



Electronic Payment Services National Interoperability Specification

“EPSNIS”

Test Report Version 2.0 Final

Created by the OmniAir Consortium Electronic Payment Services Committee with funding from OmniAir and the I-95 Corridor Coalition and oversight by the Port Authority of New York & New Jersey

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Disclosures and Acknowledgements

This material is based upon work supported by an I-95 Corridor Coalition funding award and under sponsorship and contract oversight by the Port Authority of New York & New Jersey. Any opinions, findings, and conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of I-95 or PA. This material was prepared by the OmniAir Electronic Payment Services Committee of the OmniAir Consortium and is published by it.

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Rationale for protection of the EPSNIS

OmniAir is a membership organization and its deliverables result in great part from work generously *contributed* by members. In deference to the member companies, committee members, and the Board of Directors of OmniAir, the Consortium establishes rights of intellectual property for some work. IP rewards creativity, stimulates innovation and contributes to the development of superior products – while safeguarding the public interest.

The EPSNIS is a standard meant to be used widely to support national payments interoperability. Toll facility operators and others who provide transportation services for payment will ideally specify the EPSNIS in Requests for Proposals. The private sector will offer the EPSNIS. OmniAir will test suppliers' compliance to it to ensure interoperability across suppliers and facilities – interoperability that encourages innovation, competition and lower costs.

Interoperability must be constantly defended! Copyright protection doesn't preclude use of the specification. It prevents the *fraudulent* use of the standard by entities that claim EPSNIS compliance but who in fact may not be compliant and thus NOT interoperable with other 'certified' users of the EPSNIS. Copyright also keeps the EPSNIS in the hands of the OmniAir membership who can evolve the standard over time to meet *their* needs, as *they* define them.

The EPSNIS is a product of many individuals and companies. Special thanks go to:

- *The New York State Bridge Authority* for providing the test location and engineer and site support at the Newburgh Beacon Bridge.
- *BancPass, Inc.* which provided crucial experience and significant content for the specification and who fully support what standards offer: interoperability, competition & innovation.
- *The Port Authority of New York & New Jersey* staff who provided complete oversight and offered sponsorship that gave the project credibility and buy-in from a key community.
- *The OmniAir EPS Committee* who contributed hundreds of hours of technical expertise and significant direct costs, and who also showed great stamina.
- *The I-95 Corridor Coalition* and its EPS Program Track Committee. In their goal to improve mobility through technology, they realized the value in the proposal and funded it.

- *FIS - Fidelity National Information Services, Inc.* As one of the world's top-ranked technology providers to the banking industry, they realized the market potential and importance of interoperability thus providing support and their financial expertise

Revision History

Version	Date	Revision Summary	Author
1.0	09/30/2011	OmniAir EPSNIS Test Report – Initial submittal for review	JAFa Technologies: Ed Mulka / Carol Bozarth
1.0	09/30/2011	Southwest Research Institute EPSNIS Specification Report of Findings – Initial/Final submittal	SwRI: Ted Wilmes
1.0	09/30/2011	SwRI EPSNIS Test Development Test Plan – Final submittal	SwRI: Ted Wilmes
2.0	11/28/2011	OmniAir EPSNIS Test Report – Second submittal after review and update per findings.	JAFa Technologies

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2.0 Introduction

The Electronic Payment Services National Interoperability Specification for Next Generation ETC Services (EPSNIS) is a technical standard to control a financial transaction network for electronic processing of vehicle transactions. The primary purpose of an EPSNIS controlled financial transaction network is to process toll payments; however, other categories of payments are not precluded.

This EPSNIS Test Report is the result of testing the technical specification to demonstrate that it could be used to facilitate toll transaction processing using an infrastructure similar, but not identical, to the credit card industry.

The EPSNIS employs a set of Extensible Markup Language (XML) file definitions for information exchange. XML is a general purpose specification that is well suited for describing structured data and validating format. XML file definitions are described using an XML Schema file which describes the required and optional structural elements. Each Clearinghouse Organization that uses the EPSNIS will define and control the process that checks files for compliance with the Clearinghouse Organization's business rules and serializes the information in those files for transmission to and from the Clearinghouse Organization.

The vision is for Clearinghouse Organizations to interoperate in a financial network to process transactions for their clients. File transfers can also occur between two different Clearinghouse Organizations in this financial network with each serving their own OBU Provisioners and Toll Facility Operators. It is also possible for an organization to provide the services of both an OBU Provisioner and a Clearinghouse Organization, a Clearinghouse Organization and Toll Facility Operator, or all three. The purpose of the EPSNIS Technical Specification is to provide the data standard between any two organizations in an EPSNIS network.

Toll Facility Operators, Clearinghouse Organizations, and OBU Provisioners are responsible for creating their own files using the XML schemas described by the Specification.

2.1 Purpose

The EPSNIS controls the technical system interfaces –

1. Between a Toll Facility Operator and a Clearinghouse Organization
2. Between a Clearinghouse Organization and an OBU Provisioner, **and**
3. Between two Clearinghouse Organizations.

The purpose of this test is to validate the acceptability of the EPSNIS Technical Specification to provide guidance for establishing interfaces between vendor software packages. It was not within the scope of this test to evaluate vendor software.

For the purposes of this test, one operational toll facility was used with two existing Clearinghouse Organizations that performed the function of the OBU Provisioner. The Roadside Equipment (RSE) and On-Board Units (OBUs) included both 915MHz E-ZPass toll transaction collection and 5.9GHz communications media to support vehicle to roadside tolling with lane server communications to the Clearinghouse Organization.

Data flow in the form of toll transactions files were evaluated between each of the test points using test cases taken directly from the Specification.

2.2 **Documentation**

The EPSNIS Specification document that was subjected to testing was the “OmniAir EPSNIS Test Ready Working Version 0.6, September 2010.” It was created by the OmniAir Consortium Electronic Payment Services Committee with funding from OmniAir and the I-95 Corridor Coalition and oversight by the Port Authority of New York & New Jersey. The EPSNIS Committee was comprised of OmniAir members from the public and private sectors. This version evolved through several iterations among the EPSNIS committee members from June 2009 through September 2010.

The following documents are relevant to the EPSNIS Specification:

- OmniAir EPSNIS Test Plan v1.0, May 19, 2011. Prepared by the Southwest Research Institute.
- OmniAir EPSNIS Technical Specification Test Plan_v1.2, January 25, 2010
- Proposed Functional Requirements For A “Test-Ready” EPSNIS. Prepared by HNTB. First Draft – Released For Comment February 24, 2009
- IntelliDrive Payments ConOps. Version 1, 09/21/2009.

In addition to this report, the following Southwest Research Institute documents detail the results of the EPSNIS test:

- SwRI EPSNIS Test Development Test Plan v1.0, September 30, 2011
- Electronic Payment Services National Interoperability Specification Test Development Report of Findings, Version 1.0, September 30, 2011

2.3 **Test Team**

The test was supported by a combination of I-95 funding and services-in-kind from volunteer participants from both private and public sectors. The volunteer force was a very dedicated group and put in an extraordinary effort, but there were still challenges with conflicting resource commitments. Many times EPSNIS project volunteer resources were diverted to fulfill contractual deliverables for paying customers, which is certainly understandable and justified. Even though there were a lot of late nights as evidenced by numerous email exchanges after midnight, the project ended up going on for well over a year past its original proposed schedule. The truly remarkable outcome is that even

though with an extended contract performance period that was double the original, the project still managed to come it just below budget. If given ever the opportunity to manage a project again that has a large contingency of volunteers, it should probably be done with a better insight toward management reserve when it comes to the schedule forecast. It should be noted however that even with this hindrance all the participants (on both sides of the public/private table) worked in complete harmony and unison ultimately resulting in a successful project.

BancPass – The EPSNIS Clearinghouse Organization demonstrated the interoperability, using existing BancPass software modified for this test for processing, and served as the simulated OBU Provisioner.

Fidelity National Information Services, Inc. (FIS) – The second EPSNIS Clearinghouse Organization demonstrated the interoperability, using existing FIS software for processing.

The New York State Bridge Authority (NYSBA), Newburg-Beacon Bridge – Hosted the lane level interface (vehicle to roadside) using Mark IV IAG & 5.9GHz roadside units (RSU).

Southwest Research Institute (SwRI) – Wrote the test scripts, provided guidance to ensure objectivity during testing, performed the specification test according to scripted test cases, and recorded and reported the test results.

Jafa Technologies, Inc. – Managed the budget and schedule, served as Test Manager, and furnished logistic support as required.

OmniAir – Served as the Program Manager and overseer of the testing effort.

Kapsch/Mark IV – Provided the 5.9GHz RSU and associated installation/configuration support.

SAIC – Provided the 5.9GHz OBU.

3.0 Test Objective

The primary objective of the EPSNIS Test was a Verification Interface Test to ascertain that separate entities could develop a single interface specification, thus exchanging transactions for processing in accordance with each one's internal procedures. The specific objectives were:

- To demonstrate that upon lane level generated events being captured, transactions can be generated for transmission to the Clearinghouse Organization for processing using the EPSNIS specification.

- To demonstrate that a Clearinghouse Organization processed transaction can be formatted into the appropriate EPSNIS specified transaction schema for transmission to the appropriate OBU Provisioner.
- To demonstrate that an OBU processed transaction can be formatted into the EPSNIS specified transaction schema for transmission to the Toll Facility Operator for reconciliation.

3.1 **Test Setup**

Prior to the start of the EPSNIS Verification Interface Test, a System Functional Test (SFT) was performed at the NYSBA on the designated test lanes. The SFT verified that the lane type had been installed correctly and was communicating with the up-stream server. The SFT also verified the capability to send and receive transactions from the lane to the Clearinghouse Organization.

Various security settings and firewall configurations were configured for the BancPass, NYSBA, and FIS servers in order for these servers to communicate with one another and receive and send files. Weekly technical teleconferences were held to work through these considerations and to keep the test team apprised of the status of the test.



New York State Bridge Authority, Newburgh-Beacon Bridge

Two weeks of dry run testing was performed before the official start of the test to assure communications was consistently achieved and that the file structure of each file type met the specification standard. Having the Clearinghouse Organizations, BancPass and FIS, process the transactions during this dry run period proved to be the best use of time and our Subject Matter Experts interpreting the Specification.

The following considerations were identified and documented during the weekly technical teleconferences during the dry run testing and during the official test:

- The Specification is vague about how to treat duplicate transactions, adjustments, and transaction type (debits and credits). An assumption was made and consistently applied as to the handling of duplicate transactions and adjustments.
- The Specification needs a better description of Transaction Type within the Adjustment File schema.
- The Specification is not clear how to handle empty files. Transaction files were generated hourly, including a zero byte transaction file when there were no EPSNIS lane reads at NYSBA. Those zero byte transaction files were not transmitted from/to the Clearinghouse Organizations.
- BancPass requested the timestamp be changed to CDT rather than GMT.

All of these findings, and more, are documented in the SwRI Test Report of Findings, provided in Appendix B.

The test officially started on July 19, 2011.

3.2 ***Test Process and Procedure***

Originally envisioned as a 30-day test, the test actually extended out to 69 days to accommodate participant schedules and a new LTP Toll Configuration File for an updated IP address of the 5.9GHz server. The test ended on September 26, 2011 after successfully processing 1422 files, 6399 BancPass transactions, and 1159 FIS transactions.

The NYSBA lane-generated transactions were captured and stored in a test database on servers at NYSBA for both the 915MHz and 5.9GHz transactions.



Mark IV 915MHz Antenna



Kapsch/Mark IV 5.9GHz Antenna

BancPass pulled transactions from the NYSBA servers, processed those transactions in the specified XML format, and stored those transactions, following up each transmission with Acknowledgement Files. BancPass selected appropriate OBU transactions to forward to FIS in the specified XML format. BancPass also stored the FIS processed transactions. BancPass then processed and created Reconciliation, Adjustment, and Settlement files and transmitted those files back to the Toll Facility Operator, NYSBA.

The Clearinghouse Organization performed the transaction processes to pull files, acknowledge files, extract transactions, reconcile and make adjustments, and create settlement files. Those processes were done manually at first and then configured as automatic scheduled jobs to run at designated times according to the Specification.



915MHz and 5.9GHz Roadside Equipment



5.9GHz On-Board Unit



NYSBA Vehicle with 5.9 OBU Going Through Test Lane

From an engineering perspective, Southwest Research Institute (SwRI) interacted with BancPass and FIS, the Clearinghouse Organizations, taking copies of all file types within the BancPass database in order to report and validate test cases. SwRI also generated test files and injected them into the test environment to simulate specific test cases, such as adjustments.

3.3 Test Type

SwRI created a Test Plan that assigned a Test Case Number to each baseline requirement in the EPSNIS Specification. A copy of the SwRI EPSNIS Test Development Test Plan v1.0, September 30, 2011 is provided in Appendix A. The Test Cases are defined in Appendix A, Section 2.4 Baseline Requirements. As the independent evaluator of the viability of each requirement, SwRI created Test Scripts and applied its own Test Tool to address each requirement. The Test Scripts and results are provided in Appendix A, Section 4. Test Procedures.

Each Test Procedure includes a description of the test and the requirement that was evaluated, the prerequisite conditions, and the test results. **All tests passed.** Each test is witnessed and dated. Some conditional statements or notes of explanation were offered in a Notes section; however, there were no instances that adversely affected the outcome of the tests.

4.0 Test Assessment

SwRI created a Test Report of Findings, enumerating the number of transaction files, transactions, adjustments, and reconciliations and settlement files. SwRI also offered a thorough set of recommendations identified before and during the test that will help to enhance the usability and value of the Specification. A copy of the Electronic Payment Services National Interoperability Specification Test Development Report of Findings, Version 1.0, September 30, 2011 is provided in Appendix B.

