices would include high-resolution cameras that capture quality video footage of vehicular activity, combined with real-time transactional data, to support toll system auditing and customer issue resolution.

2.1.6. Electronic Toll Collection System communications networks

The communications networks for the ETCS would consist of a secure copper-based local area network (LAN) at each Toll Zone, along with a secure fiber-optic backbone-based wide area network (WAN) that connects the Toll Zones to the facility host and BOS. Although each Toll Zone would have the ability to operate in a stand-alone mode for at least 30 days if connectivity to the WAN should fail, the WAN would be fully redundant, with automatic failover functionality. The fiber-optic backbone-based WAN would be designed and installed in coordination with MDOT's Intelligent Transportation Systems (ITS) communications network.

The ETCS communications networks would enable authorized remote users to securely connect via virtual private network (VPN) functionality and be compliant with the Payment Card Industry Data Security Standard (PCI-DSS).

2.1.7. Facility and equipment security

Only authorized management and O&M personnel would be allowed unescorted access to any ETCS facility. In addition, access to specific areas within facilities by authorized personnel would be managed and controlled using badges programmed based on work roles and responsibilities.

Roadside toll equipment enclosures/cabinets housing ETCS equipment would also be secured to allow access by only authorized maintenance personnel. Recorded digital cameras would be used to supplement facility and equipment security measures in order to provide the ability to monitor and review access activity.

2.2. Back-Office System

Figure 2-8 illustrates the relationship between the BOS and CSC operations.

