North American Toll Interoperability

Goal for North American Toll Interoperability: The ultimate vision for North American interoperability is for customers to be able to pay for travel and related services on toll facilities across the continent with a single account and a choice of payment methods. The toll industry should be able to meet customer expectations that would allow a Sunpass account holder in Florida to drive to Atlanta, Georgia, use the Georgia 400 toll facility and return home to find the toll transactions for the Georgia trips listed on their Sunpass monthly transaction report. This operation should be no different to a customer as their use of a credit card in another state to buy a meal or the use of their cell phone to make a local or long-distance telephone call while away from their home city. And, if they wish to do so, the customer should be able to pay for these items out of one account.

Full interoperability will be achieved through an evolutionary process that will focus first on *registered toll customers* driving on *participating toll facilities* within a system that is *inter-regional* in nature.

Registered Toll Customers on Participating Toll Facilities

In simple terms – the immediate goal for North American Interoperability is to achieve interoperability for *valid pre-paid toll customers* – in essence, registered toll customers. The plan does not include un-registered toll customers.

This is an important distinction. The basic premise is that interoperability can be achieved rather quickly for existing valid pre-paid toll customers through a combination of electronic and image-based technologies and the development of the necessary agreements and infrastructure to exchange and settle the associated toll transactions between participating agencies and organizations. These exchanges may be undertaken through peer-to-peer networks, centralized hub-style networks or combinations of both. But, the key element is that initial interoperability is for registered toll customers on participating toll facilities. Non-registered customers must abide by the business rules of the toll facility on which they are driving.

For toll customers, this is about *choice*. The message to be communicated is that a registered toll customer of a participating toll agency can choose to drive on a toll facility of another participating agency using their valid pre-paid account based on either a transponder read or a photograph of a correctly registered license plate number – and the participating toll agencies will guarantee payments for transactions associated with these valid accounts. Participating agencies must also be able to communicate in some fashion to customers that **"your toll account works here."**

To take advantage of the toll interoperability system, a driver/vehicle owner must have a valid toll account with some entity and the entity must be a certified participant in the national IOP system. That certification will be based on technology and operating standards currently under development.
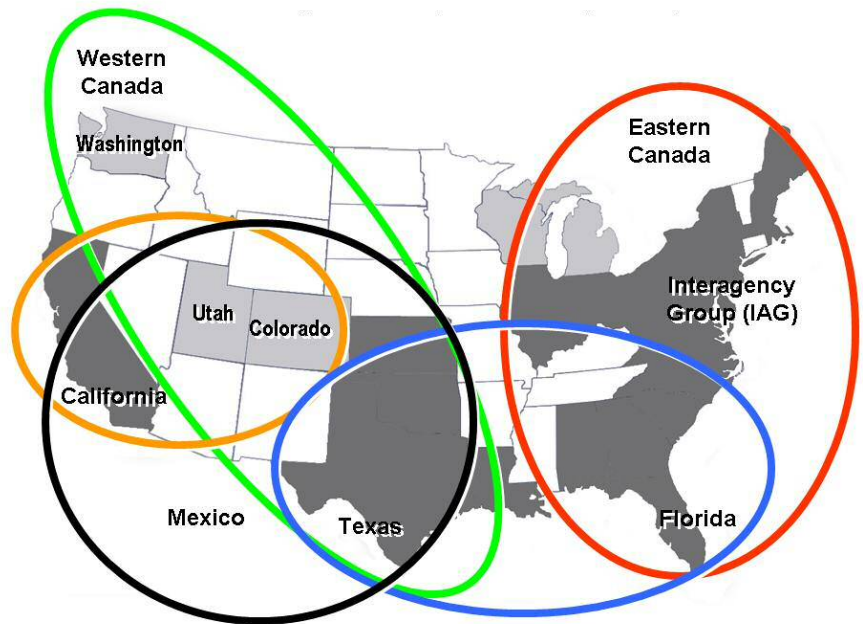
While extremely important to the effective and efficient operation of toll facilities, the support for exchanging and settling transactions for unregistered vehicle owners and/or to support cross-jurisdiction violation enforcement is a function of the operation of toll agencies and not integral to

customer interoperability. However, the transaction exchange infrastructure certainly could be used to facilitate these activities depending on the offerings from the operators of such systems.

Inter-Regional Exchange of Toll Transactions

In order to maximize the hundreds of millions of dollars of public and private investments in existing vehicle, roadside and back-office, actions are underway in various parts of the United States to facilitate the exchange of toll transactions by creating interoperability between areas of North America that already have uniform toll technologies within their regions but are different from those within their neighboring regions. The groups involved in these activities and discussions include the 14 states and 24 toll agencies that comprise E-ZPass (primarily in the US northeast), the Florida Turnpike Enterprise (FTE) and the other toll agencies that comprise the Florida-based SunPass system, the North Carolina Turnpike, the interoperable agencies within the State of Texas under the Team Texas system, the interoperable toll agencies in California known as CTOC, the Alliance for Toll Interoperability (ATI), and the 6C Working Group (multiple states and organizations including E-470 in Colorado, Washington DOT, Georgia DOT, the State of Utah, FTE, ATI, the IBTTA IOP Committee, etc.).

The outcome of these discussions and activities forms the foundation for inter-regional interoperability through the use of combinations of multi-protocol transponder tags and multi-protocol readers at the roadside and multiple transaction exchange infrastructures using existing peer-to-peer networks and new centralized hub-style networks that would facilitate the exchange of transactions from registered toll customers between regional networks and agencies. In addition to the roadside and vehicle technical solutions, these groups are also working through the institutional elements needed to support interoperability including operating agreements that would permit third-party account providers, financial messaging standards, exchange protocols and programming standards. For example, the E-ZPass system has developed an Affiliate Membership that would permit states and agencies outside of the group to participate in transaction exchange with all group members by meeting certain financial and operating requirements while not being directly involved in the governance of the group. That agreement was developed in concert with the State of Florida and should function as a model for future inter-regional toll agreements.