4.1 Test Results Summary

A summary of the EPSNIS requirements and the test results are provided in Table 4-1.

Table 4-1. Test Results Summary

ID	Requirement	Test Case	Test Results	Note
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These Extensible Markup Language (XML) files are then transmitted in their entirety using File Transfer Protocol Secure (FTPS) over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.	Test 1	PASS	Deficiency outside scope of EPSNIS. See App A, Section 4.1.6

ID	Requirement	Test Case	Test Results	Note
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using Secure FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.	Test 2	PASS	
EPSNIS-TP-15-6	Parties providing Vehicle Status Files (VSF) shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.	Test 3	PASS	File was exchanged at beginning of test. See App A, Section 4.3.5
EPSNIS-TP-15-7	Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly.	Test 4	PASS	
EPSNIS-TP-16-2	Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.	Test 5	PASS	
EPSNIS-TP-16-3	Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly.	Test 6	PASS	
EPSNIS-TP-16-4	Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File	Test 7	PASS	
EPSNIS-TP-16-5	Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.	Test 8	PASS	
EPSNIS-TP-16-6	Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed.	Test 9	PASS	
EPSNIS-TP-16-7	The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure.	Test 10	PASS	
EPSNIS-TP-16-8	If the second attempt fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.	N/A	PASS	
EPSNIS-TP-17-1	The Transaction File describes transactions and is effectively an invoice for payment.	Test 11	PASS	
EPSNIS-TP-17-2	A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.	Test 11	PASS	
EPSNIS-TP-17-3	This posting concurrently creates a demand for payment directly from the Clearing Organization to the Toll Facility Operator.	Test 11	PASS	

ID	Requirement	Test Case	Test Results	Note
EPSNIS-TP-17-4	The Clearing Organization processes this information and creates its own (offsetting) transactions.	Test 11	PASS	
EPSNIS-TP-17-5	The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.	Test 11	PASS	
EPSNIS-TP-17-6	This posting creates a demand for payment directly from the OBU Provisioner to the Clearing Organization.	Test 11	PASS	
EPSNIS-TP-17-9	All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.	Test 12	PASS	
EPSNIS-TP-17-10	The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them.	Test 12	PASS	
EPSNIS-TP-17-11	Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification.	Test 12	PASS	
EPSNIS-TP-17-12	To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File and sends the file to the Clearing Organization.	Test 12	PASS	
EPSNIS-TP-17-13	Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.	Test 12	PASS	
EPSNIS-TP-17-14	The Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated.	Test 12	PASS	
EPSNIS-TP-17-15	To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File and sends the file to the Toll Facility Operator.	Test 12	PASS	
EPSNIS-TP-18-3	A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.	Test 13	PASS	
EPSNIS-TP-18-4	A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.	Test 13	PASS	

ID	Requirement	Test Case	Test Results	Note
EPSNIS-TP-18-5	Settlement Files detail which transactions, disputes, and adjustments one network member’s bank deposit account has paid to another member’s bank deposit account. The following information types are supported by the Settlement File: <ul style="list-style-type: none"> • The transaction amount with all associated discounts, payment guarantees, and adjustments factored in. • Fees, if any 	Test 14	PASS	
EPSNIS-TP-18-8	An OBU Provisioner reports the deposits that its bank makes into the Clearing Organization’s bank. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.	Test 15	PASS	
EPSNIS-TP-18-9	A Clearing Organization reports the deposits that its bank makes into the Toll Facility Operator’s bank. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.	Test 15	PASS	
EPSNIS-TP-18-10 thru EPSNIS-TP-26-1	The XML complex types are unique named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and have multiple instances defined at each level.	Test 16	PASS	

These are detailed in SwRI Test Plan, Appendix A, Section 4. Test Procedures.

5.0 Comments and Recommendations

SwRI’s recommendations for the EPSNIS Specification are provided in Appendix B Report of Findings, Section 4. Findings, which suggests amending the Specification in certain areas for better clarification. Each recommendation is ranked according to a “Low” or “Medium” impact on the usefulness of the clarification. There were no recommendations that were regarded as a “High” severity issue.

These recommendations have been reviewed and resolved to the satisfaction of the Test Team and Southwest Research Institute. A summary of the Recommendations is provided in Table 5-1 on the next page.

6.0 Final EPSNIS Specification

The “OmniAir EPSNIS Test Ready Working Version 0.6, September 2010” document has been updated as a result of the test and recommendations as is provided in Appendix C as the “**Electronic Payment Services National Interoperability (EPSNIS) Specification.**”

Table 5-1. Summary of Comments and Recommendations

ID	Finding	Severity	Comment
EPSNIS-RPT-1	Version 0.5 of the EPSNIS specification specified the format of the xml file names for transfer. Version 0.6 removed this format requirement. Having a predetermined file name format will ease implementation and should not adversely affect the flexibility of the specification to different business scenarios.	LOW	This has been updated.
EPSNIS-RPT-2	The file schemas do not include elements that define the originator and sender of the file. While this information is known because the parties agree upon exchange locations of the files, it may be beneficial to include them in the files also so that the files, when pulled out of the context of a specific file location, can still have their origination and destination points identified.	LOW	Fields ORIGINATOR and DESTINATION added File Identifier (Section 12.1.14)
EPSNIS-RPT-3	<p>In the appendices, the complex type definitions are repeated for each file type. It would be beneficial to define complex types in one file instead of duplicating their definitions throughout the schemas.</p> <ul style="list-style-type: none"> • This will simplify keeping the XSD files consistent. • Modern code generation tools for Java and C# have trouble generating code for duplicate types in the same namespace. 	LOW	Schemas have been updated in the Appendices. Appendix A Common XSD defines the complex types in one file, as recommended.

ID	Finding	Severity	Comment
EPSNIS-RPT-4	Unclear if it is ok to send empty files if no activity occurred during period of interest or if file should have empty xml tags in it, i.e. <TRANSACTION> </TRANSACTION> versus an empty file.	LOW	Empty files are addressed in Section 6.3.
EPSNIS-RPT-5	In general, many of the fields accept free text and do not have any restrictions. A stricter schema definition may provide less flexibility on the surface but save time down the road because implementers will have a clear, documented example of valid values. Even in cases where free text is needed such as a license plate, it may be beneficial to limit the length of the field. The following fields may benefit from greater specificity in their type definitions.	MEDIUM	GD – I strongly agree. At one point we discussed implementing a “standardized parser” to allow very strict control of the schema. We discarded the idea low-value, as many of the tools (Databases for example) have built-in parsers that are not easily replaced.
EPSNIS-RPT-5.1	AccountType - STATUS has a set of acceptable values listed, this could be defined as an enumeration in the schema so that schema validation will detect unacceptable values.	MEDIUM	STATUS is added to the Account Type (Section 13.1.1) and enumerated in the Common XSD schema, Appendix A.
EPSNIS-RPT-5.2	VehicleType - YEAR is listed as a string but could be a 4 digit number.	MEDIUM	YEAR is restricted to a 4 digit number in the Common XSD schema, Appendix A.
EPSNIS-RPT-5.3	TagType - PROTOCOL – if there is a standard list of protocols, these should be enumerated here (keep in mind that as protocols change, it will still be a simple matter to update the spec to accommodate new valid protocols.)	MEDIUM	PROTOCOL is a string to accommodate a list of protocols, Appendix A Common XSD schema.
EPSNIS-RPT-5.4	PlateType - STATE – this could be an	MEDIUM	COUNTRY and STATE are enumerated as a

ID	Finding	Severity	Comment
	enumeration of state abbreviations.		string to accommodate all of North American, Appendix A Common XSD schema.
EPSNIS-RPT-5.5	ClassificationType - SHAPE - if there are specific shapes, these could be enumerated.	MEDIUM	Field IOPREGION added to the Classification Type (Section 13.1.7)
EPSNIS-RPT-5.6	ClassificationType - CLASS – same as shape, if there are specific classes, these could be enumerated.	MEDIUM	Field IOPREGION added to the Classification Type (Section 13.1.7)
EPSNIS-RPT-5.7	TollType – the specific values such as E & C could be enumerated.	MEDIUM	Field TYPE, E – ETC fare and C – Cash fare is added to the TollType (Section 13.1.8)
EPSNIS-RPT-5.8	DispositionType - STATUS – these values could be enumerated.	MEDIUM	Field STATUS enumerations are added to the Disposition Type (Section 13.1.9)
EPSNIS-RPT-5.9	TransactionType - Credit and Debit can be limited to two decimals of precision.	MEDIUM	No change. Limiting to two decimal places introduces possible rounding errors. .
EPSNIS-RPT-5.10	FileType - STATUS – these values could be enumerated.	MEDIUM	Field STATUS enumerations are added to the FileType (Section 13.1.12)
EPSNIS-RPT-5.11	ProcessRule – there does not appear to be a definition of what a process rule is in the documentation. If there are standard rules, they should be defined in the spec.	MEDIUM	No change. This is intentionally free-form to allow the user to document that the transaction had been “altered” by a rule on the originator’s side.
EPSNIS-RPT-6	Transaction Type is in the Adjustment file XSD but not in body of document. It appears that Transaction Type would need to be specified so that the adjustment could note what credit or debit should be made to the transaction.	MEDIUM	TransactionType is added (Section 13.1.10).

ID	Finding	Severity	Comment
EPSNIS-RPT-7	Reconciliation File - It is not specified if after an adjustment occurs on a transaction, if a corresponding reconciliation shall be generated and sent.	MEDIUM	Open – This can be agreed upon between parties.
EPSNIS-RPT-8	Acknowledgement File - The FileType does not provide enough error information to figure exactly what may have caused a problem. For example, ‘F – Failed to process for bad record’ is listed as a possible value. In this case, there does not appear to be any place to describe which particular record was bad such as a specific transaction ID.	MEDIUM	A list of error codes is now provided, Appendix H.
EPSNIS-RPT-9	The minimum interval for file delivery is stated for each file type. In addition, it would be good to specify a maximum interval such as the Transaction File shall be delivered no less than once per hour and no more than 10 times per hour. As it is written now, a toll facility operator could generate a transaction file for each transaction and deliver it and still fall within the specification. This could potentially cause performance issues.	LOW	Addressed in Section 6.4 Information Exchange Sequencing.
EPSNIS-RPT-10	The specification briefly mentions the clearinghouse to clearinghouse scenario in the executive summary but never again. The	MEDIUM	Clearing Organization to Clearing Organization is defined in Section 3.1 Definitions.

ID	Finding	Severity	Comment
	included sequence diagrams do not make it clear that this is a valid architecture. It may be beneficial to briefly describe the clearinghouse to clearinghouse in the specification so that it is clear that it is a valid architecture.		
EPSNIS-RPT-11	Section 10.0 Settlement File does not describe the use of DispositionType within the Transfer element of a settlement. The schema includes a disposition type with a transfer element but it is unclear how this should be used with the different statuses. For example, shall all duplicates that come across in adjustments be included in a duplicate transfer section?	MEDIUM	Open for discussion
EPSNIS-RPT-12	Test date needs to be changed in last paragraph of Section 2.0 Executive Summary.	LOW	So changed.
EPSNIS-RPT-13	Section 4.0 Information Flow references an “Account” file in an example. The specification does not define an Account file type.	LOW	“Account” file has been changed to “Vehicle Status”
EPSNIS-RPT-14	Section 5.1 Network – a VPN was not used for the 30 day test. Files were exchanged via SFTP and authentication was facilitated through the use of pre-shared keys.	LOW	Text has been deleted.
EPSNIS-RPT-15	Section 5.3 File Formats – states that functional requirements are detailed in later sections of the	LOW	Text has been deleted.

ID	Finding	Severity	Comment
	document. This document does not contain functional requirements. It is possible Functional requirements means something different here.		
EPSNIS-RPT-16	Section 5.4 Information Exchange Sequencing – Bullet two mixes Account and VSL file. Is Account file a synonym for VSL file?	LOW	“Account” file has been changed to “Vehicle Status”
EPSNIS-RPT-17	Section 5.4 Information Exchange Sequencing – first bullet in second section – leaves decision open to full vs. incremental. This should be defined clearly by the specification and not left up to the user.	LOW	Full and incremental exchanges are so defined.
EPSNIS-RPT-18	Section 5.4 Information Exchange Sequencing – loosely defines ACK file delivery, this would benefit from being set to within an hour.	LOW	Spec has been updated to address this.

7.0 Acronyms and Definitions

CDT: Central Daylight Time

Clearinghouse Organization: A legal entity that performs all of the Clearinghouse Organization functions described by this document and provides/operates EPSNIS compliant Clearinghouse Organization systems using the legal entity's own employees or vendors/contractors that the legal entity hires are responsible for. Among other functions performed by a Clearinghouse Organization, the Clearinghouse Organization:

- Provides/operates the system(s) on one side of each systems interface controlled by the EPSNIS.
- Is one of the two parties involved in each information exchange controlled by the EPSNIS.

Deposit Account: A current account at a banking institution that allows money to be deposited withdrawn by the bank account holder.

EPS: Electronic Payment Services. The EPS Committee is a formal committee of OmniAir.

EPSNIS: The Electronic Payment Services National Interoperability Specification for Next Generation ETC Services

ETC: Electronic Toll Collection

FIS: Fidelity National Information Services, Inc.

FTPS: File Transfer Protocol Secure, also known as FTP Secure and FTP-SSL, is one of the common schemas of the application layer (layer 7) in the OSI Model.

GMT: Greenwich Mean Time

Internet: The global network that uses packet switching via TCP/IP for exchanging information between most personal, commercial, non-profit (including educational institutions), and government networks.

IP: Internet Protocol, a standard commonly used to provide network function (layer 3) for the Internet in an OSI Model.