Figure 2-8: Back-Office System / Customer Service Center Systems and Operations

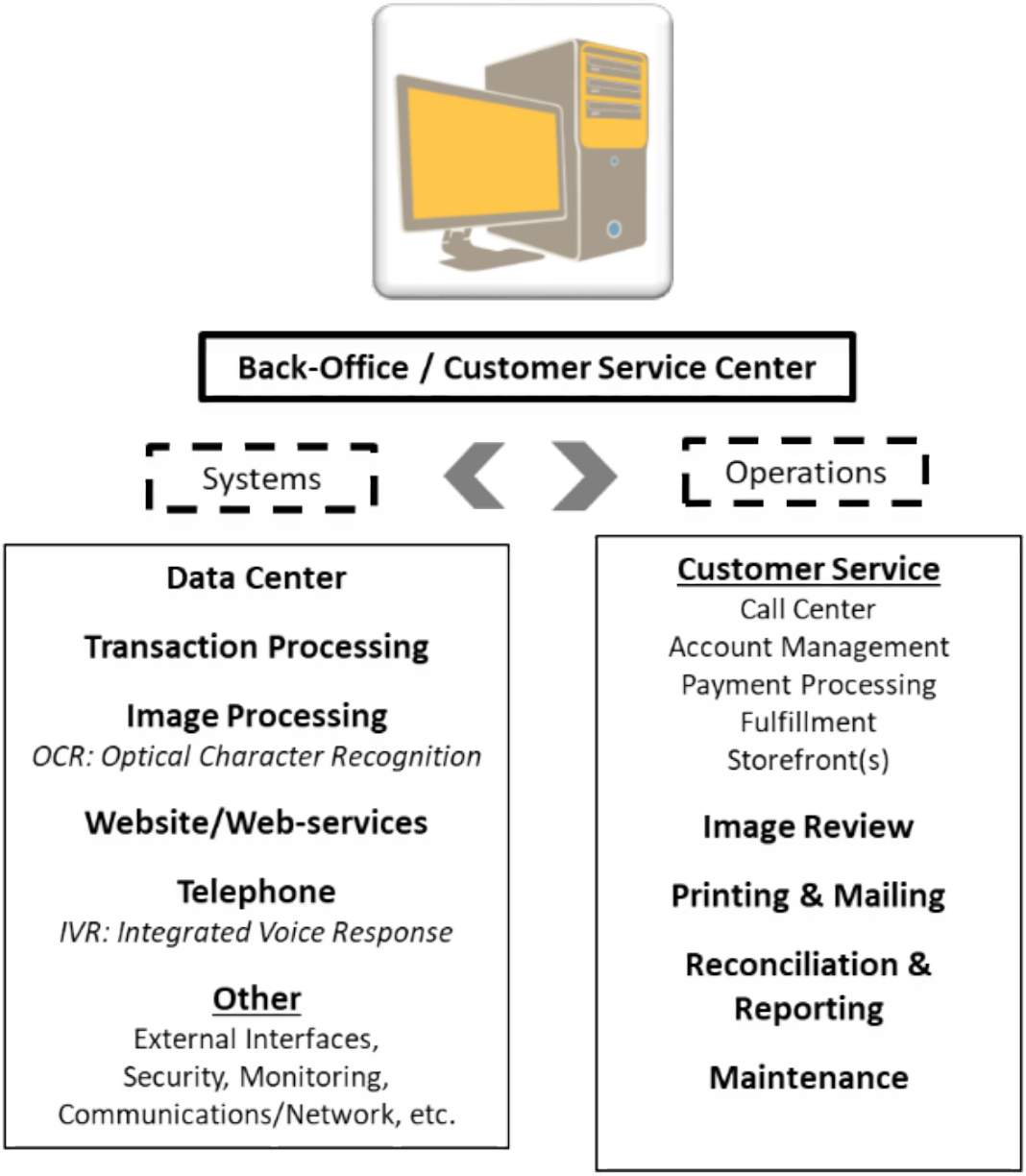
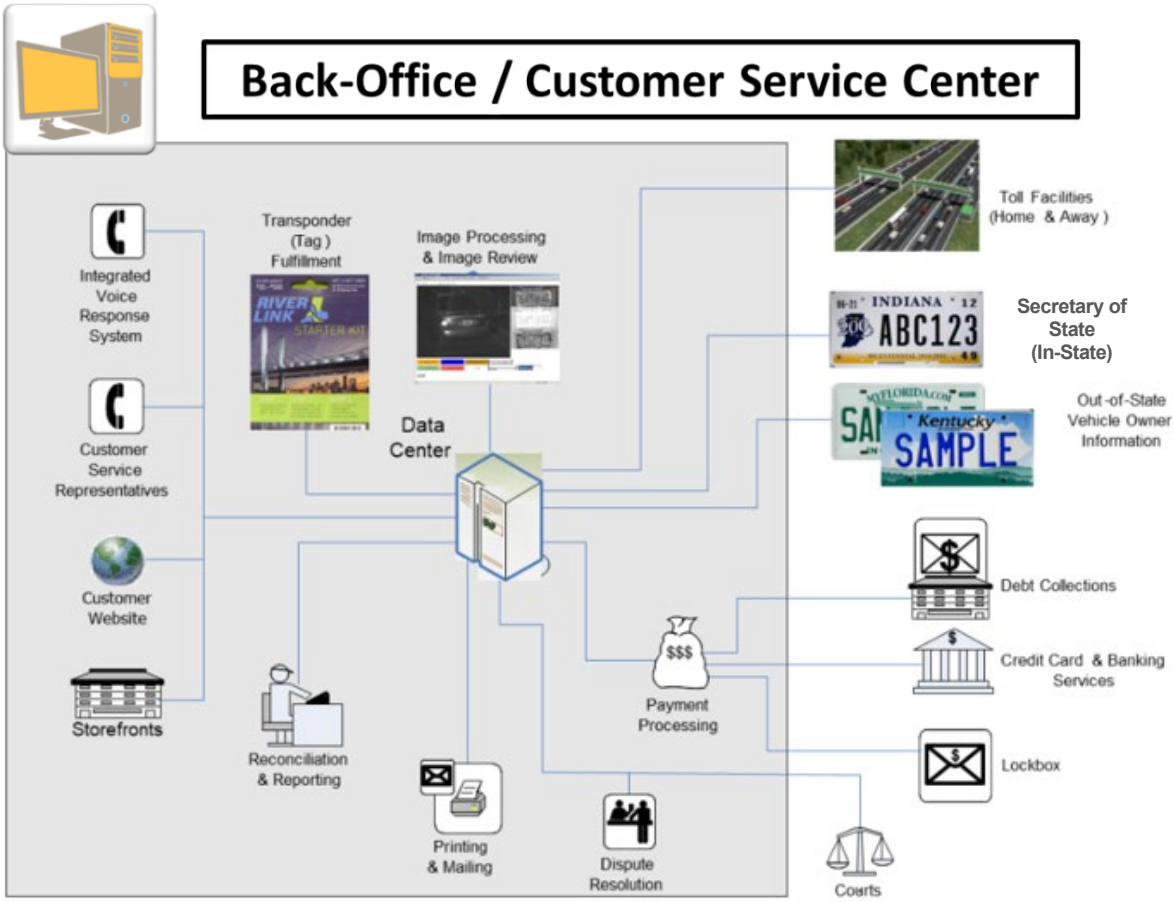