A more detailed discussion of inter-regional interoperability is provided later.

Impediments to Interoperability

The primary impediments to achieving North American interoperability are divided into two groups:

(1) **Toll Transaction Information Exchange and Payment Settlement:** These impediments are related to the need for an appropriately sized and interconnected infrastructure system to efficiently exchange toll transaction information and settle toll transaction payments across state and national borders – which includes solving the institutional and legal problems associated with handling of toll account information, creating uniform business processes and establishing the necessary agreements between agencies, states and regional toll organizations; and

(2) **Electronic Toll Collection Communications Technology:** These issues are related to the multiple, disparate roadside and vehicle technologies presently employed for electronic toll collection in different areas within North America that are not interoperable.

Interoperability will therefore be based on the elements to address these impediments.

Achieving Interoperability: Based on current industry initiatives to address these issues, interoperability will be achieved in two phases: **(1) Short-Term Reality** (interoperability activities already underway – that should be complete within a 1-5 year time frame) and **(2) Long-Term Vision** (changes that will occur beyond 5 years).

Short-Term Reality: The first steps toward North American interoperability are already underway. Toll agency owners, system operators and vendors are already adapting the approach used by the US banking system to settle checks and clear credit card transactions along with technology and account concepts used by the US cell phone industry to achieve universal phone service coverage and uniform billings as a blueprint to create the financial and technology infrastructure needed to support toll interoperability.

A cooperative effort of public and private elements, led by the Alliance for Toll Interoperability (ATI), an association mostly of IBTTA member toll agencies, is now underway with a multi-state pilot project to develop and test the financial infrastructure necessary to exchange and settle toll transactions between participating agencies using license plate photography as the basis for trips made by customers with existing pre-paid toll accounts. This process will likely involve institutional changes related to how toll account information is made available and communicated. It could also impact the way license plates are designed and produced.

Solutions to address the issues related to disparate toll technologies are also underway. These activities are essentially inter-regional in nature – focusing on interoperability between the large regional areas of tolling that already exist within the US in a manner that will also allow independent toll agencies outside of those regions to participate. The solutions include efforts by toll operators and suppliers to

investigate and implement a combination of multi-protocol transponders and multi-protocol transmitter/readers along with some conversions to new communications protocols to quickly achieve interoperability between regions. Similar to the multi-protocol transmission towers used by the US cell phone industry, multi-protocol transmitter/readers have already been successfully tested and deployed at the roadside on a number of major toll facilities in the United States. And, multi-protocol transponders have been developed that can be used to provide a choice for drivers who wish to travel into areas where agencies still have single protocol readers.

These short-term technology solutions will allow agencies, states and regions with large investments in existing disparate roadside and vehicle equipment to provide interoperability choices for their customers as the toll industry moves toward long-term solutions that involve more uniform technologies.

To ensure interoperability, these short-term (as well as the future long-term) solutions will also require the adoption of communication and messaging standards and mechanisms for testing and certification to assure the compliance of products and services being provided to the traveling public. OmniAir (an IBTTA sister organization) is positioned to facilitate the toll industry development, acceptance and implementation of the standards and certification process for interoperability.

Long-Range Vision
The roadmap for evolving to interoperability beyond five years is not technology specific because of a number of variables including:

    (1) <u>Impact of USDOT technology activities</u>

        Federal initiatives to improve the safety and operation of the transportation system are very likely to impact the functionality and design of future toll technologies employed at the roadside and in vehicles. The on-going development technology efforts by the Federal Highway Administration (now referred to as THE CONNECTED VEHICLE) to identify and institutionalize a national system for vehicle-to-roadside and vehicle-to-vehicle communications to improve safety and operations on America's roadways is likely to be the primary basis for automobile manufacturers to install a uniform communications platform in new vehicles. While it is important for the toll industry to be included in the development of the technologies and standards for these devices to ensure they provide the functionality needed for electronic toll collection and interoperability, given the size of the toll industry in North America, it is not likely that tolling will be the primary basis for this development and implementation.

        IBTTA Role: As the acknowledged representative of the combined public and private elements within the toll industry, IBTTA should be in a leadership position in ensuring that any uniform communications platform under development and testing by USDOT accommodates the development and deployment of an interoperable electronic toll collection system in North America.

(2) <u>Future changes in how transportation is funded</u>

Given the recognized need to find an adequate replacement for a gas tax that is no longer viable as a method to publically fund transportation, it is also likely that tolling will play a major role in that change and, if so, future tolling technologies will also likely be required to have different functional capabilities than those presently employed. Ideas such as managed lane networks, tolling of Interstate highways and mileage-based user fees would all have a significant impact on toll technologies, operations and financing.

IBTTA Role: Along with various transportation partners such as USDOT/FHWA, TRB, ASHTO, etc., IBTTA should take a leadership position in the research and testing of potential toll related techniques for augmenting and/or replacing the gas tax as a transportation funding mechanism.

(3) <u>Impact of multiple payment technologies and systems on the toll industry</u>

To effectively support a growing customer base, the future toll technologies must also be able to accommodate the ever changing applications of the fast-growing payment products and financial services industry. In addition to transponders and readers, it is anticipated that other mobile payment devices, technologies and systems will likely be available and desired by toll customers within and beyond the 5-year time period - such as cell phones, computer tablets, GPS-based units, etc. as well as those potential devices and systems not yet developed or even envisioned today.

IBTTA Role: As THE representative of the toll industry, IBBTA should be the centralized resource for identifying the standards to be used by application developers and service providers who wish to offer payment applications and technologies and financial services to public toll agencies and private operators.

(4) <u>Open standards, testing and certification within a competitive environment</u>

Public toll agencies, through IBTTA, ATI, OmniAir and other representative organizations, have articulated a desire for a competitive environment within which to acquire products and services from vendors and service providers. Open standards for the delivery of products and services; uniform methods for compliance testing and certification; and standard methodologies for performance testing form the basis for such an environment.

