Statewide Interstate Tolling Strategic Plan

APPENDIX A: CONCEPT OF OPERATIONS

Indiana Department of Transportation

November 2018

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1. INTRODUCTION

This document establishes a framework for how INDOT would operate and maintain a potential statewide toll program. Developing this concept of operations was an important part of the strategic planning process because it helps communicate how an INDOT 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 Indiana decides that tolling is the best means of funding major interstate improvements, INDOT will revise this document over time and provide more details as operational and maintenance standards are advanced and finalized. This document will ultimately identify program goals and specify various operational and functional requirements regarding infrastructure, equipment, and personnel that will influence the program's design, implementation, operations and maintenance 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.

2. ALL-ELECTRONIC TOLLING

The Strategic Plan describes a tolling program that uses open road tolling exclusively. This type of program is referred to as all-electronic tolling (AET). The INDOT toll system would be an 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. 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, manage customer accounts, and process customer payments.

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

- Radio frequency identification (RFID) transponders, and
- Digital camera images.

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

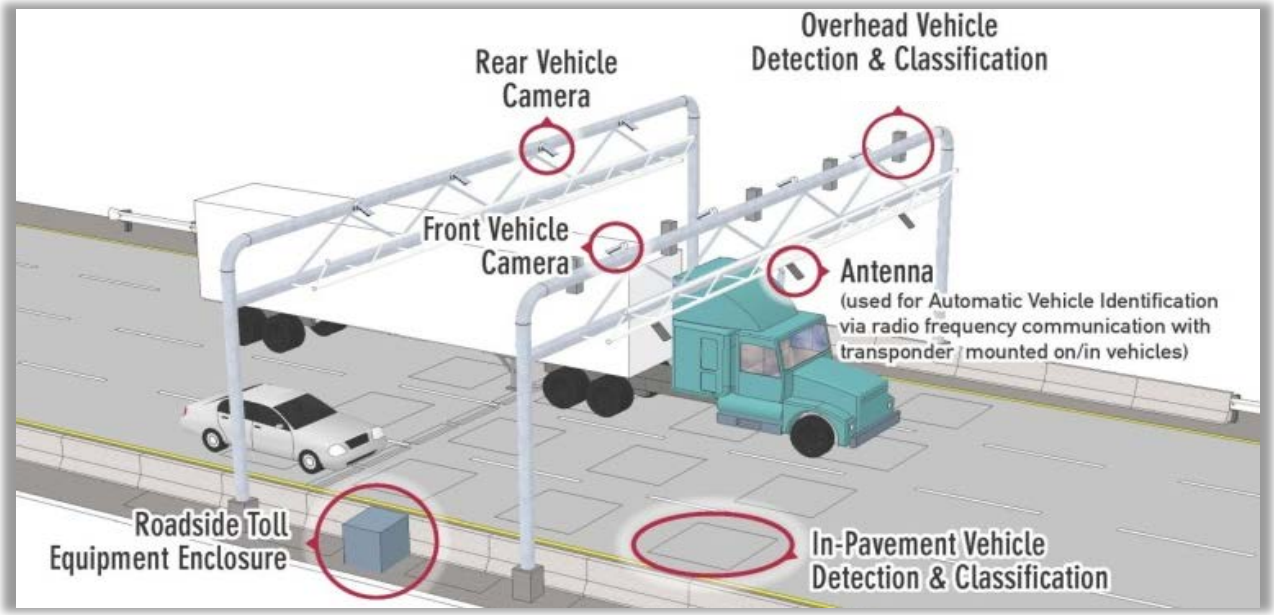
Figure 2-1: Example of an AET System Toll Zone

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 installed in enclosures along the roadside. Figure 2-2 depicts a typical dual-gantry toll zone. A more detailed gantry schematic is provided in the Supplemental Information.

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.

Toll Gantries

Toll gantries are the structures spanning the roadway on which the ETCS lane equipment is mounted. At each toll zone, dual monotube gantries would be installed. Monotube gantries provide the following benefits:

- Structure design simplicity with a modern and aesthetically appealing look;
- Toll system design and equipment mounting flexibility;

- Reduced wind load impacts resulting in improved toll system accuracy;
- Moderate cost; and
- Minimized maintenance of traffic issues during construction and installation.

Figure 2-3: Monotube Toll Gantries (Illinois Tollway)

Automated Vehicle Identification Readers

Automated Vehicle Identification (AVI) radio-frequency identification (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 essentially simultaneously. These readers, commonly referred to as multi-protocol readers, support tolling interoperability throughout the U.S. Based on the geographic location of INDOT's toll facilities, and that two toll facilities are already operating within the state, multiprotocol readers capable of communicating in the following protocols would be used:

- PS111 / TDM /IAG E-ZPass Group (more commonly referred to as E-ZPass)
- ISOC / ISO 18000–63/6C (more commonly referred to as 6C)
- ISOB_80K / SeGo – 6B (more commonly referred to as SeGo)

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

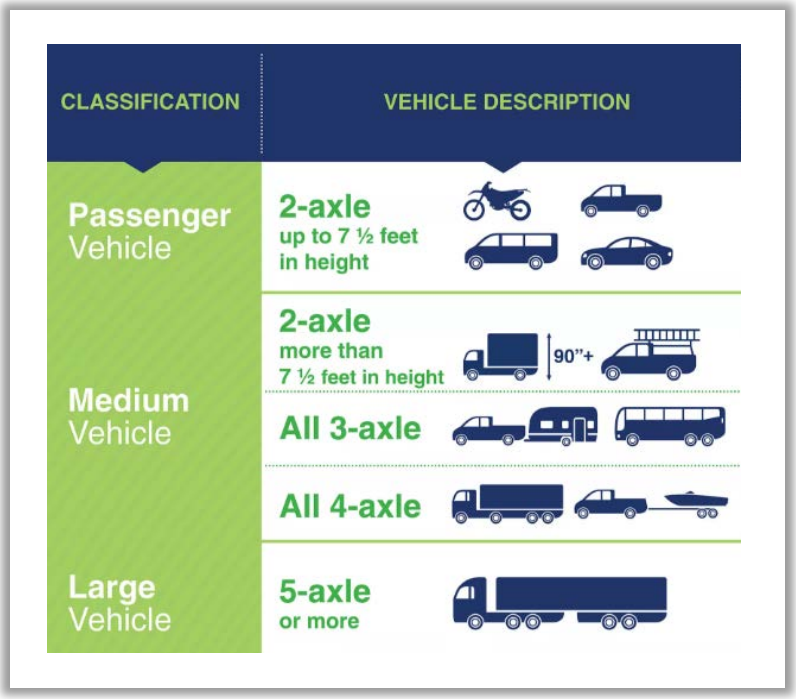
Automatic Vehicle Detection and Classification

INDOT's vehicle classification scheme would be based on axle count. The ETCS equipment at the toll zones would include devices that automatically detect and classify vehicles accordingly.

Although the classification schemes for most toll agencies throughout the U.S. are predominantly axle based (including for the Indiana Toll Road (ITR) located in northern Indiana), the vehicle classification scheme for the Ohio River Bridges (ORB) toll facilities is based on both axle count and height.