Figure 2-9 provides an overview of the BOS and its typical functions.

Figure 2-9: Back-Office System Overview



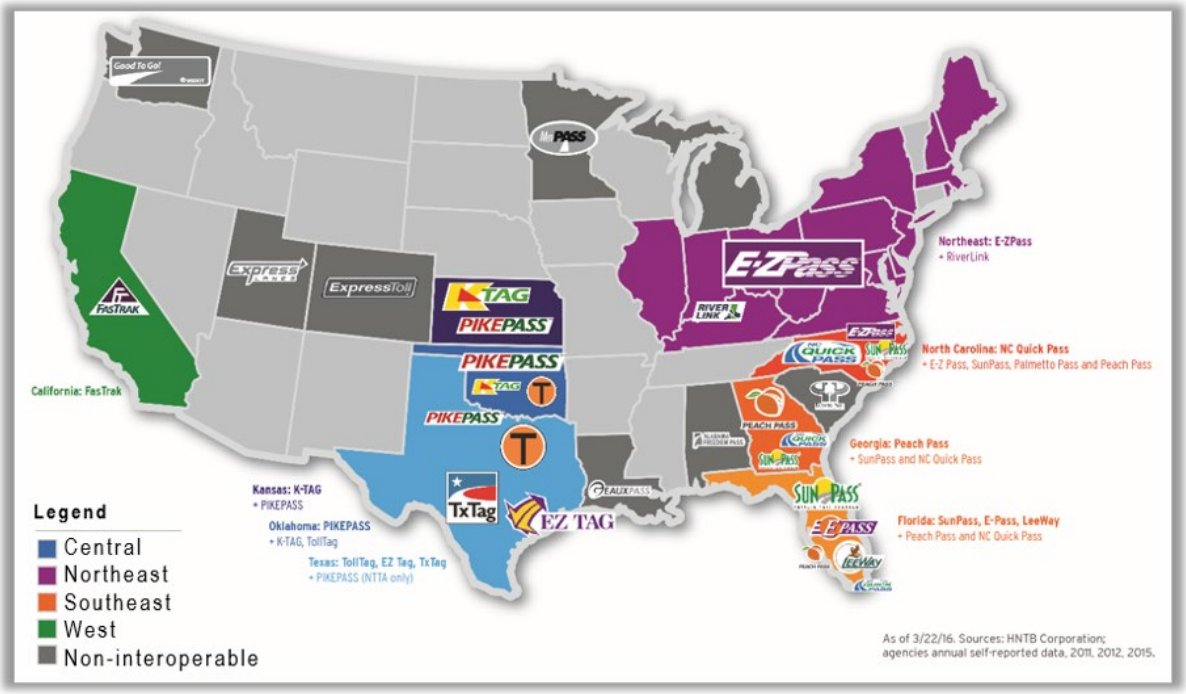
2.2.1. Interoperability

Tolling interoperability consists of the technology, processes, and agreements that enable a customer with a valid transponder and registered toll account at one toll agency (referred to as the Home Agency) to travel on another agency's toll facility (referred to as the Away or Visited Agency's toll facility) and seamlessly pay the incurred toll(s) to the Away Agency from the customer's toll account managed by the Home Agency. Today, the degree of interoperability among various toll facilities in the U.S. can be categorized by the following levels:

- Local / In-State,
- Regional, and
- National.