IBTTA Role: IBTTA, in concert with OmniAir as the primary compliance testing and certification organization, is positioned to represent the toll industry in the process of finalizing the technology standards, compliance testing and certifications to be used by the industry to create and sustain an interoperable toll system in North America. In addition, IBTTA should participate with ATI and other organizations in the development of standardized procurement procedures and performance testing methods.

In the long term, the toll industry as part of the much broader transportation industry will very likely identify more universal technology solutions. The timing of these solutions will be based on outcomes of many of the aforementioned variables. While that is occurring, (1) roadside and vehicle components will be developed and deployed to support more broadened inter-regional interoperability; (2) the toll industry will develop and/or acquire the financial infrastructure to settle toll transactions and process toll violations across jurisdictional boundaries; (3) IBTTA, working with other transportation partners, will create the standards, testing and certification processes necessary to support interoperability; (4) toll agencies and operators will be evaluating a range of communications and payment technologies to determine how they might enhance operations for the customer – all of which will be undertaken in the context of potential changes in the way transportation is funded (such as mileage-based user charging) and the possibility of future deployment of vehicle and roadway technologies focused on safety and operational objectives.

Three models represent the most plausible options to achieve North American toll interoperability:

Option A – Interconnected Regional Networks. This option would build upon the regional interoperability networks which have already been established (or which may be established in the future). Agencies would continue to possess customer accounts and the practice of revenue exchange and transaction settlement within their respective regions. Linkages between regions would be established to enable interoperability between networks. Home agencies would extend payment guarantees to other agencies through the inter-regional linkages. Agencies that are not part of a regional system would likely join one or form a new region themselves.

Option B – National System. Under this model, all agencies would join a U.S. interoperability system in which all accounts are accepted at all participating agencies across the country. Under this national system, options exist for a national account clearinghouse and for accounts to be owned by agencies or certified third-party operators.

Option C – Third Party National Toll Service Providers. Under this model, new toll payment methods are established (probably by multiple providers) that are accepted by individual toll operators. For those choosing the service, the toll customer would have a contract with the third-party provider and the providers would have guaranteed payment agreements with all participating agencies. The third party service providers provide the mechanism for North American interoperability for those customers who choose to avail themselves of this service. This option is based on the credit card model used in the retail sector. For example, Visa or American Express is a payment mechanism that is accepted by retailers and the credit card issuer provides payment guarantees for valid accounts.

It is possible that interoperability may include components of all three options. No matter what the configuration of the transaction exchange, all of these options will have the challenge of technical compatibility (transponders and readers) between the different tolling regions in the U.S.

Multiple solutions exist to address the technology hurdle:

- Use image-based transactions (IBT) for electronic tolling outside the primary region, with license plates linked to the same pre-paid accounts.
- Use multi-protocol readers at all participating agencies.
- Issue multi-protocol transponders for customers who choose national interoperability.
- Use the Connected Vehicle Program communications platform for tolling once it is implemented nationally.

Background

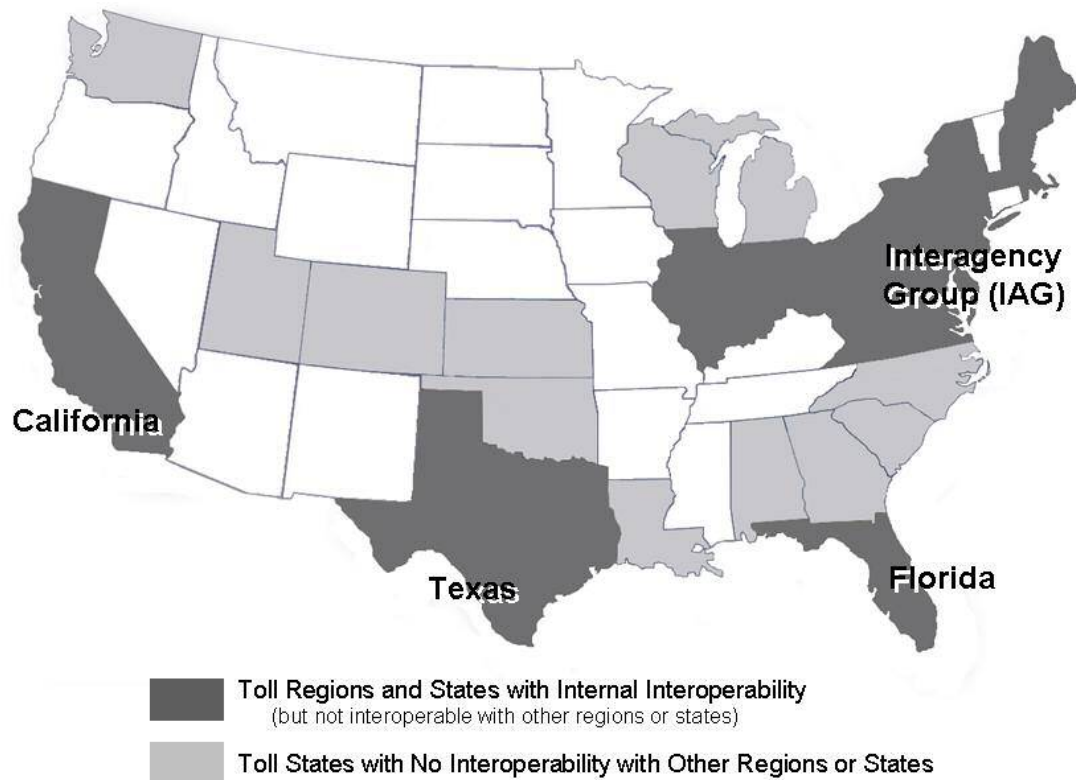### Existing Toll Environment - North America

During the past decade, there has been a significant increase in the use of electronic toll collection (ETC) on North American toll roads, bridges and tunnels as well as on new price-managed toll lane projects. Almost 40 million million vehicles are equipped with electronic toll devices (transponders) which allows toll agencies in the United States, Canada and Mexico to automatically identify customers using radio signals transmitted between the transponders and roadside toll equipment and then debit existing pre-paid accounts for the toll transactions. Toll evasion is discouraged through violation enforcement systems (VES) that use license plate photography to identify those who do not pay and employ fines and penalties which vary based on different business practices and laws for each agency or jurisdiction.