Figure 2-4 below shows the vehicle classification scheme for the ORB.

Figure 2-4: Vehicle Classification Scheme for ORB



Axle-based automatic vehicle detection and classification (AVDC) devices in a toll zone typically consist of in-pavement inductive loops complimented with overhead sensors. The loops primarily 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 life cycle equipment costs are lower than the costs for other classification schemes; and
- The equipment is not affected by weather.

Figure 2-5 below shows an example of a two-lane layout design for an in-pavement inductive loop array that is used for axle-based classification.

Figure 2-5: Example of Axle-Based AVDC Loop Layout Design

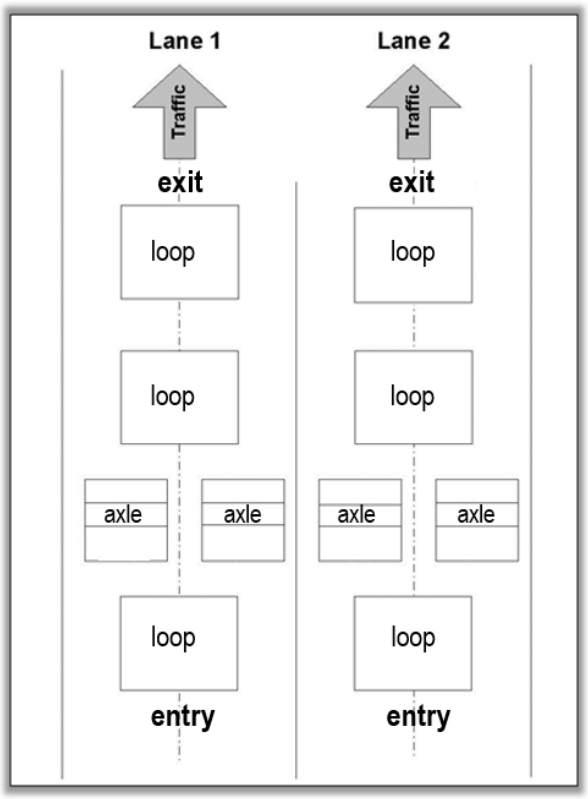
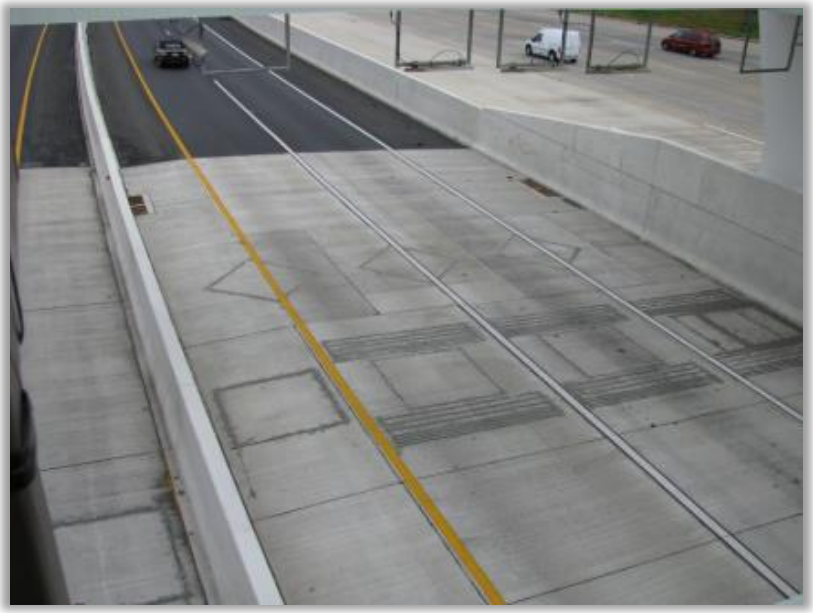


Figure 2-6 below shows an example of toll rate signage used on an axle-based classification toll facility.

Figure 2-6: Example of Axle-Based Signage

Figure 2-7 below shows an example of an in-pavement inductive loop array installation in a toll zone that uses axle-based classification.

Figure 2-7: Example of Axle-Based AVDC 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 the customer. The AVDC devices would be installed in every travel lane and

in shoulders that are wide enough to carry traffic. This approach would prohibit a vehicle from avoiding tolls by traveling in the shoulder.

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 quality readable images of vehicle license plates under a variety of typical lighting conditions as a means of vehicle identification for the purpose of toll payment.

The image capture devices would provide the ETCS with the ability to accurately capture images of vehicles and would meet industry standard performance requirements. The devices would be installed in every travel lane and in shoulders that are wide enough to carry traffic. This approach would prohibit a vehicle from avoiding tolls by traveling in the shoulder.

Figure 2-8 below shows an example of a set of images generated from ETCS cameras in a toll zone lane.

Figure 2-8: Example of Images Captured by Toll Zone ETCS Cameras

Digital Video Audit System (DVAS)

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 digital high-resolution cameras that capture quality video footage of vehicular activity which would be combined with real-time transactional data to support toll system auditing and customer issue resolution. The DVAS would allow local and remote users to view live and recorded video.

ETCS 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 zone 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 fails, the WAN would be fully redundant with automatic failover functionality. The fiber-optic backbone-based WAN would be designed and installed in coordination with INDOT's ITS communications network. INDOT plans to expand its existing ITS fiber-optic communications backbone to cover the entire lengths of I-65, I-70, and I-94.

The ETCS communications networks would enable authorized remote users to securely connect to the network using virtual private network (VPN) functionality and would be compliant with the payment card industry (PCI) data security standard (PCI-DSS).

Facility and Equipment Security

Only authorized and badged management, operations and maintenance personnel would be allowed unescorted access to any ETCS facility. In addition, access to specific areas within a facility by authorized personnel would be managed and controlled with badges based on work roles and responsibilities.

Roadside toll equipment enclosures/cabinets housing ETCS equipment would also be secured to only allow authorized maintenance personnel access.

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 2-9 illustrates the relationship between the BOS and the CSC operations:

Figure 2-9: Back-Office and Customer Service Center Operations

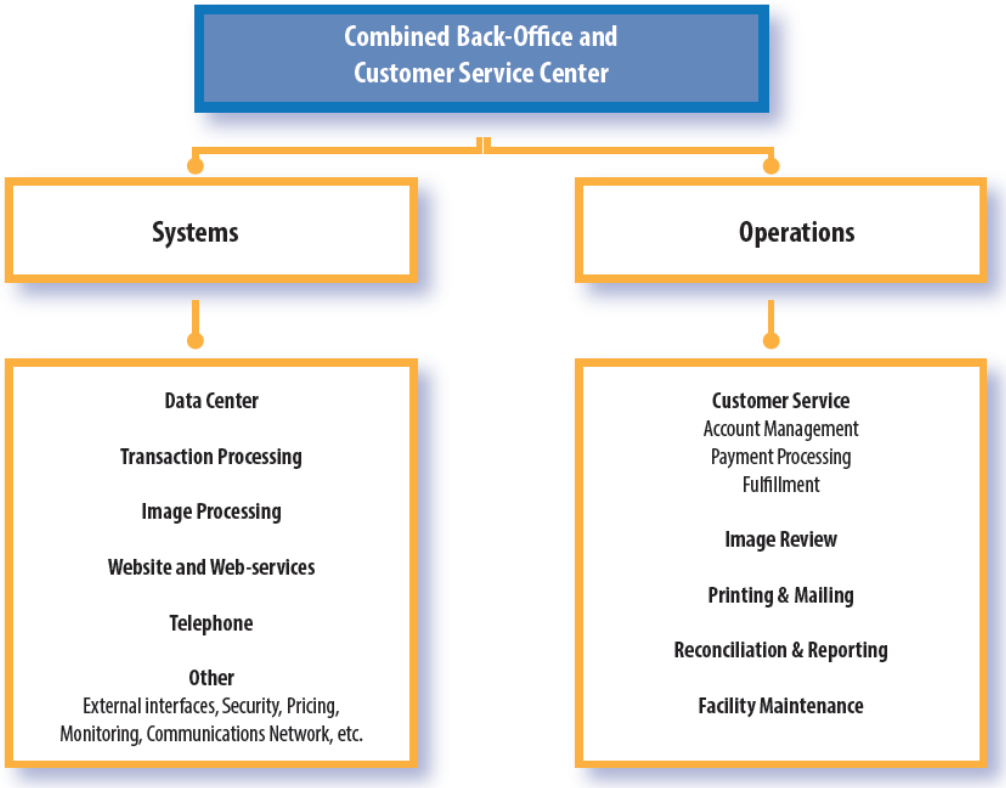
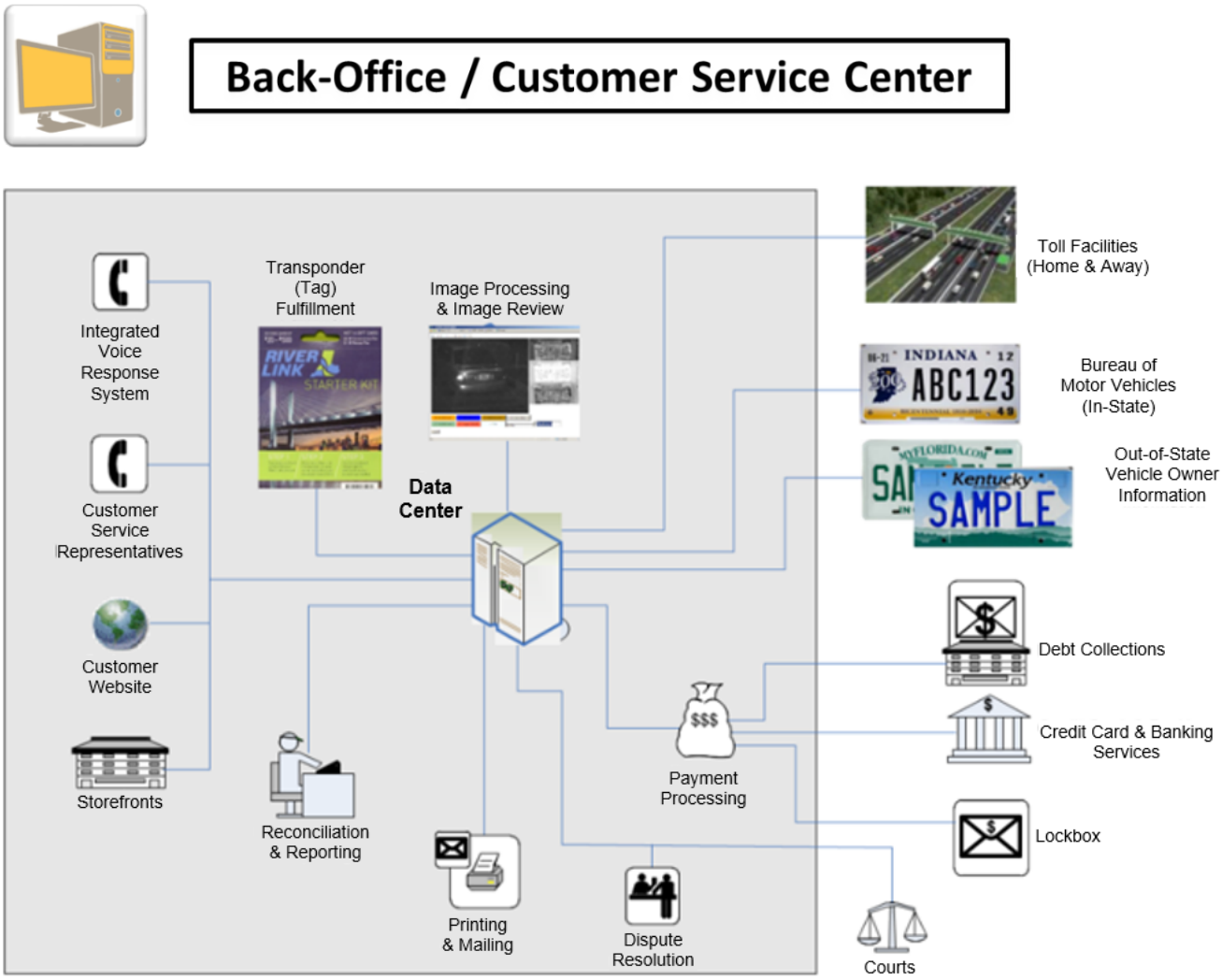


Figure 2-10 provides an overview of a back-office and customer service center and their typical functions:

Figure 2-10: Back-Office System Overview



Interoperability

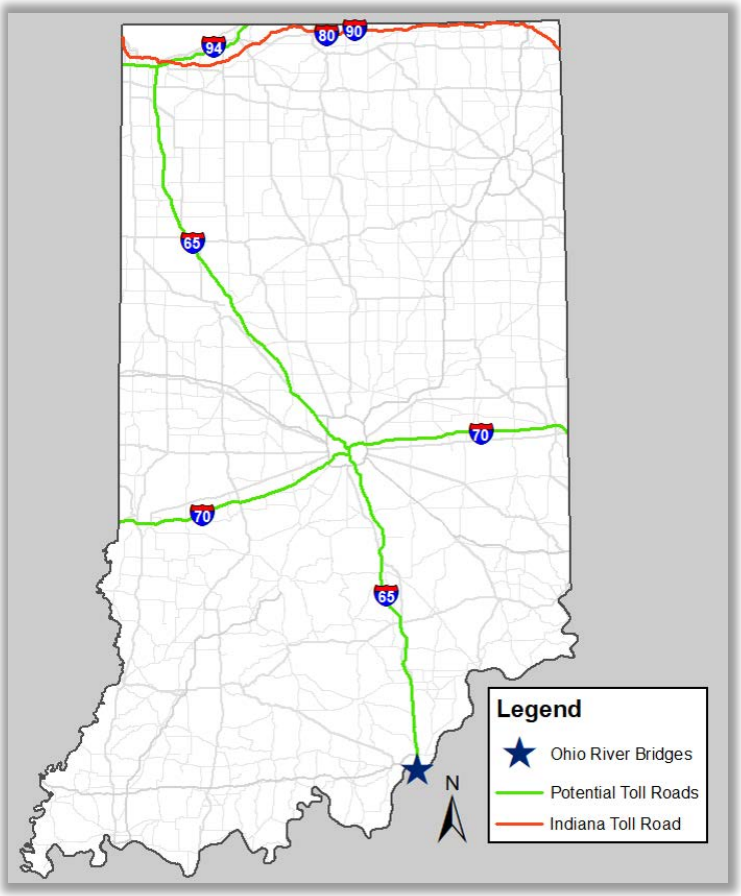
Tolling interoperability consists of the technology, processes and agreements that enable a customer with a valid transponder and registered toll account at one toll agency (referred to as the Home Agency) to travel on another agency's toll facility (referred to as the Away or Visited Agency's toll facility) 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 2-11 below shows Indiana's existing two tolled facilities:

- The Indiana Toll Road (ITR) is a 157-mile toll road (designated as I-80 / I-90) that runs east-west in northern Indiana between the Illinois and Ohio borders. It is operated by Indiana Toll Road Concession Company (ITRCC).
- The Ohio River Bridges (ORB) include the SR 265 Lewis and Clark Bridge, the I-65 Abraham Lincoln Bridge, and the I-65 Kennedy Bridge in the Louisville area. INDOT and KYTC personnel share management of the tolling operations and report to a bi-state executive board.

The map also shows the corridors that INDOT is addressing in its Interstate Tolling Strategic Plan.

Figure 2-11: Existing and Potential Indiana Toll Facilities



The map in Figure 2-12 below illustrates how toll interoperability in the U.S. has evolved to be predominantly regional.

Figure 2-12: U.S. Toll Regions

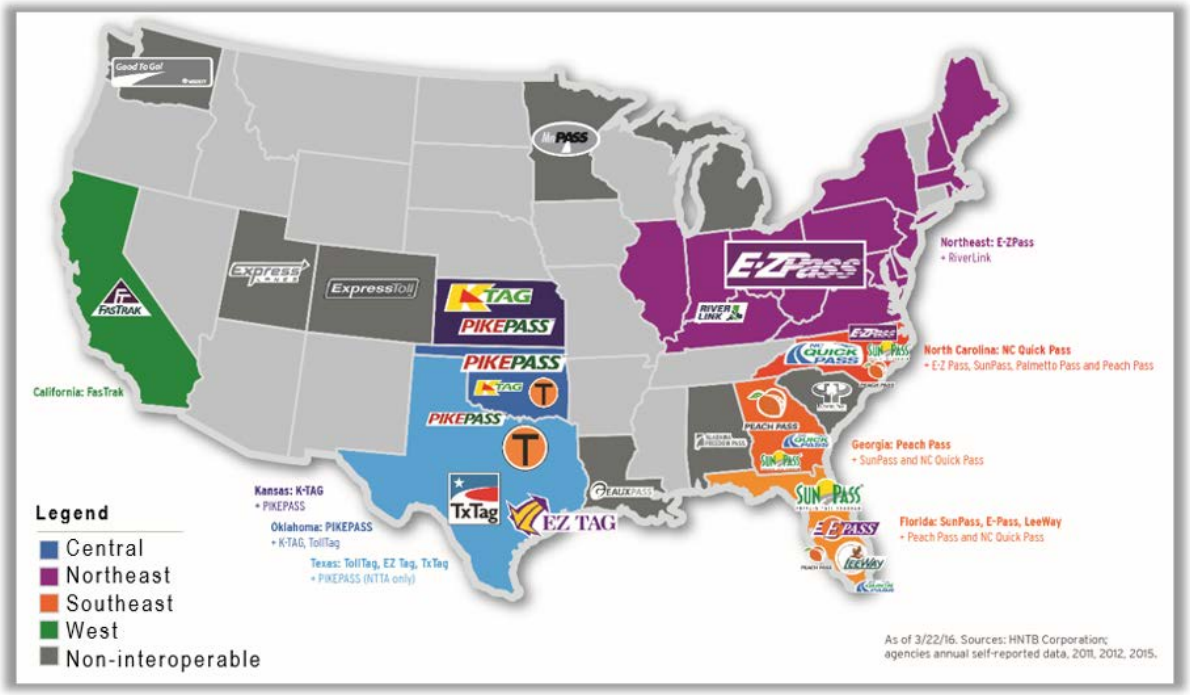


Figure 2-13: Regional and Local RiverLink Transponders issued by ORB

With Indiana being located in the E-ZPass toll region of the northeast U.S., both ITR and ORB elected to become members of the E-ZPass Group. ITR accepts and issues E-ZPass transponders, which are marketed as Indiana E-ZPass. ORB accepts and issues E-ZPass transponders, which are marketed as Regional RiverLink E-ZPass. ORB also offers less expensive transponders for local customers, which are marketed as RiverLink Local. E-ZPass is a time division multiplexing (TDM) protocol transponder, and RiverLink Local is a 6C protocol transponder.

In 2012, federal transportation legislation required national interoperability of electronic toll collection by October 2016. While interoperability is in progress in many regions, it is not yet complete nationwide (industry is currently targeting by end of 2019).

INDOT 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 currently regional interoperability service providers will mature into national interoperability by the time INDOT implements any tolling.

Joining an interoperability service provider would have the following benefits:

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

Other External Interfaces

In-State Vehicle Owner Information

The BOS would interface with Indiana's Bureau of Motor Vehicles (BMV) in order to obtain owner information for vehicles with registered Indiana 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 owner information for out-of-state vehicles based on vehicle license plates that include the following:

- State BMV (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 owner 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 unpaid toll and fees/fines that have escalated into a courts stage. Pursuing collection through the Indiana court system would only be done for vehicles registered in Indiana. Pursing collection for out-of-state vehicles would be handled through potential reciprocal enforcement agreements with other states.

PCI Compliance

All credit/debit card processing activities and related technologies would comply with the Payment Card Industry (PCI) 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 to insure required data protection practices and controls are followed.

Facility Security

Only authorized and badged management, operations and maintenance personnel would be allowed unescorted access to any BOS facility. In addition, access to specific areas within a facility by authorized personnel will be managed and controlled with badges 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.

BOS 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 local area network (LAN) that locally connects the CSC operations to the BOS and Facility Host along with a secure fiber-optic backbone-based wide area network (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 stand-alone 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 securely connect to the network using virtual private network (VPN) functionality.

2.3 Customer Service Center

Call Center

The call center is a sub-section of the toll program's customer service center (CSC) that would directly interface with toll customers via telephone calls and handle activities such as opening new transponder accounts, assisting with existing account management and maintenance, ordering new and 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 call center technology and functionality that decreases call wait and handle times which benefits both INDOT and its customers. These tools would include:

- Multi-channel Automatic Call Distribution (ACD);
- Interactive Voice Response (IVR) (see also below);
- Predictive Dialing;
- Call Recording; and
- Call Monitoring.