The map in Figure 2-10 illustrates how toll interoperability in the U.S. has evolved to be predominantly regional.

Figure 2-10: U.S. Toll Regions



Federal transportation legislation (2012 MAP-21) required national interoperability of electronic toll collection by October 2016. While interoperability is in progress in many regions, it is not yet complete nationwide.

The new Michigan Toll Authority would provide interoperability to its customers by joining an established interoperability service provider that is most cost effective. This approach is based on the assumption that the current regional interoperability service providers will mature into national interoperability by the time the new Michigan Toll Authority implements any tolling.

Joining an interoperability service provider would have the benefits of:

- No member initiation fee;
- No annual member dues; and
- Low per-transaction fees.

2.2.2. Other external interfaces

In-state vehicle owner information

The BOS would interface with Michigan's Secretary of State (SOS) in order to obtain ownership information about vehicles with registered Michigan license plates. The interface

would support an automated file exchange for daily batch processing, in addition to manual lookup functionality with authorized access.

Out-of-state vehicle owner information

The BOS would interface with commercially available entities in order to obtain ownership information about out-of-state vehicles based on license plates that include the following:

- State-specific Department of Motor Vehicles (DMV) (or state equivalent), and
- Third-parties providing such services.

With a majority of U.S. states having tolled facilities and advancing towards national interoperability, it is anticipated that states will continue to work together to make obtaining out-of-state vehicle ownership information more effective and efficient.

Collections

The BOS would interface with a Collections Agency in order to pursue outstanding unpaid tolls and fees/fines that have escalated into a collections stage. The Collections Agency would use the following tools to facilitate the debt collections process:

- Skip tracing and national change of address search;
- Collection letters;
- Predictive dialer, interactive dialer, and manual calls; and
- Payment plans.

Courts

The BOS would support the preparation of a court evidence package in order to pursue any outstanding tolls and fees/fines that have escalated into a courts stage. Pursuing collection through the Michigan court system would only be done for vehicles registered in Michigan. Pursing collection for out-of-state vehicles would be handled through potential reciprocal enforcement agreements with other states.

2.2.3. Payment Card Industry compliance

All credit/debit card processing activities and related technologies would comply with the Payment Card Industry Data Security Standard (PCI-DSS). This standard includes activity and technology requirements regarding credit/debit card data capture, storage, and transmission in order to protect cardholder data. Annual compliance audits would be performed in order to ensure required data protection practices and controls are followed.

2.2.4. Facility security

Only authorized management and O&M personnel would be allowed unescorted access to any BOS facility. In addition, access to specific areas within a facility by authorized personnel would be managed and controlled using badges programmed based on work roles and responsibilities.

Recorded digital cameras would be used to supplement BOS facility security measures in order to provide the ability to monitor and review access activity.

2.2.5. Back-Office System communications networks

The communications networks for the BOS would be similar to the network described above for the ETCS. It would consist of a secure copper-based LAN that connects the CSC operations to the BOS and Facility Host, along with a secure fiber-optic backbone-based WAN that connects the Facility Host and BOS to the Toll Zones. Although the Facility Host and BOS would have the ability to operate in a standalone mode for at least 30 days if connectivity to the WAN fails, the WAN would be fully redundant, with automatic failover functionality. In the event of an extended period of WAN outage, the toll system would also include functionality that supports the manual transfer of files typically transmitted over the WAN in order to allow for business continuity.

The BOS communications networks would enable authorized remote users to connect to the network securely using VPN functionality.

2.3. Customer Service Center

2.3.1. Call Center

The Call Center is a sub-section of the toll program's CSC that directly interfaces with toll customers via telephone calls about activities such as opening new transponder accounts, assisting with existing account management and maintenance, ordering new or replacement transponders, accepting payments, and responding to information requests. To be efficient and effective, call center customer service representatives (CSRs) would undergo continuous quality evaluation and periodic training. In addition, the Call Center operations would be supported by advanced technology and functionality that decreases call wait and handle times, benefitting both THE NEW MICHIGAN TOLL AUTHORITY and its customers. These tools would include the following traditional elements:

- Multi-channel Automatic Call Distribution (ACD),
- Interactive Voice Response (IVR),
- Predictive Dialing,
- Call Recording, and
- Call Monitoring.