LTP: Lane Transaction Processor

NYSBA: New York State Bridge Authority, provided the test location and engineer and site support at the Newburgh Beacon Bridge.

OBU: On Board Unit, the device installed in a vehicle, associated with a payment account, and used to help identify that payment account when a vehicle incurs a toll in a Toll Facility Operator.

OBU Provisioner: A legal entity that performs all of the OBU Provisioner functions described by this document and provides/operates EPSNIS compliant OBU Provisioner systems using the legal entity's own employees or vendors/contractors that the legal entity hires and is responsible for. Some of the functions performed exclusively by an OBU Provisioner include provisioning, activation, and maintenance of OBUs, and setting up, holding, and managing the associated customer payment accounts.

OSI Model: Open Systems Interconnection Reference Model, a construct commonly used to describe the various network layers and their respective functions

PA – Port Authority of New York and New Jersey

PANYNJ – Port Authority of New York and New Jersey

RSE: Road Side Equipment installed in a Toll Facility Operator for communicating with OBUs.

RSU: Road Side Unit, the device installed in a Toll Facility Operator for communicating with OBUs.

SFT: System Functional Test

SwRI: Southwest Research Institute, wrote the test scripts, provided guidance to ensure objectivity during testing, performed the specification test according to scripted test cases, and recorded and reported the test results.

Toll Facility Operator: A legal entity that performs all of the Toll Facility Operator functions described by this document and provides/operates EPSNIS compliant Toll Facility Operator systems using the legal entity's own employees or vendors/contractors that the legal entity hires and is responsible for. Some of the functions performed exclusively by a Toll Facility Operator include assessing, receiving payment for, and settling tolls for a vehicle's travel on a road, bridge, or tunnel.

TCP: Transmission Control Protocol, a standard commonly used to provide transport layer (layer 4) and possibly some session layer (layer 5) functions for the Internet in an OSI Model.

XML: Extensible Mark-up Language, a general purpose specification for describing structured information.

Appendix A –

SwRI EPSNIS Test Development Test Plan v1.0, September 30, 2011

Electronic Payment Systems National Interoperability Specification Test Development Test Plan

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

Prepared for:



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September 30, 2011

EPSNIS-TP-1.0

Electronic Payment Systems National Interoperability Specification Test Development Test Plan

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

September 30, 2011



Author – Ted Wilmes

September 30, 2011

Date



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September 30, 2011

Date

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APPENDIX A –	ACRONYMS

REVISION NOTICE

Version Identifier	Date of Issue	Summary of Changes
1.0-Draft	May 19, 2010	Initial draft release for OmniAir EPSNIS Committee review.
1.0	September 30, 2011	Final release of completed test plan.

This document contains information that is as complete as possible. Where final numerical values or specification references are not available, best estimates are given and noted To Be Reviewed (**TBR**). Items which are not yet defined are noted To Be Determined (**TBD**). The following table summarizes the TBD/TBR items in this revision of the document, and supplements the revision notice above.

Section	Description

1. PROJECT INFORMATION

The following subsections provide project information, a document overview, and identify related documents.

1.1 Project Identification

Project Title:	OmniAir EPSNIS Test Implementation
Project Number:	10-15517
Abbreviation:	EPSNIS-TP
Version Number:	1.0
Release Number:	1

1.2 Document Overview

This document defines the test procedures to evaluate the OmniAir Electronic Payment Services National Interoperability Specification (EPSNIS).

1.3 Related Documents

- BancPass System Technical Design Specification Version 0.2 July 7, 2009
- BancPass System Technical Design Specification Version 0.1 May 11, 2009
- EPSNIS Technical Specification – Interoperability Test Plan Draft Version 3.2 December 9, 2009
- NYSBA EPSNIS Transaction Simulation Test Version 1.0 April 15, 2010

2. TEST BACKGROUND

2.1 Identification

This test plan outlines the steps to verify and validate the OmniAir EPSNIS Technical Specification.

2.2 Purpose of Testing

The purpose of this testing is to test the EPSNIS specification, not the software that implements the specification. To this end, test failures related to failures of the software will not imply a failure of the specification. If a test case fails due to the software not supporting a portion of the specification, this will be noted.

2.3 Test Component Criteria

The Onboard Unit (OBU) provisioner, tolling facility, and clearing house software and hardware systems must be baselined before the initiation of this test plan. It is understood that modifications may be made to these components during the testing process. Component modification will trigger the rerunning of the appropriate test steps to verify that no regressions have occurred.

2.4 Baseline Requirements

The following table identifies the requirements from the EPSNIS Technical Design Specification and EPSNIS Specification Interoperability Test Plan and indicates which test case verifies that the requirement is met.

ID	Requirement	Test Case
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These Extensible Markup Language (XML) files are then transmitted in their entirety using File Transfer Protocol Secure (FTPS) over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.	Test 1
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using Secure FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.	Test 2
EPSNIS-TP-15-6	Parties providing Vehicle Status Files (VSF) shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.	Test 3
EPSNIS-TP-15-7	Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly.	Test 4
EPSNIS-TP-16-2	Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.	Test 5

ID	Requirement	Test Case
EPSNIS-TP-16-3	Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly.	Test 6
EPSNIS-TP-16-4	Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File	Test 7
EPSNIS-TP-16-5	Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.	Test 8
EPSNIS-TP-16-6	Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed.	Test 9
EPSNIS-TP-16-7	The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure.	Test 10
EPSNIS-TP-16-8	If the second attempt fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.	Not applicable - Operational Requirement
EPSNIS-TP-17-1	The Transaction File describes transactions and is effectively an invoice for payment.	Test 11
EPSNIS-TP-17-2	A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.	Test 11
EPSNIS-TP-17-3	This posting concurrently creates a demand for payment directly from the Clearing Organization to the Toll Facility Operator.	Test 11
EPSNIS-TP-17-4	The Clearing Organization processes this information and creates its own (offsetting) transactions.	Test 11
EPSNIS-TP-17-5	The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.	Test 11
EPSNIS-TP-17-6	This posting creates a demand for payment directly from the OBU Provisioner to the Clearing Organization.	Test 11
EPSNIS-TP-17-9	All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.	Test 12
EPSNIS-TP-17-10	The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them.	Test 12
EPSNIS-TP-17-11	Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification.	Test 12
EPSNIS-TP-17-12	To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File and sends the file to the Clearing Organization.	Test 12
EPSNIS-TP-17-13	Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.	Test 12

ID	Requirement	Test Case
EPSNIS-TP-17-14	The Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated.	Test 12
EPSNIS-TP-17-15	To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File and sends the file to the Toll Facility Operator.	Test 12
EPSNIS-TP-18-3	A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.	Test 13
EPSNIS-TP-18-4	A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.	Test 13
EPSNIS-TP-18-5	Settlement Files detail which transactions, disputes, and adjustments one network member's bank deposit account has paid to another member's bank deposit account. The following information types are supported by the Settlement File: <ul style="list-style-type: none"> • The transaction amount with all associated discounts, payment guarantees, and adjustments factored in. • Fees, if any 	Test 14
EPSNIS-TP-18-8	An OBU Provisioner reports the deposits that its bank makes into the Clearing Organization's bank. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.	Test 15
EPSNIS-TP-18-9	A Clearing Organization reports the deposits that its bank makes into the Toll Facility Operator's bank. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.	Test 15
EPSNIS-TP-18-10 thru EPSNIS-TP-26-1	The XML complex types are unique named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and have multiple instances defined at each level.	Test 16

3. TESTING PREPARATION

3.1 Test Location/Environment

The test will be conducted at the Newburgh-Beacon Bridge Toll Plaza over a test period no shorter than 30 days. A test lane and necessary tag-read equipment will be used for this testing.

3.1.1 Hardware

The following hardware will be used for this testing.

NYSBA	NA
BancPass	Dell Intel Xeon @ 200GHz 8 gigs of RAM
FIS	NA
Southwest Research Institute	Dell PowerEdge 2950 server

3.1.2 Software

The following software will be used for this testing.

NYSBA	Perl, rsync, ssh
BancPass	Python, Bourne Shell, Oracle Database, PL/SQL, SQL
FIS	FIS Clearway
Southwest Research Institute	Java, eXist XML database and XQuery test scripts

3.1.3 SwRI EPSNIS Test Tools

The Southwest Research Institute® (SwRI) EPSNIS Test Tool is made up of a number of different components. Figure 1 illustrates these components. The SwRI EPSNIS File Retriever runs on a SwRI server and periodically retrieves new EPSNIS files from the BancPass EPSNIS server via SFTP transfer. These files are inserted into an eXist XML hierarchical data store. SwRI test scripts are then executed against the eXist database to produce results for the test cases. These test scripts are written using the XQuery programming language which robustly supports native, in-language XML querying and transformation.

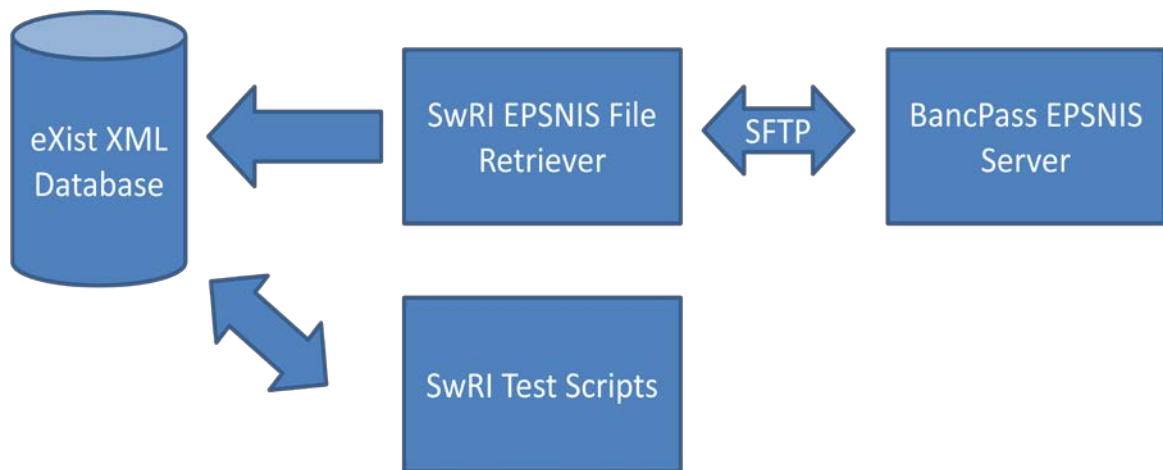


Figure 1 High level SwRI Test Tool architecture

3.2 Hardware Preparation

SwRI requires that a Windows XP+ or Linux client machine is available. This machine must have access to the OBU Provisioner, Clearing House, and Tolling Facility FTP locations.

3.3 Software Preparation

Install the EPSNIS Tester software on a system that will have read/write access to the EPSNIS FTP locations. The software required for the simulation steps outlined in the New York State Bridge Authority (NYSBA) EPSNIS Transaction Simulation Test must also be installed and functional.

3.4 Test Schedule

The following sections describe the test schedule.

3.4.1 Dry Test Run Schedule

Dry runs of these test steps will occur prior to official functional testing to help ensure issues that would result in test failures will be discovered and resolved prior to the formal testing.

3.4.2 Formal Test Schedule

Formal testing of the EPSNIS Test Implementation will occur as follows:

- Functional Testing: All of the test cases identified in the test plan below will be executed with the exception of the extended test.
- Extended Test: After successful completion of the test cases, the extended day test will be initiated. Monitoring and final analysis of the extended testing will occur remotely.

3.5 Test Stakeholders

Test stakeholders include the following organizations with the defined roles:

- OmniAir - Responsible for overall EPSNIS test specification and test implementation.
- NYSBA – Test sponsor and host site. Responsible for providing the test tolling facility system.
- BancPass – Responsible for providing the test clearing house and OBU provisioner system.

- Southwest Research Institute – Responsible for performing the specification testing and documenting the results.
- Jafa Technologies – Responsible for project oversight of the EPSNIS Test Implementation project. Will witness specification testing.
- OmniAir EPSNIS Committee

3.6 Test Personnel

Test personnel include the following:

- Southwest Research Institute – Responsible for performing the specification testing and documenting the results.

3.7 Test Unique Identifier Format

Each test will have a unique identifier in the format of T# where # is the number of the test.

3.8 Requirement Unique Identifier Format

This document was not based upon a formal requirements document so requirements are labeled in the following format for these tests:

EPSNIS-<Doc>-<Page>-<Section/Row>

<Doc> is either TDS for Technical Design Specification or TP for Interoperability Test Plan. <Page> is the page number the requirement was found on in the document. <Section/Row> is either the section, in the case of the Technical Design Specification, or table row, in the case of the Interoperability Test Plan, that the requirement was found or derived from.

3.9 Test Exception Handling

Test failures will be reported to the Test Manager. Since this testing is focused on verifying the specification, changes to the hardware and software will be acceptable during testing. If hardware and/or software changes are needed, the effected test cases will be rerun.

3.10 Completion Criteria

Testing will be completed when all test cases have been passed.

3.11 Test Results

The test results will be stored in this test plan document.

3.12 Defect Tracking

Defects shall be recorded in an issue tracking log.

3.13 Test Data Collection

The EPSNIS test is meant to be performed in two phases; data collection and verification. During the data collection phase, the EPSNIS Tester will be monitoring and injecting test transactions into the EPSNIS workflow. All EPSNIS traffic will be captured by the EPSNIS Tester and used during the testing phase.

The EPSNIS Tester will not only capture traffic but also inject Files into the test system environment. These injections will be pre-scripted and designed to test specific portions of EPSNIS.

The simulation tool described in the NYSBA EPSNIS Transaction Simulation Test document will also be injecting transactions into the system during the test when needed. For example, the NYSBA code is not capable of generating an adjustment file so the EPSNIS Tester will be used to generate these. The EPSNIS Tester will also collect these transactions for later review and verification.