Recent deployment of all-electronic tolling (AET) facilities that eliminate cash toll collection on some or all of a toll facility's lanes has resulted in increased attention and use of ETC. AET has also generated the development of video toll collection (VTC) as a replacement for cash collection. VTC uses VES-type license plate photography to identify customers that do not have transponder accounts as a supplement to the ETC. VTC can employ pre-paid accounts that are similar to ETC accounts or may use post-paid business rules to send bills to customers for transactions after they drive on the toll facility.

Presently, North American toll agencies generate over $10 billion of annual revenue. By comparison, the US DOT collects approximately $30 billion in federal fuel taxes every year.

Four large regions of technological and financial interoperability already exist within the United States. These areas combine to represent over 90% of all of the toll customers and toll revenues generated in the country.

United States Toll Interoperability Locations

Toll Regions and States with Internal Interoperability (but not interoperable with other regions or states)

Toll States with No Interoperability with Other Regions or States

The largest area of interoperable toll systems is located primarily in the northeastern United States. Operating under the single E-ZPass brand, this region is comprised of 24 public agencies in 14 states that form a consortium known as the Interagency Group (IAG). E-ZPass toll agencies presently have 13 million toll customers with pre-paid ETC accounts. E-ZPass presently generates approximately $5.25 billion of toll revenue per year from 2.4 billion annual ETC transactions. E-ZPass technology is based on proprietary technology provided by Kapsch. The pre-paid toll transactions are interchanged through a system of peer-to-peer connections between the E-ZPass service centers.

The other three large areas of toll interoperability are located within the states of Florida, Texas and California.

Florida has five major toll agencies with 3.5 million pre-paid account holders operating under multiple ETC brand names, the most prominent of which is Sunpass. Florida toll agencies generate approximately $1 billion in revenue from almost 800 hundred million annual ETC transactions. In addition, three Florida agencies have converted facilities to AET which generate an additional $20 million in annual post-paid VTC revenue. All Florida agencies use transponders based on proprietary technologies provided by Transcore. Pre-paid toll transactions within the Sunpass sysem are exchanged primarily through a central hub provided by the Florida Turnpike Enterprise.

Texas has four major toll agencies with a total of 2.5 million pre-paid account holders also operating under multiple ETC brands. Together, the agencies generate approximately over $ 900 hundred million per year based on more than 700 hundred million annual ETC transactions. A number of Texas agencies have also converted some facilities to AET, generating in excess of an additional $100 million in annual post-paid VTC revenue. All of the Texas agencies use a Transcore ETC technology that is similar to that used in Florida but with enough differences that the equipment is not interoperable. Pre-paid transactions in Texas are processed by three home toll agencies that issue the Texas interoperable transponder.

California has four major toll systems with approximately two million account holders operating under the single FasTrak brand using a uniform transponder technology based on a California open technology standard known as Title 21 that may be produced by any provider that meets the Title 21 standard. Pre-paid toll transactions are processed in individual agency back offices and exchanged through under a statewide organization of toll agencies known as CTOC.

The remaining states with tolling have approxiamgtely 10% of the toll customers and pre-paid annual transactions in the US. The transponder technologies employed in these states include a mix of communications protocols that include California's Title 21, 18000 6C and a range of Transcore proprietary and non-proprietary protocols most of which are not presently interoperable.

The growth of electronic toll collection (ETC), all-electronic toll collection (AETC) and video toll collection (VTC) deployments has contributed to increasing interest in achieving some form of uniform system of electronic payment for customers using North American toll roads, bridges and tunnels so that drivers would not need more than one transponder and/or one account to essentially drive on any toll facility in North America. That interest has come from a wide range of constituents, including:

- **Customers of regional, state and local toll agencies**
  Primarily drivers of private automobiles and light trucks and public and private organizations with fleets of automobiles, light trucks, buses small utility vehicles that typically have one toll account with a local (home) toll agency that they normally use on local, regional and intrastate toll facilities but occasionally use for interstate and long distance trips outside of the operating area of their home toll agency

- **Commercial vehicle operators**
  Individual owned and operated heavy trucks or company-owned fleets of heavy trucks who often have multiple toll accounts at different home toll agencies around the country which often requires the trucks to carry multiple transponders because they frequently undertake interstate and long-distance trips using toll facilities to move goods and materials between regions that currently employ different radio technologies and payment methods for their ETC systems.

- **Regional, state and local toll agencies and operators with ETC systems**
  Primarily public agencies (sometimes with private contracted toll operators) that own and operate toll facilities that employ radio-frequency based equipment to collect tolls from customers with pre-paid toll accounts. Some toll agencies operate as "home" agencies that issue transponders, process ETC transactions on the roadside and operate back-office service centers where they maintain customer accounts and collect payments while other agencies function as "away" agencies that have ETC communications equipment at the roadside to capture transactions but do not issue transponders, do not have back office operations, do not maintain pre-paid accounts nor process payments. These away agencies submit their transactions to other home agencies or regional service centers for payments using the transponder ID or license plate number of the vehicle making the trip as the basis for the transaction. A home agency functions as an away agency when a trip on their facility is made by a customer whose account is maintained by another agency. That transaction must then be submitted for payment to the home agency that maintains the account. These transaction payments are settled in the IAG consortium between member agencies using a direct peer-to-peer arrangement. Florida, Texas and California primarily use hub-style service centers mixed with some direct communications to settle their transactions.