The CSRs would provide person-to-person customer service support Monday-Friday from 7:00 a.m.-7:00 p.m. Eastern Time. The IVR would provide its customer service support 24/7. If a customer telephones the Call Center outside of business hours, the IVR would indicate the business hours and allow the customer to perform various self-service functions.

2.3.2. Walk-up locations

Walk-up locations are another sub-section of the CSC. The new Michigan Toll Authority would rent/lease storefront space in order to establish customer service walk-up locations close to toll project corridors in busy metropolitan and rural communities that are underserved by third-party retailers. These walk-up locations would be staffed by skilled local CSRs capable of assisting new and existing customers with their account needs in a dynamic face-to-face customer environment.

Walk-up location CSRs would provide person-to-person customer service support Monday-Friday from 7:00 a.m.-7:00 p.m. Eastern Time.

2.3.3. Third-party retailers

The new Michigan Toll Authority would utilize local third-party retailers to supplement both transponder distribution and bill payment processing efforts. These retailers would facilitate providing customers with convenient in-person access to transponders and bill payment options. The utilization of local third-party retailers typically results in the following key benefits:

- Reduced capital and operational costs associated with the CSC and walk-up locations,
- Customer convenience, and
- Increased transponder market share resulting in decreased toll collection costs.

2.3.4. Inventory and fulfillment

Transponder fulfillment, a CSC support function, involves a series of processes to inventory, secure, control, and distribute transponders. CSC fulfillment resources would maintain a secure inventory of transponders and distribute them in accordance with security protocols to registered account holders via walk-up locations and first-class mail.

2.3.5. Payment processing

Payment processing, another CSC support function, involves receiving and applying customer payments on a daily basis. Payments requiring manual handling would be received through various channels, including direct mail or walk-up locations, in several forms, including cash and checks. The BOS would auto-process account replenishment payments, website payments, and IVR payments. The new Michigan Toll Authority's CSC would train all customer service resources on how to securely accept and handle cash and check remittances, apply payments to the correct accounts and/or invoices, and process payments if remittances lack account and/or invoice information.

In addition to cash and checks, allowed forms of payment would include:

- Credit Cards (Visa, Mastercard, and American Express);
- Debit Cards (with Visa or Mastercard logo);
- Automated Clearing House (ACH) linked directly to a bank account; and

- Mobile/Web Payment Service Providers (e.g., Stripe, Venmo, PayPal, Zelle, etc.).

2.3.6. Self-service channels

Based on standard industry practices, the BOS and CSC operations would include self-service channels designed to reduce the number of CSR calls/contacts by assisting customers with various routine account management tasks, such as making payments and obtaining account balances. The BOS would provide reports for each self-service channel that would be analyzed routinely to ensure the customer experience is effective and efficient. The self-service channels would include IVR, a website, and a mobile application.

Interactive Voice Response

A front-end IVR call management system would answer all inbound calls to the CSC with a greeting that encourages callers to choose the option to "self-help" with various routine account tasks or opt to be routed to a CSR during normal business hours through an Automatic Call Distribution (ACD) system.

Website

A website would be the most convenient and effective self-service channel for handling all but the most complex customer issues, including opening new accounts, updating established accounts, accepting payments, and providing general toll facility information. Since the website is a primary interface between the public and the tolling operations, the details of the website design and functionality would be closely coordinated with the new Michigan Toll Authority's public relations efforts.

Mobile application

A mobile application would be a small-scale version of the website, with reduced financial transaction features in order to avoid secondary exposure of customer credit card data. Safe driving practices would be reinforced throughout the mobile application.