3.13.1 Data Collection Steps

The following steps describe the process that must be followed to collect data from the EPSNIS system. The data collection portion of this test will run for four hours.

1. Stop the EPSNIS test systems.
2. Start the EPSNIS Tester and load the Test Specification test script.
3. Start the EPSNIS Tester.
4. Start the EPSNIS test systems.
5. At the end of the four hour test period, stop the EPSNIS Tester. ¹

Upon stopping the EPSNIS Tester, the totality of the data generated during the test will be available for analysis. The data will be archived by the EPSNIS Tester in both its original XML format and as discrete data elements in the EPSNIS Tester's database for later analysis. Section 4 outlines the steps for performing tests using that data.

¹ Note that the following test steps may actually be applied to an arbitrarily long data collection period. Consequently, these same test steps will be run against the data collected during the 30 day or greater test period.

4. TEST PROCEDURES

The following sections contain the test cases to perform the OmniAir EPSNIS Specification testing.

4.1 Test 1: XML Format Validation

Test Unique Identifier:	T1
Tester:	Ted Wilmes

4.1.1 Test Description

This test case verifies that the EPSNIS systems are producing valid Vehicle Status, Transaction, Reconciliation, Adjustment, Settlement, and Acknowledgement files.

4.1.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

4.1.3 Prerequisite Conditions

- EPSNIS Tester database has been populated with Test EPSNIS data.
- XML Schema Definition (XSD) files for Vehicle Status, Transaction, Reconciliation, Adjustment, Acknowledgement, and Settlement have been provided.

4.1.4 Test Results Evaluation

The user will confirm that all Vehicle Status, Transaction, Reconciliation, Adjustment, Settlement, and Acknowledgement files produced by the OBU Provisioner, Clearing House, and Tolling Facility conform to the EPSNIS specification file transfer formats.

4.1.5 Test Procedures

The user will execute the following steps:

1. Sample 1 file of each type.
2. Validate each file against the EPSNIS XSD files.

4.1.6 Notes

The BancPass acknowledgement files did not pass the schema validation due to an extra <detail> element. It was determined that this was due to a limitation of the Oracle XML generation tools. Since this was not due to a specification deficiency, this test case is still marked as passed.

4.1.7 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.2 Test 2: FTPS Connection

Test Unique Identifier:	T2
Tester:	Ted Wilmes

4.2.1 Test Description

This test case verifies the presence and operation of all required EPSNIS FTP locations.

4.2.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

4.2.3 Test Results Evaluation

The user will confirm that the EPSNIS Tester can connect to the OBU Provisioner, Clearing Organization, and Toll Facility Operator FTP locations.

4.2.4 Test Procedures

The user will execute the following steps:

1. Enter FTP connection information in the table below.

FTP Server OBU Provisioner	
Host	99.41.66.244
Username	fisuser
Path	/export/fisuser/filedrop
FTP Server Clearing Organization	
Host	99.41.66.244
Username	bpuser
Path	/export/nysba/filedrop
FTP Server Toll Facility Operator	
Host	99.41.66.244
Username	nysba
Path	/export/nysba/filedrop

2. Configure the EPSNIS file loader with the FTP connection information for both FTP servers.
3. Start the EPSNIS file loader and confirm that all FTP connections are made successfully.

4.2.5 Notes

None.

4.2.6 Test Results



PASS



FAIL

SwRI: Ted Wilmes

Date: 9/26/2011

4.3 Test 3: Vehicle Status File Delivery Frequency

Test Unique Identifier:	T3
Tester:	Ted Wilmes

4.3.1 Test Description

This test case verifies that VSF are delivered at the proper frequency to all necessary parties.

4.3.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-6	Parties providing VSF shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.

4.3.3 Test Results Evaluation

The user will confirm that the OBU Provisioner sends at least one Vehicle Status File per hour to the Clearing House. The user will then confirm that the reception of a Vehicle Status File from the OBU Provisioner will result in the transmittal of a corresponding Vehicle Status File to the Toll Facility Operator.

4.3.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Enter "Validation" mode.
3. Run the "Delivery Frequency Validator".
4. Verify the "Delivery Frequency Validator" test indicates success.

4.3.5 Notes

The accounts for this test stayed the same for the duration so the VSL file was only exchanged between parties once at the beginning of the testing.

4.3.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.4 Test 4: Transaction File Delivery Frequency

Test Unique Identifier:	T4
Tester:	Ted Wilmes

4.4.1 Test Description

This test case verifies the frequency of Transaction File delivery from the Tolling Facility to the Clearing House operator.

4.4.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-7	Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly.

4.4.3 6.5.3 Test Results Evaluation

The user will confirm that the Toll Facility Operator sends at least one Transaction File per hour to the Clearing House. The user will then confirm that the reception of a Transaction File from the Toll Facility Operator will trigger the transmittal of a corresponding Transaction File to the OBU Provisioner.

4.4.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator".
3. Verify the "Delivery Frequency Validator" test indicates success.

4.4.5 Notes

None.

4.4.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.5 Test 5: Reconciliation File Delivery Frequency

Test Unique Identifier:	T5
Tester:	Ted Wilmes

4.5.1 Test Description

This test case verifies the frequency of Reconciliation File delivery.

4.5.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-2	Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.

4.5.3 Test Results Evaluation

The user will confirm that the OBU Provisioner sends at least one Reconciliation File per hour to the Clearing Organization. The user will then confirm that the reception of a Reconciliation File from the OBU Provisioner will trigger the transmittal of a corresponding Reconciliation File to the Toll Facility Operator.

4.5.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator".
3. Verify the "Delivery Frequency" test indicates success.

4.5.5 Notes

None.

4.5.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.6 Test 6: Adjustment File Delivery Frequency

Test Unique Identifier:	T6
Tester:	Ted Wilmes

4.6.1 Test Description

This test case verifies that Adjustment Files are delivered at the proper frequency to all necessary parties.

4.6.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-3	Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly.
EPSNIS-TP-16-4	Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File

4.6.3 Test Results Evaluation

The user will confirm that the Toll Facility Operator sends at least one Adjustment File per hour to the Clearing House. The user will then confirm that the reception of an Adjustment File from the Toll Facility Operator will trigger the transmittal of a corresponding Adjustment File to the Toll Facility Operator.

4.6.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator" task.
3. Verify the "Delivery Frequency Validator" task indicates success.

4.6.5 Notes

None.

4.6.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.7 Test 7: Settlement File Delivery Frequency

Test Unique Identifier:	T7
Tester:	Ted Wilmes

4.7.1 Test Description

This test case verifies that Settlement Files are delivered to the proper parties at the correct interval.

4.7.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-5	Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.

4.7.3 Test Results Evaluation

The user will confirm that the OBU Provisioner sends at least one Settlement File per hour to the Clearing House. The user will then confirm that the reception of a Settlement File from the OBU Provisioner will trigger the transmittal of a corresponding Settlement File to the Toll Facility Operator.

4.7.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator".
3. Verify the "Delivery Frequency Validator" test indicates success.

4.7.5 Notes

None.

4.7.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.8 Test 8: Acknowledgement File Generation

Test Unique Identifier:	T8
Tester:	Ted Wilmes

4.8.1 Test Description

This test case verifies that Acknowledgement Files are generated in response to each transmitted file.

4.8.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-6	Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed.

4.8.3 Test Results Evaluation

The user will confirm that each transmitted file results in the delivery of an Acknowledgement File.

4.8.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator" test script.
3. Verify the "Delivery Frequency Validator" test indicates success.

4.8.5 Notes

None.

4.8.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.9 Test 9: Acknowledgement File Resend

Test Unique Identifier:	T9
Tester:	Ted Wilmes

4.9.1 Test Description

This test case verifies the systems' response to the transmittal of invalid files.

4.9.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-7	The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure.
EPSNIS-TP-16-8	If the second attempt fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.

4.9.3 Test Results Evaluation

The user will confirm that in the cases where no acknowledgement was received upon initial transmittal of a File, the File was resent.

4.9.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate a malformed transaction file from NYSBA.
3. Verify that BancPass generates an acknowledgement file indicating failure.
4. Send a properly formed transaction file from NYSBA.

4.9.5 Notes

None.

4.9.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.10 Test 10: Malformed XML Generates Error Acknowledgement File

Test Unique Identifier:	T10
Tester:	Ted Wilmes

4.10.1 Test Description

This test case verifies that the delivery of a file containing improperly formatted XML generates an Acknowledgement File containing error information.

4.10.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

4.10.3 Test Results Evaluation

The user will confirm that the delivery of a partial Vehicle Status File will result in the generation of an Acknowledgement File containing error information.

4.10.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate a malformed transaction file and send from NYSBA.
3. Verify that BancPass generates an acknowledgment file indicating an error.

4.10.5 Notes

None.

4.10.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.11 Test 11: Transaction Validation

Test Unique Identifier:	T11
Tester:	Ted Wilmes

4.11.1 Test Description

This test case verifies that all disputes Transaction demands for payment are handled appropriately by the system.

4.11.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-17-1	The Transaction File describes transactions and is effectively an invoice for payment.
EPSNIS-TP-17-2	A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.
EPSNIS-TP-17-3	This posting concurrently creates a demand for payment directly from the Clearing Organization to the Toll Facility Operator.
EPSNIS-TP-17-4	The Clearing Organization processes this information and creates its own (offsetting) transactions.
EPSNIS-TP-17-5	The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.
EPSNIS-TP-17-6	This posting creates a demand for payment directly from the OBU Provisioner to the Clearing Organization.

4.11.3 Test Results Evaluation

The user will confirm that all Transaction Files result in the correct demand for payment and necessary transmittal of Transaction Files between organizations.

4.11.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Transaction Timeline" test.
3. Verify the "Transaction Timeline" indicates success.

4.11.5 Notes

None.

4.11.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.12 Test 12: Dispute Validation

Test Unique Identifier:	T12
Tester:	Ted Wilmes

4.12.1 Test Description

This test case verifies that all disputes result in the correct generation and delivery of Reconciliation Files.

4.12.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-17-9	All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.
EPSNIS-TP-17-10	The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them.
EPSNIS-TP-17-11	Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification.
EPSNIS-TP-17-12	To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File and sends the file to the Clearing Organization.
EPSNIS-TP-17-13	Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.
EPSNIS-TP-17-14	The Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated.
EPSNIS-TP-17-15	To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File and sends the file to the Toll Facility Operator.

4.12.3 Test Results Evaluation

The user will confirm that the all disputed transaction result in the delivery of the necessary Reconciliation Files.

4.12.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate a NYSBA adjustment file with a duplicate transaction entry and send to BancPass.
3. Verify that BancPass correctly removes the duplicate transaction from the end of day settlement totals.

4.12.5 Notes

None.

4.12.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.13 Test 13: Adjustment Validation

Test Unique Identifier:	T13
Tester:	Ted Wilmes

4.13.1 Test Description

This test case verifies that all disputes result in the correct adjustments.

4.13.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-18-3	A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.
EPSNIS-TP-18-4	A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.

4.13.3 Test Results Evaluation

The user will confirm that the proper nullification and/or adjustment of transactions is made when adjustments are made.

4.13.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate an adjustment with a duplicate transaction entry from BancPass to FIS.
3. Verify that FIS correctly removes the duplicate transaction from the daily settlement total.

4.13.5 Notes

None.

4.13.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.14 Test 14: Settlement Validation

Test Unique Identifier:	T14
Tester:	Ted Wilmes

4.14.1 Test Description

This test case verifies that all transactions result in the proper settlements.

4.14.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-18-5	Settlement Files detail which transactions, disputes, and adjustments one network member's bank deposit account has paid to another member's bank deposit account. The following information types are supported by the Settlement File: <ul style="list-style-type: none">• The transaction amount with all associated discounts, payment guarantees, and adjustments factored in.• Fees, if any
EPSNIS-TP-18-8	An OBU Provisioner reports the deposits that its bank makes into the Clearing Organization's bank. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.
EPSNIS-TP-18-9	A Clearing Organization reports the deposits that its bank makes into the Toll Facility Operator's bank. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.

4.14.3 Test Results Evaluation

The user will confirm that all accepted transactions result in the delivery of the proper Settlement Files.

4.14.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Summary Report" test.
3. Verify the settlement transaction numbers match the daily transaction counts for both parties with adjustments taken into account.

4.14.5 Notes

None.

4.14.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.15 Test 15: XML Schema Validation Test

Test Unique Identifier:	T15
Tester:	Ted Wilmes

4.15.1 Test Description

This test case verifies that all XML files conform to the EPSNIS Specification schema definitions.

4.15.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-18-10 thru EPSNIS-TP- 26-1	The XML complex types are unique named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and have multiple instances defined at each level.

4.15.3 Test Results Evaluation

The user will confirm that all XML files conform to the EPSNIS Specification schema definitions.

4.15.4 Test Procedures

The user will execute the following steps:

1. Sample one example of each file type.
2. Validate each file against the EPSNIS XSD files.

4.15.5 Notes

None.

4.15.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.16 Test 16: Vehicle Duplicate Processing

Test Unique Identifier:	T16
Tester:	Ted Wilmes

4.16.1 Test Description

This test case verifies that the clearing house organization will correctly reject any duplicate vehicle transactions.

4.16.2 Requirements Addressed

ID	Requirement
EPSNIS-TDS-3.2	The clearing house organization will reject any duplicate vehicle identified through the account cross check and propagate the rejection back to the toll facility.

4.16.3 Test Results Evaluation

The user will confirm that duplicate vehicle transactions are rejected by the clearing house and the toll facility is notified.