- **International, national, regional and state toll road and transportation organizations**
  The IBTTA, ATI and the previously mentioned regional toll consortiums in the United States have been interested in and working toward interoperability solutions. In addition, organizations like the American Association of Motor Vehicle Agencies (AAMVA), a number of state Departments of Transportation (DOT) and ancillary organizations like the American Trucking Association (ATA) also have interests in solving this issue. AAMVA's interest is centered on the need for vehicle owner information to support intrastate and interstate video toll collection and violation enforcement and the role that organization might play in facilitating the exchange of information. Traditional state DOT's are becoming much more involved in tolling because of the growth of HOT Lane and Managed Lane projects in urban areas. And, ATA along with a number of large national trucking companies are interested in solving the multi-transponder, multi-account issue that interstate trucking companies have to deal with.

- **Federal, state and local elected and appointed officials**
  Interoperability has become an area of interest at the federal level for both elected officials and staff and for state and local officials primarily because of how tolling fits into ideas for augmenting and/or replacing the gas tax as the primary funding mechanism for transportation. The interoperability of toll systems becomes a much more important issue as governments look for more reliable and equitable methods to fund transportation. Ideas such as the addition of price-managed lanes, tolling on the US interstate highway system and universal mileage-based user charging all become much more feasible if North American toll systems are interoperable.

Current Interoperability Initiatives

<u>**Alliance for Toll Interoperability (ATI)**</u>
Formed approximately three years ago, ATI is an organization of public toll road operators focused on creating toll interoperability within North America. ATI's initial activities have centered on using license plate and vehicle owner identification as the basis for the first step toward achieving wide scale interoperability for existing pre-paid toll customers. The basic idea would be to exchange ETC transaction information through a centralized service facility for unidentified customer trips at a participating local "home" agency to determine if the trips were made by customers with active pre-paid accounts from other "away" toll agencies who also participate in the exchange system. If a transaction is identified as belonging to an active customer from another participating agency, the service center could present the transaction for settlement to the home agency and the funds debited from the customer's account.

Interoperability Hub
ATI is underway with a pilot project to demonstrate the feasibility of using centralized service centers (often called hubs) to exchange transactions and settle payments for toll account holders initially using license plate photography as the basis for the transaction. Four vendors were selected through a national competitive process to initially process video transactions from six participating agencies representing three different regions within the United States. The information being exchanged includes the license plate number and transaction information (toll amount, date, time, locations, etc.) related to trips on the respective agency facilities that cannot be associated with any of their existing pre-paid accounts. The pilot project should demonstrate the effectiveness, reliability, cost and key business rules that must be finalized in order for this centralized approach to provide value to toll customers and agencies. It is anticipated the pilot will identify the minimum operating criteria that must be met for a vendor to qualify to provide such a service for toll agencies and will determine which of the competing vendors meet those qualifications. The outcome should result in certified third party service providers that following well-defined terms and conditions that require the provider to follow a set of business rules, codes of conduct, privacy guidelines, ethics practices and accountability.

Interstate License Plate Information Exchange
Efforts are underway to identify the methods and institutional requirements for state Departments of Motor Vehicles (DMV) to make vehicle owner information available to the toll industry to support both billing and violation enforcement based on photographically captures license plate numbers.

ETC Interoperability with IAG E-ZPass, I-95 Coalition, Florida Sunpass, and North Carolina Quickpass

The IAG consortium, operating under the E-ZPass brand, along with the states of Florida (mostly operating under the Sunpass brand) and North Carolina (operating as Quickpass) are working towards interoperability on the eastern US coastline along the I-95 corridor. The agencies are also coordinating with the I-95 Coalition that has fostered a uniform technology and operating approach for commercial vehicles on the I-95 corridor. E-ZPass is currently working directly with Florida and North Carolina toll agencies to achieve interoperability between the three systems within the next year. Discussions have also taken place with Georgia and it is expected that the state toll agency will participate once certain technological issues are worked out.

Technology Interoperability

The technology approach centers on using the multi-protocol transmitter/readers already installed in Florida and soon to be installed in North Carolina to read the communications protocol used by E-ZPass transponders in addition to the respective transponder protocols for each of their systems. The E-ZPass protocol also forms the basis for the Pre-Pass program used by the I-95 Coalition to allow heavy trucks to by-pass state operated I-95 weigh stations, thus saving time and fuel by not requiring trucks to slow down for DOT inspection. The Pre-Pass technology should therefore be usable as toll transponders for IAG, Florida and other toll agencies.

Transaction Settlement

To settle transactions along the I-95 corridor, E-ZPass is suggesting the use of their existing peer-to-peer arrangement that today exchanges more than $2.5 billion annually between their member agencies.

ISO 18000 6C Interagency Working Group

Toll agencies within the states of Washington, Utah, Colorado and Georgia are involved in deployment of a new transponder technology based on an open standard known as ISO 18000 6C. This communications standard has been used by numerous industries to identify everything from parcels to passports. Because of the heavy investment in the development and use of 6C worldwide and the extremely efficient production as a decal-based stick-on tag, the unit cost of the transponders are in the vicinity of less than $2 in large volumes. The extremely low costs and tested quality of performance has attracted the interest of additional states that now are investigating 6C for possible vehicle identification and tolling. To facilitate implementation standards for the states already committed to deploying 6C and to provide information for the additional interested states, a 6C Interagency Working Group was formed.

The group is comprised of the following:
- Georgia)
- Utah

- North Carolina
- Florida
- Colorado
- E-ZPass (IAG)

Testing and Deployment of 6C Tags and Multi-Protocol Readers

The following represents the current status of testing and deployment of 6C for tolling.