2.3.7. Printing and mailing

Printing and mailing are CSC support functions. Due to the anticipated high volume of ongoing printings and mailings, the new Michigan Toll Authority would utilize an outsourced third-party printing and mailing service provider (commonly referred to as a Mailhouse). The Mailhouse would utilize high-capacity, high-speed printers and mail processing equipment to print and mail customer letters, statements, invoices, and notices. The Mailhouse would also utilize address verification services, if applicable, to support efficient and effective customer communications.

In addition, the new Michigan Toll Authority would utilize the CSC operations in order to receive and process returned mail and mail fulfilled transponder orders.

2.3.8. Image review

The BOS and CSC operations would include functionality and procedures to review vehicle license plate images provided by the ETCS. The purpose of image review would be to identify the license plate information (i.e., state, type, and characters) in order to associate the vehicle with vehicle ownership information and identify any image capture performance issue in any Toll Zone (e.g., incorrect camera triggering, incorrect camera field-of-view, images that are too dark, etc.).

The BOS would include an optical character recognition (OCR) engine incorporated into a "double-blind" manual review confirmation process for images with OCR results below a proven high-confidence level.

Due to the anticipated size of the CSC operations, manual image review would be performed by a combination of dedicated staff and cross-trained customer service staff. Image review would be done with a high degree of accuracy in order to provide public confidence in the system and maximize revenue collection.

2.3.9. Disaster recovery and business continuity

Provisions would be included for a Disaster Recovery (DR) location and operations that would support business continuity and the preservation of customer and transactional data during a major outage event affecting the primary BOS and CSC location. The DR provisions would be designed to a level of redundancy and operational readiness consistent with industry risk management policies. Industry best practices would include planning for short-term communications loss by allowing for toll transactions, images, and video to be stored locally at each toll location for at least 30 days.

2.3.10. Payment Card Industry compliance

All credit/debit card processing activities and related technologies would comply with the PCI-DSS. This standard includes activity and technology requirements regarding credit/debit card data capture, storage, and transmission in order to protect cardholder data. Annual compliance audits would be performed to ensure that required data protection practices and controls are followed.

2.3.11. Facility security

Only authorized management and O&M personnel would be allowed unescorted access to any CSC facility. In addition, access to specific areas within a facility by authorized personnel would be managed and controlled using badges programmed based on work roles and responsibilities.

Recorded digital cameras would be used to supplement CSC facility security measures in order to provide the ability to monitor and review access activity.

2.3.12. Transponders

The new Michigan Toll Authority would issue 6C protocol transponders. The primary form factor would be a windshield sticker, but a customer would, if needed, be able to obtain an external bumper mount or motorcycle sticker form factor as well.

This approach is based on the assumption that U.S. toll agencies have either replaced or upgraded their toll systems and operations to accept 6C protocol transponders for national interoperability purposes by the time the new Michigan Toll Authority implements any tolling.

The new Michigan Toll Authority issuing 6C protocol transponders would have the following benefits:

- Consistency with existing protocol transponders issued for the International Bridge, Mackinac Bridge, and Blue Water Bridge;
- Lowest cost for inventory;
- Easier customer communications, minimizing customer confusion; and
- Removal of a potential barrier to entry to account establishment.

2.3.13. Anonymous transponder accounts

The new Michigan Toll Authority would not allow for a customer to establish an anonymous transponder account but instead require that all customer transponder accounts be registered with at least the customer's name, address, and license plate information.

A new Michigan Toll Authority transponder sold through any third-party retail store would be able to be registered and activated by the customer contacting the Call Center, visiting a walk-up location, or using the website or mobile application.

Not allowing for anonymous transponder accounts would have the following benefits:

- Fewer customer issues if a transponder is not read in the lane,
- CSC has the ability to contact customers to resolve any account issues, and
- Decreased costs to collect tolls.

2.3.14. Invoicing

The new Michigan Toll Authority would generate and issue invoices for accounts with any video toll and/or fee on a monthly basis, similar to the monthly billing methodology utilized by typical utility and cellphone companies. An account's monthly invoice cycle date would be based on the date of the account's first transaction. Invoices would also be cumulative, wherein any subsequent invoice would indicate any past due amount, along with details on new amounts due and any adjustments and payments posted during the cycle. In addition, invoices would indicate to the customer how much the customer would have saved if the customer had utilized a pre-paid transponder account.