4.16.4 Test Procedures

The user will execute the following steps:

3. Start the EPSNIS Tester.
4. Run the "Duplicate Vehicle" test.
5. Verify that the "Duplicate Vehicle" test indicates success.

4.16.5 Notes

None.

4.16.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.17 Test 17: 30-Day Test

Test Unique Identifier:	T17
Tester:	Ted Wilmes

4.17.1 Test Description

This test case verifies that the transactions generated during the 30-Day Test conform to the EPSNIS Specification.

4.17.2 Requirements Addressed

This test case addresses all of the previously mentioned requirements by referring to the previously executed test steps.

4.17.3 Test Results Evaluation

The user will confirm that transactions collected during the 30-Day Test conform to the EPSNIS Specification. If they do not for certain periods, the user will confirm that the issues causing these discrepancies have been fixed.

4.17.4 Test Procedures

The user will execute the following steps:

1. Start the EPSNIS Tester.
2. Run the “30-Day” test. This test will inject transactions into the system over a 30-day period and the steps outlined in the NYSBA EPSNIS Transaction Simulation Test. This will inject a combination of synthetic and real-world transactions into the test system.
3. Upon completion of the “30-Day” test script, run tests T1 thru T16 of this document to verify that transactions conform to the EPSNIS Specification.

4.17.5 Notes

None.

4.17.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

5. NOTES

None.

APPENDIX A

List of Acronyms

EPSNIS	Electronic Payment Services National Interoperability Specification
FTPS	File Transfer Protocol Secure
NYSBA	New York State Bridge Authority
OBU	Onboard Unit
SwRI	Southwest Research Institute
TBD	To Be Determined
TBR	To Be Reviewed
TDS	Technical Design Specification
VSF	Vehicle Status Files
XML	Extensible Markup Language
XSD	XML Schema Definition

Appendix B –

EPSNIS Test Development Report of Findings Version 1.0, September 30, 2011

Electronic Payment Systems National Interoperability Specification Test Development Report of Findings

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

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September 30, 2011

EPSNIS-Rpt-1.0

Electronic Payment Systems National Interoperability Specification Test Development Report of Findings

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

September 30, 2011



September 30, 2011

Author – Ted Wilmes

Date



September 30, 2011

Manager – Josh Johnson

Date

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APPENDIX A –	ACRONYMS

REVISION NOTICE

Version Identifier	Date of Issue	Summary of Changes
1.0	September 30, 2011	Initial Release

This document contains information that is as complete as possible. Where final numerical values or specification references are not available, best estimates are given and noted To Be Reviewed (**TBR**). Items which are not yet defined are noted To Be Determined (**TBD**). The following table summarizes the TBD/TBR items in this revision of the document, and supplements the revision notice above.

Section	Description

1. Project Information

The following subsections provide project information, a document overview, and identify related documents.

1.1 Project Identification

Project Title:	OmniAir EPSNIS Test Implementation
Project Number:	10-15517
Abbreviation:	EPSNIS-RPT
Version Number:	1.0
Release Number:	1

1.2 Document Overview

This document details the findings produced by Southwest Research Institute from the period before, during, and after the OmniAir Electronic Payment service National Interoperability Specification (EPSNIS) 30-day test.

1.3 Related Documents

- OmniAir EPSNIS Test Ready Working Version 0.6, September 2010
- EPSNIS Technical Specification Test Plan_v1.2, January 25, 2010
- SwRI EPSNIS Test Development Test Plan v1.0, September 30, 2011

2. Test Overview

2.1 Purpose

The purpose of this report is to compile the findings produced while evaluating the EPSNIS specification and running the 30 day EPSNIS test development test. The purpose of this report is not to evaluate the software used during testing, but to review EPSNIS specification. Southwest Research Institute (SwRI), an independent non-for-profit research and development firm, was responsible for conducting the testing and documenting the test findings in this report.

2.2 Test Period

The EPSNIS test development test was initially scheduled for 30 days but ended up running longer than expected due to interfacing and scheduling issues not related to the specification itself. The test period ended up being from July 19, 2011 thru September 26, 2011, for a total of 69 days.

2.3 Test Architecture

Figure 1 illustrates the system architecture utilized for this test. This test differed slightly from the example architecture described in the specification document in that there was no separate OBU provisioner. Instead, two clearing organizations, BancPass and FIS were used. BancPass received transactions from the toll facility, NYSBA, and transferred the FIS transaction accounts to FIS.

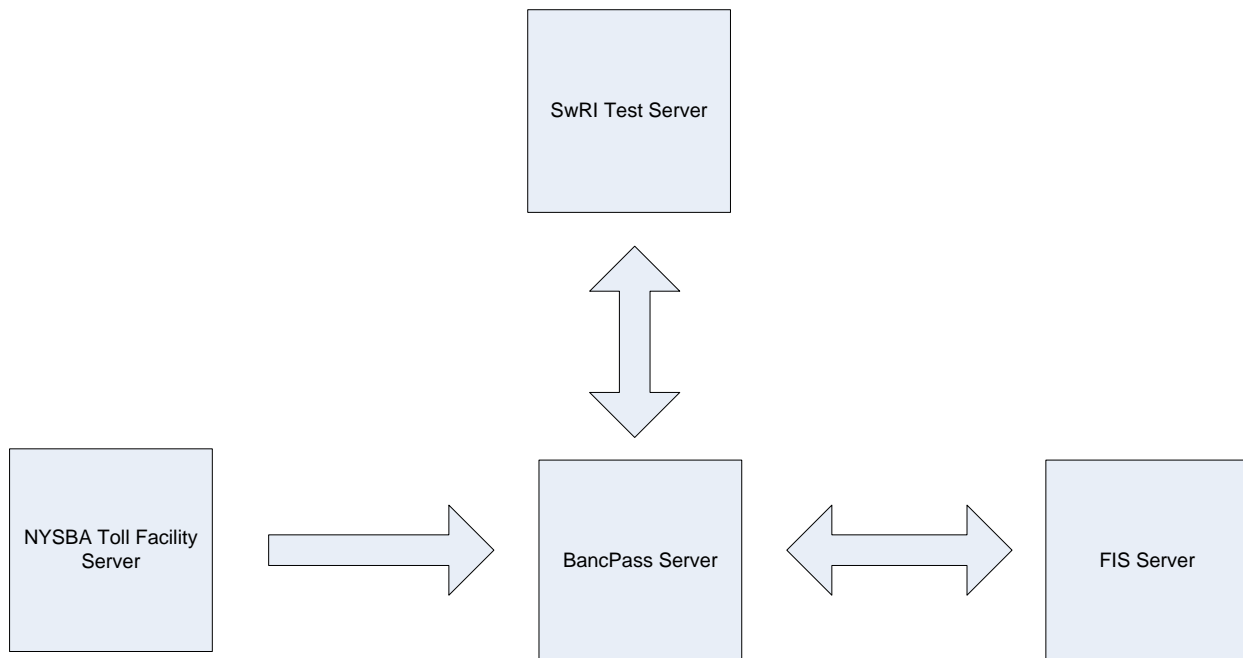


Figure 1. High Level Test Architecture

2.4 Transactions Generation Methods

Transactions for the test were derived from a number of methods. Existing 9.15MHz E-ZPass non-revenue tag read events were captured and assigned a toll amount and then used to create test transactions. This allowed testing in operational lanes without interference with the existing toll collection and audit system. Borrowed 5.9GHz equipment was also installed in the same operational lanes and read events were collected and used to create additional test transactions. Fully synthetic test transactions, generated by SwRI, were also used in cases where the NYSBA software was not capable of producing a specific file type, such as adjustments.

2.5 Analysis Tools

A number of tools were employed to analyze the transactional data generated during the EPSNIS Specification test. Transaction, Reconciliation, Acknowledgement, Settlement, and Adjustment files were copied off of the BancPass server and inserted into an instance of the eXist database. eXist is a hierarchical XML database which allows direct querying and reporting off of XML formatted documents through the use of XQuery. XQuery scripts were written to verify the steps from the test plan and to retrieve additional data required for the evaluation.

3. Test Results

A long term test was performed as part of the EPSNIS specification evaluation. Descriptions of the test procedures and the individual test results can be found in the accompanying SwRI EPSNIS Test Development Test Plan. The test plan was completed successfully for the long term test and all test cases passed.

3.1 Test Statistics

Figure 2 shows the breakdown of processed transactions, by party and file type, for each day of the 30 day test.

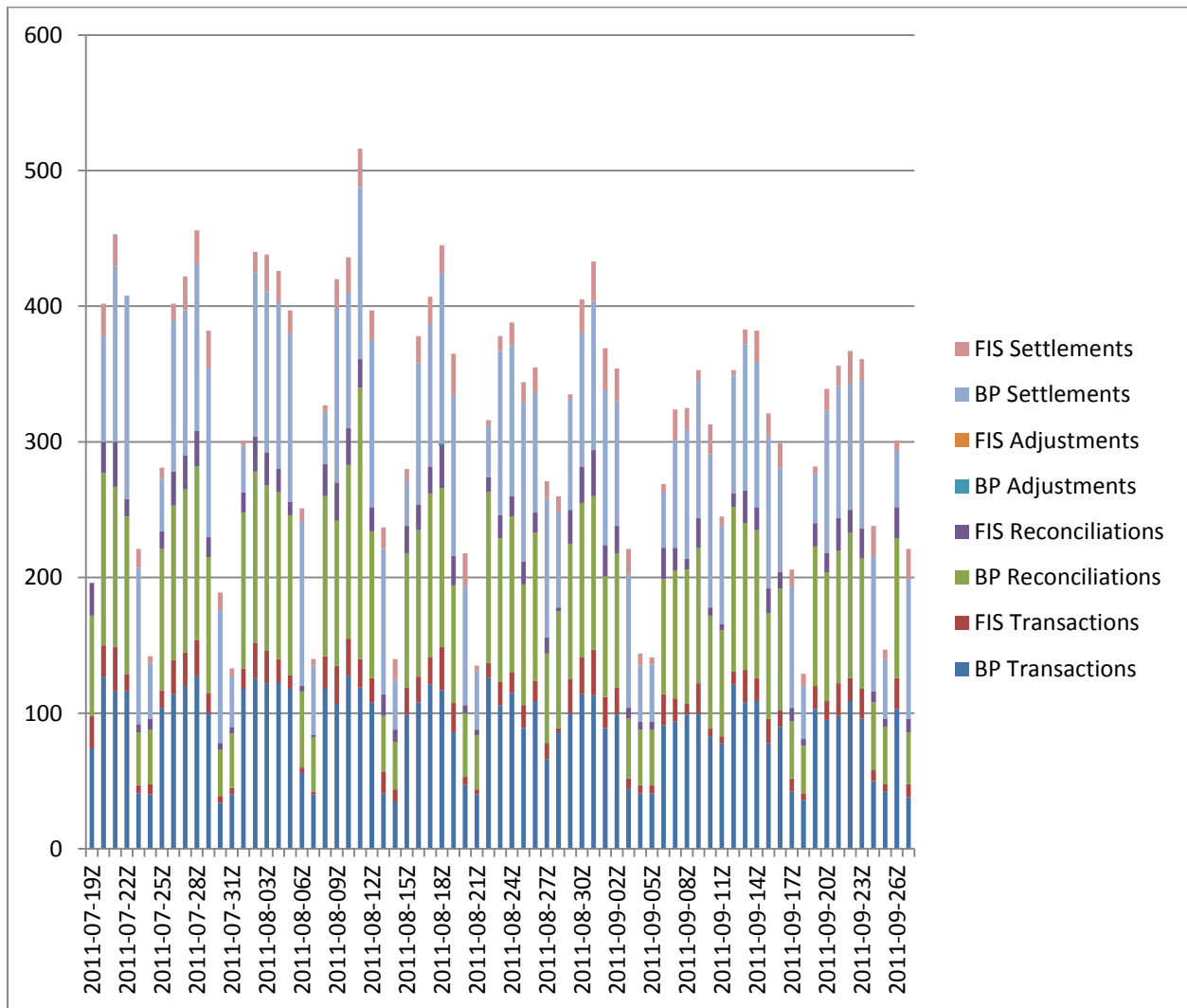


Figure 2. Transactions Processed by BancPass and FIS

Table 1 shows the file counts for each file type exchanged. These counts tally the total files sent by each party for each file type and do not represent transaction counts. The Vehicle Status List is not included because it was exchanged between parties once at the beginning of the test. This was done because the account list did not change throughout the test period.

Table 1. File counts

	Transaction	Reconciliation	Adjustment	Settlement
NYSBA	1422	-	1	-
BP	1422	1424	1	70
FIS	-	1684	-	70

Table 2 shows the total number of transactions sent and settled for BancPass and FIS. The disparity in numbers is related to a number of development issues that were resolved during the first two weeks of testing and was not a result of a specification deficiency.

Table 2. Transaction counts

FIS Transactions	Settled
1159	1100
BancPass Transactions	Settled
6399	6166

4. Findings

The following sections note items discovered before and during the execution of the 30 day test. Many of these findings came as a result of working through the integration process with BancPass and FIS and noting areas of confusion that arose due to ambiguities in the specification text. For the purpose of the long term test, certain assumptions were made and the issue of confusion was noted as a finding and included below.