Colorado
E-470 ORT
- Installation/testing of Sirit ID5204 Readers on ramps and mainline
- Currently reading Title-21 and 6C

Utah
I-15 HOT Lanes
- Actively reading 6C with Transcore E6 Readers

Georgia
GA 400 ORT and I-85 HOT Lanes
- Installation/testing of Transcore Sego and 6C with Sirit ID5204 Readers

Washington
SR 167 HOT Lanes
- Actively reading 6C and Transcore ATA tags with Sirit ID5204 Readers

Tacoma Narrows Bridge ORT
- Installation planning to read Transcore Sego and 6C with Transcore E6 readers

SR 520 ORT
- Actively reading 6C and Transcore ATA (but not tolling) with Sirit ID5204 Readers

Development Uniform 6C Programming Standards

The Working Group has established a Programming Requirements Task Force to coordinate and draft standard programming language for the 6C tags to ensure that tag programming will be compatible between jurisdictions. The areas of concern include the following:
- Memory mapping
- Transponder ID numbering
- Security and data integrity validation
- Transponder ordering and deliver (manifest information)
- Compatibility with existing deployments

<u>OmniAir</u>

The OmniAir Consortium is the leading advocate for the national deployment of open, effective, and interoperable advanced transportation technologies to dramatically improve the safety, mobility and efficiency of highway transportation. OmniAir is comprised of members from the public and private sector who are involved in intelligent transportation systems (ITS) & telematics and who support the application of open-standards-based to transportation systems. Through the member-defined OmniAir Certification program and OmniAir Certification Services, an affiliate test organizations, members are working for open standards, third-party certification, and competitiveness in ITS and the advance transportation telematics industry.

The activities of OmniAir related to interoperability are divided into the following groups:

Certification and Testing

OmniAir's membership brings the perspective of both the public and private sectors to issues like ensuring interoperability compliance through certification and testing, one of the key elements in overcoming the technology issues facing the toll industry. OmniAir is perfectly positioned to undertake the role of the Certification Entity (CE) for the toll industry by employing a classic template approach to certification.

In this case, the industry being certified (the toll industry) is what is called "client." This is an important concept. The various components of the toll industry must accept being a client of interoperability and this requires some new actions on their part.

The client (public and private toll industry participants) work with the CE to co-develop the specific technology/application requirements that become part of the test specification which in turn the CE uses to create the test tools.

A key understanding in this process is that the client (the toll industry) is the expert in what their requirements are. The CE is the expert in taking those requirements and creating the test apparatus and managing the testing regime.

The CE then completes the test apparatus and locates and accredits a test-facility that does the actual tests and returns the results of said tests to the CE (the Wi-Fi model). The CE is the entity experienced in: (1) reviewing test labs and processes as compliant to certain standards (typically ISO or NIST standards relating to running a test lab); (2) reviewing lab test results; and; (3) issuing – if the product passes – a certificate of compliance and/or interoperability to the supplier, allowing the supplier's product to be placed on qualified purchasing lists (QPL).

The Electronic Payment Services National Interoperability Specification (EPSNIS)
This development and test project took is complete as of 9/30/11 (reports are available). The key players were I-95CC for funding, the Port Authority of New York New jersey (PANYNJ) for project oversight, NYSBA (?) who provided the test site, E-ZPass Group for staff support, SwRI (?) for test services, and on the private side, JAFA Technologies for project management, Kapsch for hardware/integration, BancPass and Fidelity Information Services for transaction management and OmniAir for program management. The EPSNIS is a technology agnostic, federally-funded, open, payment systems interface created and tested by companies, nearly all of which involved are IBTTA.

OCS/6C Committee Collaboration
In 2010, OmniAir created an affiliate called OmniAir Certification Services (OCS). The OCS is a non-profit, non-member, independent test entity with its own board of directors. It was created to manage certification test programs for clients (sanctions test tools, accredits labs, etc.) and issue certificates of compliance and interoperability. OCS is working now with the informal 6C Working Group to flesh out a 6C tolling certification program.

The process for providing 6C technology certifications is anticipated to be up and running and doing technology by mid-2012 and would benefit from formal IBTTA support. The process would involve:

1. In this case, OmniAir, acting as the CE, would work with the 6C Working Group to arrive at an agreed-upon understanding/interpretation of the 6C standard, including the additional requirements that make 6C technology suitable for the tolling environment. The product of this collaboration would be called the 'IBTTA 6C-For-Tolling specification' (6CFT) if, IBTTA wanted to participate and support this effort. Question: Who "owns" this specification? Answer: It needn't be owned by IBTTA, the CE or anyone. It doesn't have to be owned at all. The point is that the industry must reference it in their certification program.

2. With 6CFT standard, the CE would develop the test tool/apparatus and would then credential this apparatus as the officially-recognized, toll standard based on 6C. It is very important that there be just one implementation of the standard. The problem we have now is that suppliers take an "open standard" (like California's Title 21) and interpret it differently when they build their products. They can say they built to the standard, but if there is no agreed upon single interpretation of the standard that the industry agrees is "THE ONE STANDARD" then toll agencies end up with tags and readers that don't fully interoperate (like Title 21).

3. The Lab component: the CE typically doesn't own a lab (too expensive). Instead, they would accredit the labs that are capable of doing the required tests (for example, the lab has basic accreditation from A2LA, follows certain ISO test-lab standards for radio devices and has the equipment needed to accommodate the 6C specification and perform the tests in a reliable and repeatable way).

4. Toll operators can then create RFPs that require all technology submitted in response to the RFP must be CE-certified and on a QPL. This is the only reason a supplier would come to the CE in the first place – because his customer required it. There is little market benefit to the supplier to do this on their own. Therefore, toll operators MUST require that open-technology-based devices they intends to procure must come from a CE-certified QPL to ensure interoperability. Without this requirement, the same interoperability issues that occur with Title 21 and current 6C deployments will continue.

5. A supplier would submit to the CE (or a CE accredited lab) their roadside and vehicle-based devices to test.

6. The lab, using the test suite it was granted the rights to use by the CE, would test to see whether the device complies to the 6C standard. If so, the device is "standards compliant."

7. Then, using a reference unit (one known to be compliant), the lab checks the device for interoperability with that unit (or units, as the bench grows). If so, it is then identified as "interoperable."

8. The lab sends test results to the CE which interprets the results and ensures that processes followed by the lab were correct and yielding a valid, unambiguous, incontrovertible test result.