Utilizing a monthly and cumulative invoicing methodology would have the following benefits:

- Easier customer communication and less confusion,
- Customers can anticipate and plan for paying invoices,
- Mitigation of spikes in call and walk-up volumes, and
- Decreased costs to collect tolls.

2.4. Procurement Strategy

The new Michigan Toll Authority would utilize a two-pronged approach to procuring the tolling systems described herein.

The first step is to procure a statewide ETCS provider. The scope of work would include designing, installing, integrating, and maintaining all of the needed roadside and lane devices and providing necessary related resources. Depending on the new Michigan Toll Authority's plan and schedule, the ETCS provider's contract and schedule would need to be flexible in order to accommodate a phased toll implementation for and within the various project corridors.

A separate parallel approach would procure a BOS and CSC provider or team. The scope would include designing, implementing, operating, and maintaining all of the needed BOS and CSC elements.

3. Intelligent Transportation Systems

MDOT has employed ITS for many years in order to provide a safer and more reliable travel experience for Michigan drivers. ITS consist of multiple independent electronic components transmitting real-time data to a Traffic Management Center (TMC). ITS in the tolled environment employs the same components in a higher density in order to detect, respond, and manage weather- and traffic-related events as quickly and safely as possible. The objective of this enhanced ITS coverage is to minimize traffic diversion to non-tolled alternative routes.

3.1. Traffic Management Center

MDOT monitors and manages incidents on major roadways at TMCs. These TMCs have the software, hardware, staffing and processes necessary to manage traffic and weather incidents on portions of major roadways. The TMCs rely on infrastructure that transmits video images and road sensor data needed for incident detection, analysis, response, and management. As MDOT and the new Michigan Toll Authority continues to evaluate what a potential statewide toll program could look like, the TMCs' role in a successful program cannot be overstated. Maintaining ridership on tolled corridors requires dedicated electronic and human resources to detect, respond, communicate, and manage weather and traffic incidents in a timely manner. Figures 3-1 and Figure 3-2 show example TMCs in Texas.

Figure 3-1: Example Traffic Management Center (North Texas Tollway Authority in Dallas)

Figure 3-2: Example Traffic Management Center (Texas Department of Transportation in Mesquite)

3.2. Intelligent Transportation Systems Communications Network

The existing ITS communications network backbone typically consists of fiber-optic cable (see Figure 3-3) supplemented by cellular communications in or near major urban areas. Directly connected to this backbone are ITS components such as closed-circuit traffic cameras, roadway condition sensors, dynamic message signs (DMS'), and travel-time sensors. The TMC requires communications with traffic cameras, DMS', and other roadway devices for the entire length of each toll corridor. In addition, the toll system requires dedicated communications with each tolling location. Therefore, the new Michigan Toll Authority would expand the fiber-optic cable backbone along the entire length of the tolled corridors.

Figure 3-3: Multi-Strand Fiber-Optic Cable

3.3. Incident Detection

Traffic incidents are typically defined as roadway occurrences that have negative impacts to the normal flow of traffic. Examples include a ladder in the roadway, a stalled car on the shoulder, or an accident that blocks the free flow of traffic. To reliably detect incidents across a large geographic area, the new Michigan Toll Authority would install an array of fixed and Pan-Tilt-Zoom (PTZ) traffic cameras in major urban areas in sufficient quantity to monitor interchanges and areas with higher-than-average occurrences of traffic incidents. Traffic cameras would be added in rural areas with less exposure to incident-related traffic diversion. The cameras would be monitored by cloud-based analytic software and produce an alarm in as few as ten seconds of an incident's occurrence. This proven traffic camera/metadata analytics technology monitors real-time traffic camera feeds and would alert the TMC when and where an incident exists. The fixed camera alarm highlighting the incident would allow TMC resources to access the corresponding PTZ camera, examine

the incident before determining the correct response, and prepare first responders with details of the incident prior to their arrival on scene.