ID	Finding	Severity	Comment
EPSNIS-RPT-1	Version 0.5 of the EPSNIS specification specified the format of the xml file names for transfer. Version 0.6 removed this format requirement. Having a predetermined file name format will ease implementation and should not adversely affect the flexibility of the specification to different business scenarios.	LOW	
EPSNIS-RPT-2	The file schemas do not include elements that define the originator and sender of the file. While this information is known because the parties agree upon exchange locations of the files, it may be beneficial to include them in the files also so that the files, when pulled out of the context of a specific file location, can still have their origination and destination points identified.	LOW	
EPSNIS-RPT-3	<p>In the appendices, the complex type definitions are repeated for each file type. It would be beneficial to define complex types in one file instead of duplicating their definitions throughout the schemas.</p> <ul style="list-style-type: none"> • This will simplify keeping the XSD files consistent. • Modern code generation tools for Java and C# have trouble generating code for duplicate types in the same namespace. 	LOW	
EPSNIS-RPT-4	Unclear if it is ok to send empty files if no activity occurred during period of interest or if file should have empty xml tags in it, i.e. <TRANSACTION></TRANSACTION> versus an empty file.	LOW	
EPSNIS-RPT-5	In general, many of the fields accept free text and do not have any restrictions. A stricter schema definition may provide less flexibility on the surface but save time down the road because implementers will have a clear, documented example of valid values. Even in cases where free text is needed such as a license place, it may be beneficial to limit the length of the field. The following fields may benefit from greater specificity in their type definitions.	MEDIUM	

ID	Finding	Severity	Comment
EPSNIS-RPT-5.1	AccountType - STATUS has a set of acceptable values listed, this could be defined as an enumeration in the schema so that schema validation will detect unacceptable values.	MEDIUM	
EPSNIS-RPT-5.2	VehicleType - YEAR is listed as a string but could be a 4 digit number.	MEDIUM	
EPSNIS-RPT-5.3	TagType - PROTOCOL – if there is a standard list of protocols, these should be enumerated here (keep in mind that as protocols change, it will still be a simple matter to update the spec to accommodate new valid protocols.)	MEDIUM	
EPSNIS-RPT-5.4	PlateType - STATE – this could be an enumeration of state abbreviations.	MEDIUM	
EPSNIS-RPT-5.5	ClassificationType - SHAPE - if there are specific shapes, these could be enumerated.	MEDIUM	
EPSNIS-RPT-5.6	ClassificationType - CLASS – same as shape, if there are specific classes, these could be enumerated.	MEDIUM	
EPSNIS-RPT-5.7	TollType – the specific values such as E & C could be enumerated.	MEDIUM	
EPSNIS-RPT-5.8	DispositionType - STATUS – these values could be enumerated.	MEDIUM	
EPSNIS-RPT-5.9	TransactionType - Credit and Debit can be limited to two decimals of precision.	MEDIUM	
EPSNIS-RPT-5.10	FileType - STATUS – these values could be enumerated.	MEDIUM	
EPSNIS-RPT-5.11	ProcessRule – there does not appear to be a definition of what a process rule is in the documentation. If there are standard rules, they should be defined in the spec.	MEDIUM	
EPSNIS-RPT-6	Transaction Type is in the Adjustment file XSD but not in body of document. It appears that Transaction Type would need to be specified so that the adjustment could note what credit or debit should be made to the transaction.	MEDIUM	
EPSNIS-RPT-7	Reconciliation File - It is not specified if after an adjustment occurs on a transaction, if a corresponding reconciliation shall be generated and sent.	MEDIUM	

ID	Finding	Severity	Comment
EPSNIS-RPT-8	Acknowledgement File - The FileType does not provide enough error information to figure exactly what may have caused a problem. For example, 'F – Failed to process for bad record' is listed as a possible value. In this case, there does not appear to be any place to describe which particular record was bad such as a specific transaction ID.	MEDIUM	
EPSNIS-RPT-9	The minimum interval for file delivery is stated for each file type. In addition, it would be good to specify a maximum interval such as the Transaction File shall be delivered no less than once per hour and no more than 10 times per hour. As it is written now, a toll facility operator could generate a transaction file for each transaction and deliver it and still fall within the specification. This could potentially cause performance issues.	LOW	
EPSNIS-RPT-10	The specification briefly mentions the clearinghouse to clearinghouse scenario in the executive summary but never again. The included sequence diagrams do not make it clear that this is a valid architecture. It may be beneficial to briefly describe the clearinghouse to clearinghouse in the specification so that it is clear that it is a valid architecture.	MEDIUM	
EPSNIS-RPT-11	Section 10.0 Settlement File does not describe the use of DispositionType within the Transfer element of a settlement. The schema includes a disposition type with a transfer element but it is unclear how this should be used with the different statuses. For example, shall all duplicates that come across in adjustments be included in a duplicate transfer section?	MEDIUM	
EPSNIS-RPT-12	Test date needs to be changed in last paragraph of Section 2.0 Executive Summary.	LOW	
EPSNIS-RPT-13	Section 4.0 Information Flow references an "Account" file in an example. The specification does not define an Account file type.	LOW	
EPSNIS-RPT-14	Section 5.1 Network – a VPN was not used for the 30 day test. Files were exchanged via SFTP and authentication was facilitated through the use of pre-shared keys.	LOW	

ID	Finding	Severity	Comment
EPSNIS-RPT-15	Section 5.3 File Formats – states that functional requirements are detailed in later sections of the document. This document does not contain functional requirements. It is possible Functional requirements means something different here.	LOW	
EPSNIS-RPT-16	Section 5.4 Information Exchange Sequencing – Bullet two mixes Account and VSL file. Is Account file a synonym for VSL file?	LOW	
EPSNIS-RPT-17	Section 5.4 Information Exchange Sequencing – first bullet in second section – leaves decision open to full vs. incremental. This should be defined clearly by the specification and not left up to the user.	LOW	
EPSNIS-RPT-18	Section 5.4 Information Exchange Sequencing – loosely defines ACK file delivery, this would benefit from being set to within an hour.	LOW	

5. Conclusions

The extended test of the EPSNIS was completed on September 23, 2011. All test cases described in the EPSNIS Test Development Test Plan passed. Table 3 shows the total counts for all files involved with the test. There were a number of instances where files were not transmitted on schedule or were not constructed correctly. These were development related issues and not considered deficiencies of the specification. Since the purpose of the test was to evaluate the specification and not the software itself, these development issues were not counted as negative results against the specification.

Table 3. File counts

	Transaction	Reconciliation	Adjustment	Settlement
NYSBA	1422	-	1	-
BP	650	1424	1	70
FIS	-	1684	-	70

Table 4 shows the total number of transactions that were created and settled by BancPass and FIS. Because of the previously mentioned development issues, total transaction, reconciliation, adjustment, and settlement counts did not always clear out as they would have in a production system.

Table 4. Transaction counts

FIS Transactions	Settled
1159	1100
BancPass Transactions	Settled
6399	6166

As with any fledgling specification, there were a number of recommendations that came out of this process. These recommendations were made with the intent to make the specification as easy and straightforward as possible to implement by a developer. With this in mind, there are a number of areas of the specification that would benefit from further clarification and detail. In addition, it is recommended that the XSD documents themselves be constrained more tightly when it comes to data types. Many of these recommendations came out of the process of preparing for and running the long term test.

Appendix C –

EPSNIS Specification Version 1.0, November 2011



Electronic Payment Services National Interoperability Specification

“EPSNIS”

Specification
Version 1

Created by the OmniAir Consortium
Electronic Payment Services Committee with
funding from OmniAir and the I-95 Corridor
Coalition and oversight by the Port Authority
of New York & New Jersey

Version as of November 2011

OmniAir Consortium, Inc., 105 N. Virginia
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Disclosures and Acknowledgements

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Rationale for protection of the EPSNIS

OmniAir is a membership organization and its deliverables result in great part from work generously *contributed* by members. In deference to the member companies, committee members, and the Board of Directors of OmniAir, the Consortium establishes rights of intellectual property for some work. IP rewards creativity, stimulates innovation and contributes to the development of superior products – while safeguarding the public interest.

The EPSNIS is a standard meant to be used widely to support national payments interoperability. Toll facility operators and others who provide transportation services for payment will ideally specify the EPSNIS in Requests for Proposals. The private sector will offer the EPSNIS. OmniAir will test suppliers' compliance to it to ensure interoperability across suppliers and facilities – interoperability that encourages innovation, competition and lower costs.

Interoperability must be constantly defended! Copyright protection doesn't preclude use of the specification. It prevents the *fraudulent* use of the standard by entities that claim EPSNIS compliance but who in fact may not be compliant and thus NOT interoperable with other 'certified' users of the EPSNIS. Copyright also keeps the EPSNIS in the hands of the OmniAir membership who can evolve the standard over time to meet *their* needs, as *they* define them.

The EPSNIS is a product of many individuals and companies. Special thanks go to:

- *The New York State Bridge Authority* for providing the test location and engineer and site support at the Newburgh Beacon Bridge.
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- *The OmniAir EPS Committee* who contributed hundreds of hours of technical expertise and significant direct costs, and who also showed great stamina.
- *The I-95 Corridor Coalition* and its EPS Program Track Committee. In their goal to improve mobility through technology, they realized the value in the proposal and funded it.

Revision History

Version	Date	Revision Summary	Author
Final, Version 1	11/28/2011	Recommended changes as a result of the EPSNIS Test and Findings	OmniAir

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2.0 **Executive Summary**

The Electronic Payment Services National Interoperability Specification for Next Generation ETC Services (EPSNIS) technical standard is written to control a financial transaction network for electronic processing of vehicle transactions. The primary purpose of an EPSNIS controlled financial transaction network is to process toll payments; however, other categories of payments are not intentionally precluded.

This EPSNIS employs a set of Extensible Markup Language (XML) file definitions for information exchange. XML is a general purpose specification that is well suited for describing structured data and validating format. XML file definitions are described using an XML Schema file which describes the required and optional structural elements. Each Clearing Organization that uses the EPSNIS will define and control the process that checks files for compliance with the Clearing Organization's business rules and serializes the information in those files for transmission to and from the Clearing Organization.

The vision is for Clearing Organizations to interoperate in a financial network to process transactions for their clients. File transfers can also occur between two different Clearing Organizations in this financial network with each serving their own OBU Provisioners and Toll Facility Operators. It is also possible for an organization to provide the services of both an OBU Provisioner and a Clearing Organization, a Clearing Organization and Toll Facility Operator, or all three. The purpose of the EPSNIS Technical Specification is to provide the data standard between any two organizations in an EPSNIS network.

Toll Facility Operators, Clearing Organizations, and OBU Provisioners are responsible for creating their own files using the XML schemas described by this specification. These file creation responsibilities and their corresponding transmission are summarized in Figure 1 - EPSNIS Information Flow.

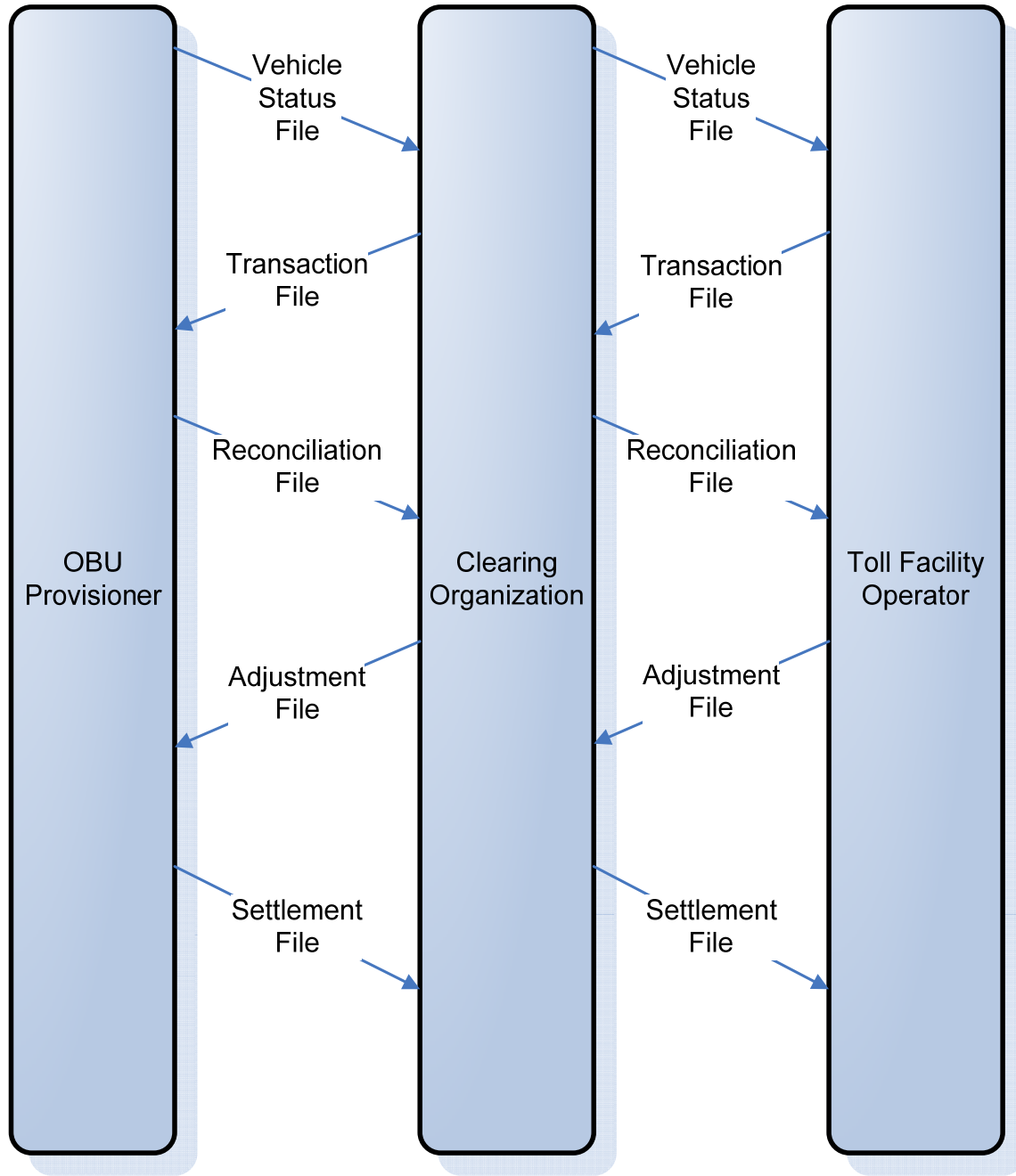


Figure 1 - EPSNIS Information Flow

This version of the EPSNIS has been developed to completely support OmniAir’s 2011 testing at the New York State Bridge Authority’s Newburgh-Beacon Bridge and to determine what is required next to use the EPSNIS in a production environment to facilitate revenue collection.