9. The CE then issues a pass or failure notice. If the product failed in the lab (there are several metrics and if the device fails just one of them, if could get a "fail" grade), the CE contacts the vendor (privately) and tells them what metrics of the test their product failed. The vendor could fix those things and resubmit for a regression test – a test on the failing item.

10. If they pass (or if they passed the first time), the CE issues the product a certificate of compliance and/or interoperability and makes that result known on a publicly available website or some other means.

11. Field/lane testing of qualified devices: this is left to the operator because each operator has unique conditions that are difficult to harmonize across the industry. However, one could standardize certain elements of the lane environment (or agree on certain minimum performance metrics) and – in cooperation with the CE – incorporate these into another level of compliance that could be certified.

NOTE; This process can also be applied to elements like the EPSNIS. Much of the process is the same but in this case, it is easier because it doesn't require field tests. The data coming from a toll point to a back-office provider/customer service center is tested and assured that it is indeed in the format as specified in the EPSNIS.

Transaction Concept of Operations
This just-completed paper produced by USDOT is not ETC specific per se but does focus on payment and transaction management within a nationally-interoperable system. It is thus applicable to the IBTTA framework for interoperability.

IBTTA Interoperability Committee
The IBTTA Interoperability Committee (IOP) is comprised of a steering committee made up of a Chairman, Vice-Chairs and professional staff provided by the association. The Vice-Chairs oversee five sub-committees:

- Transponder/Reader Technology Sub-Committee
- License Plate and Violation Enforcement Sub-Committee
- Transaction Settlement Sub-Committee
- The Business Case Sub-Committee
- Operations Sub-Committee

The steering committee is responsible for development of the overall direction and conceptual planning for achieving interoperability with the recognition that many other organizations are providing leadership or have a vested interest in the outcome of these efforts. Because there are so many active players in this endeavor, coordination is also a key responsibility of the steering committee. In addition to the IBTTA Board of Directors, executives and staff, the following organizations have been a focal point for the committee:

- Alliance for Toll Interoperability (ATI)
- E-ZPass Interagency Group
- OmniAir
- I-95 Coalition
- US DOT/FHWA
- AAMVA
- States, Regions & Agencies Involved in Testing and Transponder/Reader Procurements (IAG, WashDot, Utah DOT, GDOT/SRTA, etc.)
- US House of Representatives Transportation Committee

The following represents the areas of discussion and interest of each of the sub-committees:

Transponder/Reader Technology Sub-Committee

The sub-committee is led by Tom Knuckey (Atkins), JJ Eden (North Carolina Turnpike, ATI & AECOM) and PJ Wilkins (E-ZPass). Their focus has been to identify the activities underway that would help achieve interoperable tolling technologies from the public and private sectors Areas of interest include (but are not limited to):

- Costs of transponder protocols and form factors
- Costs of different reader technologies
- Multi-protocols - ability to read multi-tags or use multi-protocol readers
- Investigation of ISO 18000 6C
- Intellidrive as a solution today and/or tomorrow
- Interaction with ATI & OmniAir
- Establishment of Base Testing Criteria and potential sharing of agency testing results

License Plate and Violation Enforcement Sub-Committee

This sub-committee is led by Dave Kristick (Denver E-470)and Rosa Rountree (Golden Ears Bridge, Vancouver, Canada and Aegis). This sub-committee discussions have centered on:

- Federal rules to bring some standardization to plates
- Registration information access
- Registration holds across jurisdictional lines
- Information exchange across jurisdictions
- Interaction with ATI, AAMVA & toll operators

Transaction Settlement Sub-Committee

This sub-committee is led by Jack Opiola (D'artagnan Consulting) and JJ Eden (North Carolina turnpike, ATI & AECOM). The sub-committee focus has been on:

- Customer payment options
- Business rules between settlement agencies
- Revenue guarantees
- Collections/violations across state lines
- Security/privacy – how data is protected
- Agency/Vendor agreements
- Interaction with ATI and OmniAir

The Business Case Sub-Committee

This sub-committee is led by Scott Stewart (IBI) and Ed Regan (Wilbur Smith). The purpose of this sub-committee is:

- Quantifying the business/economic case – the costs and benefits of changing transponder and reader protocols
- Investigate alternate models/methods
- Identifying other services/opportunities and models
- Look at revenue recognition/unit costs/leakage & standard reporting methods

Operations Sub-Committee

This sub-committee is led by Tim McGuckin (OmniAir) and Greg Lefrois (HNTB). The primary focus of the sub-committee is to identify the approaches for implementing:

Technology and transactions standards implementation, testing and certification
Video tolling/video standards
Customer agreements

A Customer-Driven Solution - North American Interoperability

Definition

The ultimate goal for interoperability means *customers may pay for travel and related services across jurisdictions with a single account and a choice of payment methods.*

Meaning

The following explanations are provided to provide clarity of meaning for each of the elements of the definition.

Customers: Drivers or vehicle and business owners who have valid toll accounts

…pay for travel and related services: Fees on roads, bridges, tunnels, HOT & managed lanes and services like parking, food, gas, etc. on participating facilities

…across jurisdictions: Countries, regions, states (interstate and intrastate), counties, cities, and agencies

… with a single account: One account - serviced by a transaction settlement system open to multiple providers

… choice of payment methods: Customer may choose multiple payment options offered by account and service providers