The call center CSRs would provide person-to-person customer service support from 7:00am to 7:00pm (Eastern Time), Monday through Friday.

The call center 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 call center's business hours and allow the customer to perform various self-service functions.

Note that the toll program's CSC would be separate from INDOT's existing Customer Service Center (855-INDOT4U).

Walk-up Locations

Walk-up locations are another sub-section of the CSC. In busy metro and rural communities that are underserved, INDOT would rent/lease storefront space to establish customer service walk-up locations close to toll project corridors. These walk-up locations would be staffed by local skilled customer service representatives capable of assisting new and existing customers with their account needs working in a dynamic face-to-face customer environment.

Walk-up location CSRs would provide person-to-person customer service support from 7:00am to 7:00pm (Eastern Time), Monday through Friday.

Third-Party Retailers

INDOT 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.

Currently, ITR transponders (marketed as Indiana E-ZPass) can be purchased at participating northern Indiana CVS stores. Also, ORB starter kits with local RiverLink transponders can be purchased and reloaded at participating Speedway and Thorntons stores near Louisville and southeastern Indiana.

INDOT use of local third-party retailers would have the following benefits:

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

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.

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 a walk-up location, and would be in several forms, including cash or check. The BOS would auto-process account replenishment payments, website payments, and IVR payments. INDOT's CSC would train all customer service resources how to securely accept and handle cash and check remittances, how to properly apply payments to the correct accounts and/or invoices, and how to process a payment if the remittance is lacking 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.)

Self-Service Channels

Based on standard industry practices, the BOS and CSC operations would include self-service channels designed to reduce the number of customer service center representative calls/contacts by assisting customers through 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 routinely analyzed to insure the customer experience is effective and efficient. The self-service channels would include:

Interactive Voice Response

A front-end interactive coice response (IVR) call management system would answer all inbound calls to the Customer Service Center 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 customer service representative 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, taking 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 continuously closely coordinated with INDOT's public relations efforts.

Mobile App

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

Printing and Mailing

Printing and mailing are Customer Service Center support functions. Due to the anticipated high volume of ongoing printings and mailings, INDOT 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, INDOT would utilize the CSC operations to receive and process returned mail and to mail fulfilled transponder orders.

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 accurately identify the license plate information (i.e., plate state, type and characters) in order to associate the vehicle with vehicle owner information and to identify any image capture performance issue in any toll zones (e.g., incorrect camera triggering, incorrect camera field-of-view, images too dark, etc.).

The BOS would include an optical character recognition (OCR) engine incorporated into a "double-blind" 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 along with maximizing revenue collection.

Disaster Recovery and Business Continuity

INDOT would include provisions 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 INDOT's 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.

PCI Compliance

All credit/debit card processing activities and related technologies would comply with the Payment Card Industry (PCI) 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 to insure required data protection practices and controls are followed.

Facility Security

Only authorized and badged management, operations and maintenance 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 with badges 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.

Transponders

INDOT 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 a motorcycle sticker form factor as well.

This approach is based on the assumption that U.S. toll agencies, including any in the nearby Chicago area, have either replaced or upgraded their toll systems and operations to accept 6C protocol transponders for national interoperability purposes by the time INDOT implements any tolling.

Currently, ORB's toll system is able to communicate with 6C transponders. As such, however, the ORB toll system is considered merely compatible with, not interoperable with, 6C transponders from any Away Agency.

INDOT issuance of 6C protocol transponders would have the following benefits:

- Lowest cost for inventory;
- Easier communications to customers, minimizing customer confusion; and
- Removal of potential entry barrier to account establishment.

Anonymous Transponder Accounts

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

Currently, ITR does not allow anonymous transponder accounts but ORB does. Although ITR sells transponders at third-party retailer stores, ITR currently requires the customer to contact the ITR CSC to register the store bought transponder in order to make it active. ORB also sells transponders at third-party retailer stores but does not require registration prior to activation.

An INDOT transponder sold through any third-party retailer store could be easily registered and activated by the customer contacting the call center, visiting a walk-up location, using a mobile app, or using a website.

A policy by INDOT to not allow anonymous transponder accounts would have the following benefits:

- Fewer customer issues if transponder not read in lane;
- CSC ability to contact customer to resolve any account issues; and
- Decreased costs to collect tolls.

Invoicing

INDOT would generate and issue invoices for accounts with outstanding unpaid toll and/or fee on a monthly basis similar to the monthly billing methodology utilized by typical utility and cell phone companies. An account's monthly invoice cycle date would be based on the date of the account's first transaction. Invoices would be cumulative wherein any subsequent invoice would indicate any past due amount along with details on new amounts due and 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.

INDOT use of a monthly and cumulative invoicing methodology would have the following benefits:

- Easier customer communication and less customer confusion;
- Customer ability to and plan for paying invoices;
- Minimal spikes in call and walk-up volumes; and
- Decreased costs to collect tolls.

2.4 Procurement Strategy

INDOT would utilize a two-pronged approach to procuring the tolling systems described herein.

INDOT would procure a statewide ETCS provider whose scope of work would include designing, installing, integrating and maintaining all of the needed roadside and lane devices and providing the necessary related resources. Depending on INDOT'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 process would be used to procure a BOS and CSC provider (most likely, a team of providers) whose scope would include designing, implementing, operating and maintaining all of the needed BOS and CSC elements.

An All-Electronic Tolling (AET) system 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.

3. INTELLIGENT TRANSPORTATION SYSTEMS

INDOT has employed intelligent transportation systems (ITS) for many years to provide a safer and more reliable travel experience for Indiana drivers. ITS consist of multiple independent electronic components transmitting real-time data to a traffic management center (TMC). ITS in the tolled environment employs essentially the same components in higher density 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. The following sub-sections describe the major components of the ITS.

3.1 Traffic Management Center

INDOT monitors and manages incidents on major roadways at TMCs in Indianapolis and Gary. 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 INDOT 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.

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

Figure 3-2: Example Traffic Management Center (TxDOT in Mesquite, TX)

3.2 ITS Communications Network

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

The existing ITS communications network backbone is typically fiber-optic cable 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 (DMSs), and travel-time sensors. The TMC requires communications with traffic cameras, DMSs, 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, INDOT would expand the fiber-optic cable backbone along the entire length of the tolled corridors.

3.3 Incident Detection

A “traffic incident” is typically defined as a roadway occurrence that has a predictively negative impact 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, INDOT would install an array of fixed and pan-tilt-zoom (PTZ) traffic cameras in urban areas in sufficient quantity to monitor major interchanges and areas having higher than average occurrence of traffic incidents. As the project progresses, traffic cameras would be added in rural areas that have less exposure to incident related traffic diversion. The cameras would be

monitored by cloud-based analytic software and produce an alarm in as little 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 quickly access the corresponding PTZ camera, closely examine the incident before determining the correct response, and prepare first responders with details of the incident prior to their arrival on scene.

Traffic Sensors

INDOT would install traffic sensors at strategic urban locations for the purpose of measuring traffic. Messages would be displayed on Dynamic Messages Signs notifying motorists of predictable travel times to major intersections. As the project progresses, relationships with third-party traffic and navigation service providers, such as Waze and BlueTOAD, would increase the accuracy of predictive travel times and provide additional benefits such as notifying Indiana drivers in advance of roadway construction or major incidents.