3.0 **Objectives**

The purpose of the Technical Specification document is to describe the file exchange process and proposed file structures for information exchange of ETC services. This document is not intended to describe the internal processes used to utilize the files or manage the tolling process within each organization.

3.1 **Definitions**

Clearing Organization: A legal entity that performs all of the Clearing Organization functions described by this document and provides/operates EPSNIS compliant Clearing Organization systems using the legal entity's own employees or vendors/contractors that the legal entity hires are responsible for.

Information is exchanged between a Toll Facility Operator and a Clearing Organization and between a Clearing Organization and an OBU Provisioner. Each is responsible for creating their own files using the XML schemas described by this Specification. File transfers can also occur between two different Clearing Organizations in this financial network with each serving their own OBU Provisioners and Toll Facility Operators. Each Clearing Organization that uses the EPSNIS defines and controls the process that checks files for compliance with the Clearing Organization's business rules and serializes the information in those files for transmission to and from the Clearing Organization.

Among other functions performed by a Clearing Organization, the Clearing Organization:

- Provides/operates the system(s) on one side of each systems interface controlled by the EPSNIS.
- Is one of the two parties involved in each information exchange controlled by the EPSNIS.

Closed Barrier System: A method of toll collection in which the toll amount is based on where each individual vehicle enters and exits (a "ticket" system)

Deposit Account: A current account at a banking institution that allows money to be deposited withdrawn by the bank account holder.

DSRC: Dedicated Short Range Communications

EPS: Electronic Payment Services. The EPS Committee is a formal committee of OmniAir.

EPSNIS: The Electronic Payment Services National Interoperability Specification for Next Generation ETC Services

ETC: Electronic Toll Collection

FHWA: Federal Highway Administration

FTPS: File Transfer Protocol Secure, also known as FTP Secure and FTP-SSL, is one of the common schemas of the application layer (layer 7) in the OSI Model.

GMT: Greenwich Mean Time

IEEE: The Institute of Electrical and Electronics Engineers

Internet: The global network that uses packet switching via TCP/IP for exchanging information between most personal, commercial, non-profit (including educational institutions), and government networks.

IP: Internet Protocol, a standard commonly used to provide network function (layer 3) for the Internet in an OSI Model.

ISP: Internet Service Provider

Issuing Bank: A bank issuing a credit card, debit card, or similar general-purpose payment account and responsible for the underlying financial relationship with the consumer, business, or non-profit to which it was issued.

LCL: Local time of the tolling lane/zone

Merchant Bank: The bank contracted by the OBU Provisioner to process credit card, debit, and other electronic payment transactions for the purpose of funding the customer toll accounts maintained by the OBU Provisioner.

OBU: On Board Unit, the device installed in a vehicle, associated with a payment account, and used to help identify that payment account when a vehicle incurs a toll in a Toll Facility Operator.

OBU Provisioner: A legal entity that performs all of the OBU Provisioner functions described by this document and provides/operates EPSNIS compliant OBU Provisioner systems using the legal entity's own employees or vendors/contractors that the legal entity hires and is responsible for. Some of the functions performed exclusively by an OBU Provisioner include provisioning, activation, and maintenance of OBUs, and setting up, holding, and managing the associated customer payment accounts.

Open Barrier System: A method of toll collection in which the toll amount is independent upon where each individual vehicle enters and exits.

OSI Model: Open Systems Interconnection Reference Model, a construct commonly used to describe the various network layers and their respective functions

RSU: Road Side Unit, the device installed in a Toll Facility Operator for communicating with OBUs

TLS: Transport Layer Security, a standard commonly used to provide transport layer (layer 4) functions for the Internet in an OSI Model

Toll Facility Operator: A legal entity that performs all of the Toll Facility Operator functions described by this document and provides/operates EPSNIS compliant Toll Facility Operator systems using the legal entity's own employees or vendors/contractors that the legal entity hires and is responsible for. Some of the functions performed exclusively by a Toll Facility Operator include assessing, receiving payment for, and settling tolls for a vehicle's travel on a road, bridge, or tunnel.

TCP: Transmission Control Protocol, a standard commonly used to provide transport layer (layer 4) and possibly some session layer (layer 5) functions for the Internet in an OSI Model.

USDOT: United States Department Of Transportation

VPN: Virtual Private Network, a logical network established within a larger network to provide certain special attributes. Special attributes include authentication, encryption, quality of service, protection from denial of service, and others.

XML: Extensible Mark-up Language, a general purpose specification for describing structured information.

XSLT: Extensible Stylesheet Language Transformations, a XML based standard for describing the transformation of XML into other document formats.

3.2 **Background**

3.2.1 **Existing ETC Systems**

Electronic Toll Collection is a common practice today. In some regions of the United States, there are technical, financial, and other arrangements that have been established that allow a single OBU to be used for paying tolls elsewhere within the region where it was issued. Arguably, the better known "brands" of such regional arrangements are:

- E-ZPass (in the northeastern quadrant of the continental United States)
- FasTrak (in California)
- SunPass (in Florida)
- TxTag (in Texas)

There are no known arrangements in place between any of these brands that would enable an OBU to electronically pay tolls outside the region where it was issued.

3.2.2 **FHWA**

In September 2007, the Federal Highway Administration (FHWA) issued a Notice of Proposed Rule Making pertaining to "Interoperability Requirements, Standards, or Performance Specifications for Automated Toll Collection Systems." Arguably, adoption of such a rule could produce interoperability across two or more regions of the

United States that are not interoperable today and/or could result in the nationwide adoption of a single tolling interoperability standard.

3.2.3 **USDOT**

The USDOT launched the VII initiative. Arguably, this initiative could result in the deployment of OBUs and associated roadside equipment utilizing the 5.9GHz (DSRC) frequency licensed by the Federal Communications Commission for the exclusive use of the transportation industry and/or could result in the nationwide adoption of a single tolling interoperability standard.

3.2.4 **Related Documents**

IEEE 802.11p – Wireless Access for the Vehicular Environments (WAVE)

4.0 **Information Flow**

The EPSNIS Information Flow illustrated earlier in Figure 1 includes five information exchanges that occur on the left side of Figure 1 and five similar exchanges that occur on the right side. An information exchange on the left side of Figure 1 contains the same information types as the corresponding information exchange on the right side, resulting in five sets of file type “twins”. These similarities enable this EPSNIS to fully specify all of the information exchanges in Figure 1 using just five file structures (and an Acknowledgement File), specifically the:

- Vehicle Status File structure as detailed in Section 7.0.
- Transaction File structure as detailed in Section 8.0.
- Reconciliation File structure as detailed in Section 9.0.
- Adjustment File structure as detailed in Section 10.0.
- Acknowledgement File structure as detailed in Section 11.0.
- Settlement File structure as detailed in Section 0.

The Clearing Organization processes information. Any information the Clearing Organization sends may purposefully not be identical to the information it receives. Clearing Organizations may alter data (e.g. to provide value-added services such as financial surety) or remove data (e.g. to convert a violation into a toll transaction without disclosing the relationship between a license plate and a customer account). Because the information contained in any file will probably not be identical to that of its twin, the terms A-File and B-File are used to differentiate the two:

- A-File appropriately connotes original information and an initial transmission. Only OBU Provisioners and Toll Facility Operators create A-Files and transmit A-Files.
- B-File appropriately connotes both a derivative of an A-File and subsequent transmission. Only Clearing Organizations create B-Files and transmit B-Files.

As an example:

1. A Vehicle Status A-File is created by the OBU Provisioner.
2. The OBU Provisioner then transmits this Vehicle Status A-File to the Clearing Organization.
3. The information in the Vehicle Status A-File is processed by the Clearing Organization and used with other information by the Clearing Organization to create a Vehicle Status B-File.
4. The Clearing Organization then transmits this Vehicle Status B-File to the Toll Facility Operator.

The contents of the five file structures are further defined in Sections 7.0 through 0 with the XML Schema descriptions presented in Section 13.0. The current XML Schemas are provided in Appendix A Common XSD through Appendix G Settlement XSD.

5.0 Money Flow

EPSNIS has been developed to allow every Clearing Organization to set up its own policies and business rules when it comes to the payments to be made by the OBU Provisioner to the Toll Facility Operator. In this manner, Clearing Organizations with different Service Levels can coexist in the EPSNIS network.

The standard supports offerings where all payments to be made by several OBU Provisioners to one Toll Service Provider are consolidated by the Clearing Organization (so payments are made from the OBU Provisioner to the Clearing Organization and then from the Clearing Organization to the Toll Service Provider), while other Clearing Organizations may request payments to be made directly by the OBU Provisioner to the Toll Service Provider, accordingly to the Settlement files.

6.0 Architecture

6.1 Network

A Clearing Organization may provide generic services and/or premium value-added services (e.g. fraud control, financial surety, disaster recovery, etc.) and have special/specific network requirements to support each of these.

- Detailed specifications for the various network layers used for the connection between each Clearing Organization and each OBU Provisioner will be mutually decided and agreed to by these respective parties for production environments.
- Similarly, detailed specifications for the various network layers used for the connection between each Toll Facility Operator and their contracted Clearing Organization will be mutually decided and agreed to by these respective parties for production environments.

6.2 **Information Exchange Mechanisms**

During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 7.0 through 0. These XML files are then transmitted in their entirety using File Transfer Protocol Secure (FTPS) over the network described in Section 6.4. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

After the initial testing, Clearing Organizations may make private arrangements with OBU Provisioners and/or Toll Facility Operators for:

- Extracting, reducing, transmitting, and re-assembling information in EPSNIS controlled XML files
- Authentication
- Security
- Performance monitoring
- Network traffic management and bandwidth allocation
- Disaster recovery
- Any other functions the Clearing Organization may use in providing value-added services

6.3 **File Formats**

The XML Schema files are presented in Appendix A Common XSD through Appendix G Settlement XSD. In the case where a party does not have any data for the last time period to send, they shall send a file containing only an empty root element. Zero length files shall not be exchanged.

6.4 **Information Exchange Sequencing**

Data file exchange between Clearing Organization and Toll Facility is illustrated in Figure 2 - Data File Exchange between Clearing Organization and Toll Facility.

During initial testing of the EPSNIS, the information exchange sequencing requirements are as follows:

- Parties providing Vehicle Status Files (VSF) shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.
- Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly. All transactions must reflect the account status, payment guarantee, and other information of the latest full replacement VSF and any incremental update VSF that were received prior to the time of each transaction.

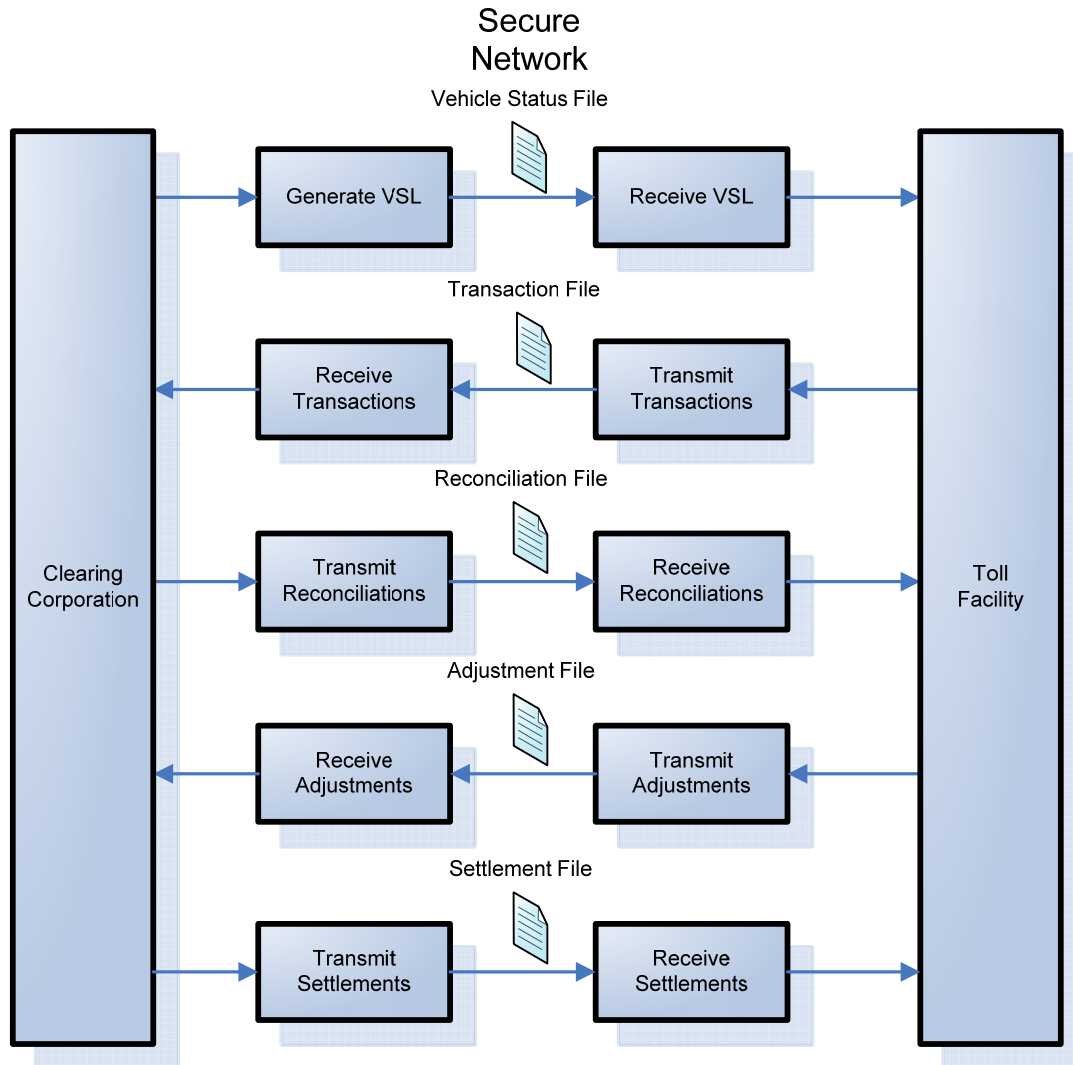


Figure 2 - Data File Exchange between Clearing Organization and Toll Facility

- Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.
- Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly. Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File.
- Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.