3.3.1. Traffic sensors

The new Michigan Toll Authority would install traffic sensors at strategic urban locations for the purpose of measuring traffic. Messages would be displayed on DMS' notifying motorists of predictable travel times to major intersections. Relationships with third-party traffic and navigation service providers over time would increase the accuracy of predictive travel times and provide additional benefits, such as notifying drivers in advance of roadway construction or major incidents.

3.3.2. Traffic cameras

The new Michigan Toll Authority's typical traffic camera array would consist of four fixed cameras and one PTZ camera mounted on an engineered camera pole of appropriate height for a given area. Typically, there would be two fixed cameras looking in one direction and two fixed cameras looking in the other direction, each with a defined non-overlapping area of coverage. Figure 3-4 displays an example of a traffic camera array. TMC resources would manipulate the PTZ cameras to examine an incident and then monitor the incident as needed to act as a "spotter" supporting first responders. The fixed cameras would also be monitored by a cloud-based analytics provider.

Figure 3-4: North Texas Tollway Authority Traffic Camera Array

3.4. Incident Management

Most toll agencies employ the philosophy, "what gets measured gets managed." Traffic incidents have the potential to disrupt toll revenue for a period of time longer than it takes to clear an incident. In order to manage incidents effectively, the new Michigan Toll Authority would track Key Performance Indicators (KPIs), such as traffic incident detection, response, and clearance times. Routine review of incident locations and KPIs would lead to preventative or heightened response measures deliberately designed to avoid or limit exposure to traffic diversion and toll revenue leakage in urban areas. The new Michigan Toll Authority would use the KPIs to determine staffing levels and training programs for the TMC and incident response programs that support the goal of continuous improvement. Because drivers expect a higher level of service on tolled roadways than on non-tolled roadways, the timely clearing of minor incidents and accidents increases confidence in predictable travel time on toll corridors.

3.4.1. Courtesy patrol

The TMC has the primary responsibility to dispatch courtesy patrol to provide motorist assistance in major urban areas with traffic camera coverage. Courtesy patrol service would be expanded along the tolled corridors. Courtesy patrol would be assigned coverage areas of approximately 15 centerline miles during peak travel times and up to 30 centerline miles during off-peak hours. It would help stranded motorists, provide protection at incident scenes, and assist during disasters, regional emergencies, and evacuations. By responding to non-emergency situations and clearing non-injury incidents quickly, the courtesy patrol team would reduce the burden of State Police and other law enforcement personnel. The current process of establishing rolling coverage for courtesy patrol would no longer be necessary because traffic camera spacing and cloud analytics would alert TMC operators to an incident's exact location. The TMC would then provide the location and nature of the incident to the closest courtesy patrol and provide "spotter" support while the incident is addressed.

3.4.2. Dynamic Message Signs

DMS' are large, electronic signs that overhang or appear along major highways in many Michigan metropolitan areas. The signs are typically used to display information about traffic conditions, travel times, construction, and road incidents. DMS' on toll systems can be used to provide toll information in addition to the typical uses. Where not present today, DMS' would be erected prior to major interchanges.

3.4.3. Coordination with emergency responders

The TMC would coordinate with emergency responders when necessary to respond to incidents involving multiple vehicles, incidents resulting in disabled vehicles, incidents involving a group of people, etc., that cannot or should not be handled as a routine courtesy patrol-type incident. The TMC dispatchers would also provide "spotter" communications with officers and first responders, either directly through cell phones, 911 dispatch, or an incident management-response representative to advise them of possible safety risks. The unique perspective provided by PTZ, and fixed traffic cameras would enable TMC dispatchers to monitor an incident's environment while first responders manage the incident itself.

3.4.4. Wrecker services

Toll facility-endorsed wrecker service vehicles staged along portions of toll corridors with a history of higher-than-normal incidents during peak travel times would significantly decrease incident clearance times. Contracts for staged wreckers in defined areas would include obligations for both parties that protect a wrecker company's right as a first responder in a given geographic area (subject to time limits before a second wrecker company is called) and protect the new Michigan Toll Authority's obligation to clear an incident quickly and safely.