Traffic Cameras

INDOT'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 the other direction, each having a defined non-overlapping area of coverage. Each fixed camera would monitor a quarter of a mile of defined roadway for incidents. 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. As mentioned above, the fixed cameras would also be monitored by a cloud based analytics provider.

Figure 3-4: Traffic Camera Array (NTTA)

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 that incident. In order to effectively manage incidents, INDOT 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. INDOT would use the KPIs to determine staffing levels and training programs for the TMC and Hoosier Helpers program that support the goal of continuous improvement. Because drivers expect a higher level of service on tolled roadways than on non-tolled roadways, timely clearing of minor incidents and accidents increases confidence in predictable travel time on toll project corridors.

Courtesy Patrol (Hoosier Helpers)

Figure 3-5: INDOT Hoosier Helpers Vehicle

The TMC has the primary responsibility to dispatch Hoosier Helpers to provide motorist assistance in major urban areas having traffic camera coverage. Hoosier Helper service would be expanded along the tolled corridors. Hoosier Helpers would be assigned coverage areas of approximately 15 center line miles during peak travel times, and up to 30 center line miles during off-peak hours. They would assist 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 Hoosier Helpers team would reduce the burden of Indiana State Police and other law enforcement personnel. The current process of establishing rolling coverage for Hoosier Helpers would no longer be necessary because traffic camera spacing and cloud analytics would alert TMC operators of an incident’s exact location. The TMC would then provide the location and nature of the incident to the closest Hoosier Helper and provide “spotter” support while the incident is addressed. Depending on traffic and weather conditions, this proactive approach to incident detection and response could be faster and more accurate than motorists calling “511” or “911”.

Dynamic Message Signs

Dynamic message signs (DMS) are large, electronic signs that overhang or appear along major highways in many Indiana metropolitan areas. The signs are typically used to display information about traffic conditions, travel times, construction, and road incidents. Travel time information is the default message that appears on a DMS daily from 5:00 A.M. to 9:00 P.M. The signs are also used overnight if needed for construction, road incidents, weather information, Amber/Silver Alerts or any other type message deemed relevant and appropriate to motorists in a specific geographic area. Where not present today, DMSs would be erected prior to major interchanges and venues such as sport complexes that have frequent well attended events.

Coordination with Emergency Responders

The TMC would coordinate with emergency responders when necessary to respond to incident(s) involving multiple vehicles, incidents resulting in disabled vehicles, or incidents involving a group or groups of people, etc. that cannot or should not be handled as a routine Hoosier Helper type incident. The TMC dispatchers would also provide “spotter” communications with officers and first responders directly through cell phones, through 911 dispatch, or through an incident management responding Hoosier Helper 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.

Wrecker Services

Wrecker service vehicles staged along portions of the toll corridors that have a history of higher than normal incidents during peak travel times would significantly decrease incident clearance times. Toll facility contracts for staged wreckers in defined areas would include obligations for both parties that 1) 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 2) protect INDOT’s obligation to clear an incident quickly and safely.

ITS in the tolled environment employs essentially the same components in higher density to detect, respond, and manage weather and traffic related events as quickly and safely as possible.

4. ROADWAY

As a rule, roadway maintenance standards are different for tolled roadways than non-tolled roadways. Maintenance standards for both have the same goal of providing a safe and efficient travel experience. However, expectations for toll road patrons are much higher, and acceptable tolerances are much lower. Toll roads are dependent on ridership to exist, and toll agencies compete against non-tolled alternative routes for ridership. Higher standards of ride quality, aesthetics, and incident response are fundamental to attracting ridership necessary to maintain consistent and predictable toll revenue.

4.1 Routine Roadway Maintenance

INDOT Work Performance Standards have clearly defined processes to safely perform routine and emergency roadway maintenance. INDOT would not change *how* routine maintenance is performed. However, it would update the frequency of *when* several routine activities are performed, and *reduce* repair response times for roadway elements to be no less than Indiana Toll Road (ITR) Service Level Agreement (SLA) response time.

Since the ITR toll facility has similar roadway attributes to the toll project corridors and the ITR contracted level of service (LoS) and SLA standards of performance exceed standards for traditional highway facilities, the ITR's minimum standards of performance would be used as a baseline for the INDOT toll project corridors. Examples of ITR contract defined SLA response times are provided in the Appendix.

4.2 Routine Maintenance Operations

INDOT would maintain the tolled corridors at a LoS greater to or equal to the LoS prescribed for the ITR. With a few exceptions in areas that may have a higher LoS, INDOT would maintain the corridors in accordance with the maintenance objectives, guidelines, and criteria provided in the ITR lease agreement. In summary, this lease agreement requires that ITR be maintained in the best possible conditions at all times. As with ITR, INDOT would develop annual inspection reports for the tolled corridors that document conditions against baseline performance criteria.

Figure 4-1: Indiana Toll Road (ITR)

Ride Quality

INDOT would maintain the ride quality of toll project corridors at no less than ITR Ride Quality Standards. Adopting a consistent quality standard for tolled roadway maintenance would provide Indiana motorists with a consistently high ride quality experience regardless of their chosen Indiana tolled facility.

Mowing

INDOT's routine mowing frequency would increase from INDOT's current annual mow cycle standards of two and a half times per season for urban areas and one and a half times per season for rural areas to no less than ITR's standard of four times per season for mainline areas and as needed for interchange areas.

Litter Pickup

INDOT's routine litter pickup standards would increase from litter pickup prior to the first mow cycle to no less than ITR's standard of weekly roadside litter collection.

Snow and Ice Control

INDOT's Snow and Ice Control Policy classifies interstates as Class I roadways (ADT 10,000+ vehicles). It is expected that these corridors will remain open and passable during winter storm events. Service objectives for Class I routes call for service to

mainline pavements, ramps, and turn lanes approximately every two hours. INDOT would continue to follow this standard on the tolled corridors.

4.3 Maintenance of Traffic During Routine Maintenance Activities

INDOT would continue to use its existing Work Zone Traffic Control Handbook for the tolled corridors. Routine maintenance and preventative maintenance projects requiring lane closures would be scheduled to be started and completed during non-peak times such as nighttime and weekends, or in off-peak directions to minimize traffic congestion and diversion.