There is also an unwritten basic principle related to providing choices to customers that extends to toll road operators. In order to provide the range of services envisioned within an interoperable toll system at reasonable prices to customers, toll operators must also be able to choose identification & payment technologies based on open standards in a competitive environment.
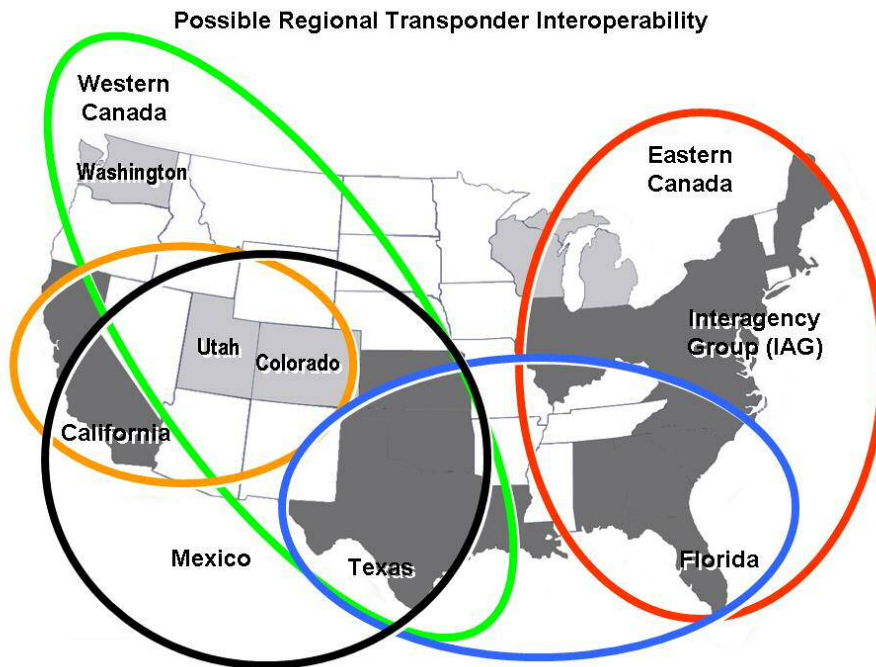
Interoperability Today

Inter-Regional Transponder Interoperability

The initial approach to interoperability would be technology independent. It would not require a universal transponder technology in the vehicle or on the roadside. Initial transponder interoperability could be achieved inter-regionally over the 1-5 year time frame by using a combination of multi-protocol readers, multi-protocol transponders, conversions to different transponder protocols and accommodation of alternative payment methodologies. This strategy takes advantage of the existing investment in roadside and vehicle technologies while also allowing agencies to incorporate new payment schemes using cell phones and other mobile devices.

Inter-regional interoperability would be created through understanding the opportunities presented by adjacent regions and states and the lack of significant current demand for toll trips that span from the eastern side of North America to the western side.

The following depicts an example of inter-regional interoperability and identifies the technology modifications that would have to occur to support these scenarios.

Possible Regional Transponder Interoperability

Eastern US and Canada

To achieve transponder interoperability, agencies would likely have to deal with three basic protocols: (1) the current IAG protocol manufactured by Kapsch, (2) the current Florida "sticker-tag" protocol produced by Transcore and (3) the 6C protocol (provided through multiple vendors) being installed by Georgia and investigated by Florida and other agencies on the east coast. Florida presently has multi-protocol readers installed and those readers could be

modified to accept the IAG and 6C protocols along with the existing Florida sticker tag. Florida is also investigating the possible conversion of old "hard-case" transponders to a new portable multi-protocol tag that would carry the Transcore sticker tag and the IAG protocols within the same case. North Carolina is also investigating multi-protocol readers and multi-protocol tags with some of the same type of combinations in mind. Florida is also investigating the possibility of using 6C in a multi-protocol tag arrangement. Toll agencies in eastern Canada would thus have a number of options for achieving transponder interoperability with the eastern US. The final decisions related to Florida, Georgia, North Carolina and Canada in concert with the recent IAG decision to maintain their existing protocol for another five years, should form the basis for short-term regional interoperability along the eastern coast of North America.

Southeastern US and Southwestern US
Based on efforts underway in Texas' Louisiana and Oklahoma to become compatible with the Transcore-based 6B transponders currently in use in these states, this region should be able to achieve transponder interoperability with the southeastern US by using either multi-protocol readers or adjustments to their current transponders and readers – all based on the 6B protocol.

Northwestern US and Western Canada (with possible addition of SW US)
Between Colorado, Utah, Washington and British Columbia, Canada, the opportunity to become transponder interoperable is based on the use of 6C and Transcore 6B sticker-tag technologies. WashDot, UDOT and E-470 in Denver have all implemented 6C protocol transponders and reading equipment. Western Canadian toll agencies are investigating the implementation of 6C. Conversion by states in the Southwest to multi-protocol readers and/or the addition of the 6C protocol transponder could bring Texas, Oklahoma and Kansas into this mix of regionally interoperable states.

California, Utah and Colorado
With California and Colorado already employing Title 21 transponders and readers, the only thing lacking for interoperability between those states is the institutional agreements. However, because of the mountain separating this area, there has not been a substantial enough demand for interoperability. Now, with Utah implementing 6C on their HOT Lanes and E-470 implementing 6C transponders, it would seem improbable that Title 21 will be anything but a California protocol. For California to become interoperable with any of the surrounding states, they will have to implement multi-protocol readers and or begin conversion to the one of the new protocols – the most likely of which would be 6C.

Mexico, California, Colorado/Utah and Southwestern US
Because the entire country of Mexico is installing 6C on all registered vehicles, the opportunity to become interoperable with Mexico is immediate for Utah and Colorado. This installation adds to the rationale for Texas and California to ultimately be looking at 6C in at least some type of multi-protocol environment to be interoperable with Mexico, Colorado and Utah.

Interoperability Tomorrow

Because the financial infrastructure will be in place and maturing well within the five-year time frame to handle all types of toll transaction settlements, now is the time to begin planning for the change in technology that will occur beyond five years that will allow us to move from the initial regional approach to full national interoperability. This coincides with the time frame for the IAG to begin replacement of the existing Kapsch technology and the modernization of a large percentage of toll lanes and the conversion of lanes to AET for many IAG member agencies.

These circumstances should lead to the following discussion:

As we look at changing technology for upwards of 80% of the toll payers in the US, it would be reasonable to begin discussing a possible uniform technology that could support future mileage-based user fee charging as well as provide the backbone for complete North American toll interoperability.