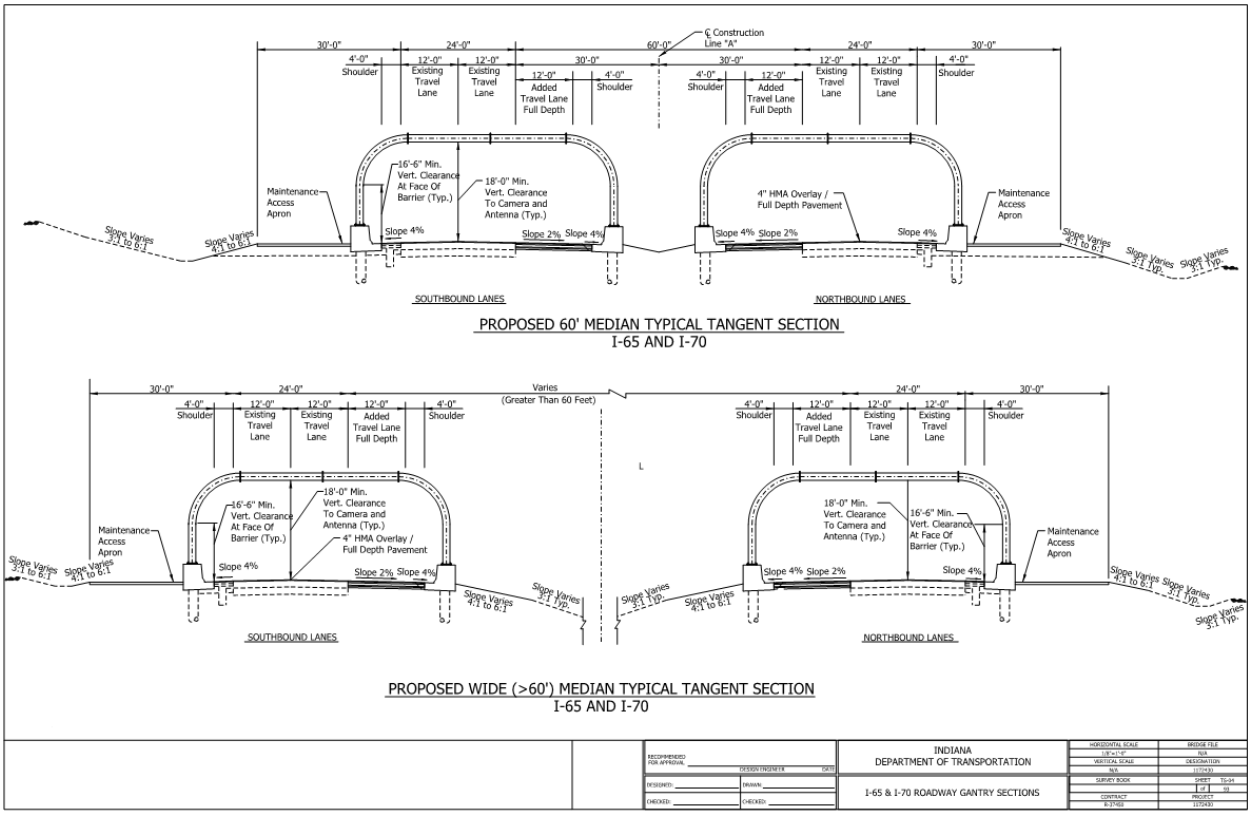
INDOT would not change how routine maintenance is performed. However, it would update the frequency of when several activities are performed.

5. SUPPLEMENTAL INFORMATION

5.1 Initial Design Concept for a Gantry

Following is an initial design concept for a toll gantry developed as part of the strategic planning process.

Figure 5-1. Mono Tube Gantry Typical Section



5.2 Examples of ITR Performance Standards

Following are relevant examples of various ITR performance standards:

Policy for Performing Pavement and Shoulder Maintenance Work	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the maintenance, repair or replacement to the Roadway features within the maximum time duration set forth in the table below:	
Roadway Pavement Work to be Performed	**Maximum Time Duration**
Bituminous Surface Repairs	14 Days
Pothole Repairs: - Temporary - Permanent	 24 Hours 1 Month
Joint & Crack Repairs	3 Months
Spalled Pavement Repairs	6 Months
Settled and Heaved Pavement Repairs	48 Hours
Base and Subbase Repairs	1 Month
Grinding and Profiling Repairs	3 Months
Access Roads	6 Months
The ITR Concessionaire shall complete the maintenance, set forth in the table below according to the minimum frequency of occurrence provided therein:	
Maintenance to be Performed	**Minimum Frequency of Occurrence**
Sweeping & Cleaning; - Mainline (Not required on regular basis) - Ramps - Shoulders - Curbs, Median and Roadside Barriers - Toll Plaza Lane	 (Clean-up of spills only) 6 Months 12 Months 6 Months (or as needed) 1 Month (or as needed)

Policy for Performing Pavement Delineation Maintenance	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the maintenance, repair, replacement, and or relocation work to the Pavement Delineation, within the maximum time duration set forth below:	
Maintenance to be Performed	**Minimum Time Duration**
Reflective Pavement Markers	30 Days
Roadside Delineators	45 Days
Prismatic Reflectors: - Attached to barriers, guardrails, etc. - Attached to Piers and Fenders In Various Waterways	 30 Days 30 Days
Pavement Markings: - Letters or symbols - Striping	 45 Days 30 Days

Policy for Performing Drainage Maintenance and Slope Repair Work	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the cleaning, adjustment, repair or replacement of the deficient element or component to full operation within the maximum time duration set for below:	
Item	**Maximum Time Duration**
Roadway Drainage System: - Frames & Grates - Structures - Pipes & Conduits	 48 Hours 30 Days 30 Days
Bridge Drainage System	48 Hours
Earth Slopes	30 Days
Curb & Gutter	60 Days
Ditches	60 Days
Under-Drain System: - Roadway	 30 Days
Erosion Control System: - Temporary - Permanent	 24 Hours 60 Days

Policy for Performing Landscape Roadside Maintenance	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the maintenance, repair or replacement to the landscape and roadside features within the maximum time duration set forth below:	
Landscape or Roadside Feature	**Maximum Time Duration**
Landscape: - Sight Distance Obstruction - Vegetative Waste - Trees - Plants, Shrubs, Flowers, Turf	 2 Hours 2 Days 7 Days 14 Days
Roadside Litter: - Illegal Dumping	 2 Hours
Fencing: - Temporary Repairs - Permanent Repairs	 2 Days 30 Days
Irrigation System	7 Days

Policy for Performing Landscape Roadside Maintenance	
The ITR Concessionaire shall complete the maintenance set forth in the table below according to the minimum frequency of occurrence provided therein:	
Maintenance to be Performed	**Minimum Frequency of Occurrence**
Roadway and Facilities Mowing: - Mainline - Interchanges - Facility Lawns	 4 Times Yearly (Growing Season) As needed Weekly (Or as Needed)
Landscape: - Removal of Nuisance Vegetation	 Every 30 Days (Growing Season)
Litter Control: - Roadside Litter Collection - Emptying of Litter Receptacles	 Every 7 Days Every 2 Days, or once they become full: whichever occurs first

Policy for Bridge & Structure Maintenance	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the maintenance, repair or replacement work to Bridges and structures, and their components within the maximum time duration set forth in table below:	
Bridge or Structure Feature	**Maximum Time Duration**
Bridge Decks & Wearing Surfaces: - Traveled lanes - Remainder of Deck Area	 2 Hours 5 Days
Bridge Railing and Parapets: - Temporary - Permanent	 2 Hours 2 Months
Bridge Joints	5 Days
Bridge Superstructure and Substructure Elements: - Structural Damage - Non-Structural Deterioration	 1 Hour 3 Months
Bridge Bearings	48 Hours
Bridge Painting: - Directly Exposed to Weather - Protected from Direct Weather	 3 Weeks 3 Months
Bridge Waterway Protection	5 Days
Retaining Structures: - Instability or Structural Damage - Non-Structural Damage	 24 Hours 3 Months
Tunnels	24 Hours
Structure Accessories	7 Days
The ITR Concessions shall complete the maintenance set forth in the table below according to the minimum frequency of occurrence provided therein:	
Activity to be Performed	**Minimum Frequency of Occurrence**
Bridge and Structure Cleaning: - Bridges - Overhead and Bridge Mounted Sign Structures - Retaining Walls & Other Structures	 Once Yearly, when no further Winter chemicals will be applied, but no later than May 31st.
Inspections Reports: - All Bridge Structures - Filing of INDOT Inventory/Appraisal Forms - Fracture Critical Structures & Members - Underwater Inspection	 Once Every 2 Years Once Every 2 Years Once Yearly Once Every 5 Years

Policy for Performing Third Party Damage and Emergency Maintenance Work	
The ITR Concessionaire, from the time an incident or incident-related deficiency is or reasonably should be detected or reported, shall respond and complete the repair or replacement to restore the damaged ITR component to its original condition or to a better condition within the maximum time duration set forth below:	
Event	**Maximum Time Duration**
Vehicle Incidents	15 minutes (Response) (Repair/Replacement work per requirements of the applicable Chapter)
Material Spills: - Non-Hazardous - Hazardous	 15 minutes (Response) Immediate (Response)
Vandalism Incidents: - Graffiti Removal - All Other	 24 Hours 24 Hours
Atmospheric Damage	30 minutes (Response) (Repair/Replacement work shall be made per requirement of the applicable Chapter)
Animal Incidents: - Damage - Removal of carcasses	 24 Hours 8 Hours

Policy for Performing Roadside Safety Systems Maintenance Work	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the repair or replacement work to the roadway safety feature and systems and their components within the maximum time duration set forth below:	
Roadway Safety Feature or System	**Maximum Time Duration**
Guardrail System: - Damage to Structural Integrity - Non-Structural Damage	 24 Hours 30 Days
Barrier Wall: - Damage to Structural Integrity or Stability - Non-Structural Damage	 24 Hours 45 days
Impact Attenuators	8 Hours
Toll Plaza Crash Protector Devices: - Damage to Structural Integrity - Non-Structural Damage	 12 Hours 30 days

Policy for Performing Sign Systems Maintenance	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported/ shall complete the cleaning, resetting, and replacement of missing, repair, or relocation work to the Signs and Sign System and its components within the maximum time duration set forth below:	
Sign & Sign System Classification/Type	**Maximum Time Duration**
Regulatory	24 Hours
Warning	24 Hours
Guide	2 Days
Work Zone: - Construction - Maintenance	 2 Hours 30 Minutes
Dynamic Message Signs	2 Hours
All Other Signs	3 Days

Policy for Maintenance of Lighting and Electrical Systems	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported/ shall have completed the maintenance, replacement or repair work to restore the functionality or operation of a deficient Lighting and Electrical Systems or component within the maximum time duration set forth in the table below:	
Lighting and Electrical System	**Maximum Time Duration**
Roadway & Interchange Lighting & Sign Illumination: - Lighting Controller - Light Pole Units, Mast Arms, and Foundations - Luminaries - Sign Illumination	 4 Hours 10 Days 7 Days 12 Hours
Aircraft Warning Beacons; - Service Response - Service Restoration - Permanent Repair	 1 Hour 4 Hours 7 Days
Navigational Warning Lights: - Service Response - Service Restoration - Permanent Repair	 1 Hour 4 Hours 7 Days
Cables, Conduits and Unit Ducts: - Temporary Cabling - Re-cabling and Conduit or Duct Repair - Direct Bury Cable Repair	 4 Hours 21 days 21 Days
Closed Circuit Television (CCTV) Systems: - Control Cabinet damage repair/replacement - Control Cabinet power supply interruption - Camera non-operational	 24 Hours 4 Hours 24 hours

Policy for Maintenance of Lighting and Electrical Systems Reports	
The ITR Concessionaire shall complete the maintenance set forth in the table below according to the minimum frequency of occurrence provided therein:	
Report	**Minimum Frequency of Occurrence**
Inventory of Lighting and Electrical Systems	Once per year
Roadway & Interchange Lighting and Sign Illumination Nighttime Patrol	3 Months
Aircraft Warning Beacon Nighttime Inspection	3 Months
Navigational Warning Lights Nighttime Inspection	3 Months
Re-lamping Group: - Mercury - High Pressure Sodium - Low Pressure Sodium - Fluorescent	 Once every 4 years Once every 4 years Once every 3 years Once every 2 years
CCTV Camera Replacement	Once every 8 years

Policy for Performing Toll Plaza Maintenance	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported, shall complete the maintenance, repair or replacement work to Toll Booth and Plaza systems, elements, components or appurtenances within the maximum time duration set forth in the table below:	
Toll Booth and/or Plaza Component, Element or System	**Maximum Time Duration**
Toll Booth and Plaza Signage	4 Hours
Toll Booth Gates	24 Hours
Toll Booth and Plaza Lighting	4 Hours
Toll Plaza Collection Equipment	2 Hours
Toll Plaza Canopies	10 days
Toll Booth Units	5 Days
TCS and UPS	Immediate
The ITR Concessionaire shall complete the maintenance, set forth in the table below, according to the minimum frequency of occurrence provided therein:	
Maintenance to be Performed	**Minimum Frequency of Occurrence**
Toll Booth Cleaning - Cleaning Boot signs and Windows - Emptying of Litter Receptacles	 3 Times per Week Once Daily

Policy for Performing Facility Maintenance Work	
The ITR Concessionaire, from the time a deficiency is or reasonably should be detected or reported/ shall complete the maintenance, repair or replacement work to the Facility and/or its systems, equipment, elements, components or appurtenances within the maximum time duration set forth below:	
Facility Component, Element or System	**Maximum Time Duration**
Building Exterior: - Exterior Doors - Exterior Walls - Flag Pole - Foundations - Garage Doors - Gutters - Roofing - Signs - Windows	 1 Day 4 Weeks 7 Days 7 Days 2 Days 4 Weeks 7 Days 4 Weeks 7 Days
Building Interiors: - Ceilings - Interior Doors - Interior Floors - Interior Windows - Walls and Partitions	 4 Weeks 2 Weeks 3 Weeks 1 Week 4 Weeks
Mechanical Systems: - HVAC - Plumbing	 8 Hours 12 Hours
Electrical Systems	8 Hours
Life Safety: - Communication Systems - Fire Suppression and Precaution - Medical Prevention and Attention - Security Systems	 1 Hour 4 Hours 8 Hours 1 Hour
Emergency Power Supply System	Immediate

NOTES

- The analysis contained within this document addresses potential tolling along I-65, I-70, I-94. However, no final decisions have been made about if and where to toll. Additionally, tolling may be considered along other interstates (e.g., I-64, I-74, etc.).