After the initial testing, the price a Toll Facility Operator pays and the financial risks the Toll Facility Operator retains will be affected by the sequencing of their information exchanges with their contracted Clearing Organization. This price and retained risk are also affected by the sequencing of information exchanged by their contracted Clearing Organization and the various OBU Provisioners. To maximize the breadth of business

models supported by the EPSNIS and the number of pricing options offered by Clearing Organizations after the initial testing, each:

- VSL Lists may be either full or incremental. The Toll Facility Operator will have the ability to configure how frequently they wish to receive incremental updates during the day. At a minimum, the Clearing Organization will make available: 1) Daily full updates, 2) Incremental updates hourly. If the Operator chooses to receive incremental updates less frequently, no information will be lost, and each incremental will fully supplement the last incremental the Operator received.
- Non-VSL files can be sent as soon as the receiver has acknowledged the previous file. The receiver must be able to receive multiple file-types simultaneously; but the receiver will not be required to receive and process multiple files of the same type simultaneously.
- OBU Provisioner and each Clearing Organization may mutually set the frequency of their file exchanges, the range of permissible timeliness for all data in each file, and the conditions under which a full vs. an incremental file exchange is required.

Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed. There is normally a time limit of 1 hour on receipt of an acknowledgement, but this may be adjusted based on the Toll Facility's or OBU Provisioner's requirements. The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure. If the second attempt also fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.

7.0 **Vehicle Status File**

The Vehicle Status File is descriptive of customer accounts, vehicles, tolling devices, payers, and the relationship between them. The Vehicle Status File also provides a summary of any associated payment guarantees, non-revenue details and discount plans as optional fields.

Each OBU Provisioner describes its customers' accounts to a Clearing Organization via Vehicle Status A-Files. The Clearing Organization aggregates this information and provides customer account information to a Toll Facility Operator via Vehicle Status B-Files.

The example in Figure 3 - Sample Vehicle Status File shows a Vehicle Status File with several optional entries:

1. An account with a license plate and no transponder
2. An account with an optional account type
3. An account with a specific protocol code (determined by OBU)

```

<?xml version="1.0" encoding="UTF-8"?>
<VEHICLESTATUSLIST xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="file:/E:/XMLProjects/OmniAir-Spec1/VSL.xsd">
  <AGENCY>
    <NAME>Test Agency</NAME>
    <CODE>100</CODE>
    <ACCOUNT>
      <DETAILS>
        <ACCOUNTID>1000</ACCOUNTID>
        <STATUS>G</STATUS>
      </DETAILS>
      <PLATE>
        <STATE>TX</STATE>
        <NUMBER>ABC123</NUMBER>
      </PLATE>
    </ACCOUNT>
    <ACCOUNT>
      <DETAILS>
        <ACCOUNTID>1001</ACCOUNTID>
        <STATUS>G</STATUS>
        <ACCOUNTTYPE>Commercial</ACCOUNTTYPE>
      </DETAILS>
      <PLATE>
        <STATE>TX</STATE>
        <NUMBER>XYZ123</NUMBER>
      </PLATE>
      <TAG>
        <TAGID>12345678</TAGID>
        <PROTOCOL>5900</PROTOCOL>
      </TAG>
    </ACCOUNT>
  </AGENCY>
</VEHICLESTATUSLIST>

```

License Plate Account with No Transponder

Optional AccountType

Optional Tag Protocol

Figure 3 - Sample Vehicle Status File

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix B Vehicle Status List XSD.

8.0 Transaction File

The Transaction File describes transactions and is effectively an invoice for payment.

A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.

The Clearing Organization processes this information and creates its own (offsetting) transactions. The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.

Posting of Transaction Files by the Toll Service Provider create a demand for payment, either directly or through the Clearing Organization.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix C Transaction XSD.

9.0 Reconciliation File

After receiving a Transaction B-File from the Clearing Organization, an OBU Provisioner posts the enclosed transactions to their respective customer accounts. Customer account holders may then dispute a transaction. All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.

The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them. Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification. To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File as described below and sends the file to the Clearing Organization. Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.

Similarly, the Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated. To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File as described below and sends the file to the Toll Facility Operator. Reconciliation information is used to prepare the Settlement File.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix D Reconciliation XSD.

10.0 Adjustment File

A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.

A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix E Adjustment XSD.

11.0 Acknowledgement File

Each party will be responsible for generating an Acknowledgement File upon receipt of the other EPSNIS message types. The Acknowledgement File will confirm that the file was successfully retrieved and processed or that it was received and there was one or more errors found. In the case of errors, the Acknowledgement File will contain EPSNIS specific error numbers and if applicable, the line number where the error occurred. These errors are listed in Appendix H Error Codes of this document.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix F Acknowledgement XSD.

12.0 Settlement File

Settlement Files detail which transactions, disputes, and adjustments one network member's bank deposit account has paid to another member's bank deposit account. The following information types are supported by the Settlement File:

- The transaction amount with all associated discounts, payment guarantees, and adjustments factored in.
- Fees, if any

An OBU Provisioner reports the deposits to the Clearing Organization that its bank makes. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.

A Clearing Organization reports the deposits made into the Toll Facility Operator's bank either by itself or directly by the OBU Provisioner. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix G Settlement XSD.

13.0 XML File Structure

Each XML file consists of a root element which contains a sequence of child elements that make up the set of data. Each child element may contain additional child elements to create a hierarchy. To simplify the XML definition, an XML schema is provided for each root element and a set of XML simple types and complex types. The complex types represent functional entities such as a transponder mounted in a vehicle, a set of AVC parameters or transaction posting details. This allows updates to a functional element to be made independently and makes the format more easily read. The complex types may be reused as necessary throughout the schema definition. Definitions of the shared complex types are provided in Appendix A Common XSD of this document.

13.1 **Complex Types**

The XML complex types are uniquely named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and can have multiple instances defined at each level.

Each XML file consists of a root element which contains a sequence of child elements that make up the set of data. Each child element may contain additional child elements to create a hierarchy. The complex types represent functional entities such as a transponder mounted in a vehicle, a set of AVC parameters or transaction posting details

13.1.1 **AccountType**

The AccountType is an XML complex type describing the type of vehicle account and the current account status.

Field	Type	Required	Description
ACCOUNTID	String	Yes	The account owners unique ID
GUARANTEED	String	No	The guaranteed status of the account. Allowed values are: Y for yes N for no (default) <i>Note: custom values as well</i>
ACCOUNTTYPE	String	No	The type of account defined by file originator
RESIDENTTYPE	String	No	The type of resident discount specific to the ETC provisioner
NONREVENUE	String	No	The Non-Revenue status
STATUS	String	Yes	The type of account defined by file originator, typically: V for valid B for low balance Z for no balance L for lost S for stolen R for returned

13.1.2 **VehicleType**

The VehicleType is an XML complex type describing the detailed features of the vehicle.

Field	Type	Required	Description
MAKE	String	No	The make of the vehicle
MODEL	String	No	The model of the vehicle
YEAR	String	No	The model year of the vehicle
VIN	String	No	The Vehicle Identification Number
VII	String	No	The Vehicle Infrastructure Identification number

13.1.3 TagType

The TagType is an XML complex type containing the ETC transponder information.

Field	Type	Required	Description
TAGID	String	Yes	The tag id for the transponder
PROTOCOL	String	No	The protocol used for the transponder in a multiprotocol system
AGENCY	Number	No	The agency id of the transponder used by some protocols
VEHICLECLASS	String	No	The issuers classification level for the tagged vehicle

13.1.4 PlateType

The PlateType is an XML complex type containing the license plate information for the vehicle.

Field	Type	Required	Description
STATE	String	Yes	The code for the governing entity that issued the license plate
NUMBER	String	Yes	The license plate number
STYLE	String	No	The license plate style used by the governing entity

13.1.5 AgencyAccountType

The AgencyAccountType is an XML complex type containing the detailed account information for a single vehicle.

Field	Type	Required	Description
VEHICLE	VehicleType	No	The vehicle details
PLATE	PlateType	No	The license plate details
TAG	TagType	No	The ETC transponder details
DETAILS	AccountType	Yes	The account details

13.1.6 LocationType

The LocationType is an XML complex type containing the location of the toll event.

Field	Type	Required	Description
PLAZA	String	Yes	The plaza name or code for the toll transaction
LANE	Number	Yes	The lane number for the toll transaction

13.1.7 ClassificationType

The ClassificationType is an XML complex type containing the vehicle classification from the toll facility.

Field	Type	Required	Description
IOPREGION	String	Yes	The Interoperability Region used to determine the Vehicle Class (below) e.g. TxTAG, SunPass, IAG, PikePass, KTAG, GoToGo, FasTrak.
VEHCLASS	Number	Yes	The Vehicle Class as defined by the IOP Region
HEIGHT	Number	No	The height of the vehicle in feet
WEIGHT	Number	No	The weight of the vehicle in pounds
FHWAClass	Number	No	1-8 The FHWA defined shape of the vehicle expected by the provisioner http://en.wikipedia.org/wiki/Truck_classification
TAGCLASS	String	No	The vehicle class from the provisioner
FORWARDAXLES	Number	No	The forward axle count from the AVC
REVERSEAXLES	Number	No	The reverse axle count from the AVC
INDICATEDAXLES	Number	No	The collector indicated number of axles

13.1.8 TollType

The TollType is an XML complex type containing the vehicle classification from the toll facility.

Field	Type	Required	Description
TYPE		Yes	The type of toll for the transaction which typically includes: E - ETC fare C - Cash fare
AMOUNT	Number	Yes	The amount in US Dollars for the transaction

13.1.9 DispositionType

The DispositionType is an XML complex type containing the processing status.

Field	Type	Required	Description
STATUS	String	Yes	The status of the transaction which includes: PAID – Transaction paid INVALID LOCATION – Location not recognized INVALID TAG – Tag provided is not valid INVALID PLATE – Plate account is not valid INVALID CLASS – Vehicle classification not recognized NOT FUNDED – Account not funded UNKNOWN TAG – Tag not recognized on VSL DUPLICATE – Transaction is a duplicate XLANE DUPLICATE – Transaction appears

Field	Type	Required	Description
			at additional location in close time proximity IMPROPER FORMAT – Record failed formatting check or other validation error
SUBCODE	String	No	An detailed code if the transaction status has fine grained details, such as an OBU specific description

13.1.10 TransactionType

The TransactionType is an XML complex type containing the transaction posting details.

Field	Type	Required	Description
Account	String	Yes	The account posted for this transaction from the provisioner of the account
Posted	Date	Yes	The date the account posted
Credit	Number	No	The amount credited to the account
Debit	Number	No	The amount debited from the account

13.1.11 Error

The Error is an XML complex type containing error information.

Field	Type	Required	Description
NUMBER	Number	Yes	One of the error numbers specified in Appendix H of this document.
LINE	Number	No	The line number in the file where the error occurred.

13.1.12 FileType

Field	Type	Required	Description
FILENAME	String	Yes	The name of the file that was received
ERRORS	ERROR	NO	The ERRORS element contains a list of errors detected during the processing of any of the EPSNIS documents.

13.1.13 ProcessRule

Field	Type	Required	Description
TYPE	String	Yes	The type of processing rule applied to the transaction
DETAILS	String	Yes	Details of the processing rule such as number of trips for a trip based discount

13.1.14 FileIdentifier

Field	Type	Required	Description
FILEKEY	Hex String	Yes	OmniAir 256 bit Hex PKI key used to verify file originates from an

Field	Type	Required	Description
			authenticated sender
ORIGINATOR	String	Yes	The unique string assigned to the file originator
DESTINATION	String	Yes	The unique string assigned to the intended recipient of the file

13.2 **Vehicle Status List (VSL)**

The Vehicle Status List (VSL) is a collection of accounts for one or more agencies. A single VSL transmitted from the Clearing Organization will typically contain all agencies supported by the Clearing Organization while a VSL received by the Clearing Organization from an OBU Provisioner will contain only the accounts supported by that provisioner.

Field	Type	Required	Description
VEHICLESTATUSLIST	XML Element	Yes	The root level element containing 1 or more AGENCY elements
AGENCY	XML Element	Yes	Contains a vehicle accounts for a single agency such as an ETC provisioner containing 1 or more ACCOUNT elements
NAME	String	Yes	The name of the agency
CODE	Number	Yes	The numeric code used for this agency
ACCOUNT	AgencyAccountType	Yes	An agency account entry for a single vehicle

The XML Schema file is listed in Appendix B Vehicle Status List XSD.

13.3 **Transaction File**

The Transaction file is a collection of detailed transaction events from one or more toll facilities. Files may be processed against a Clearing Organization account but may also be forwarded to an OBU Provisioner for processing. The Clearing Organization will store the transaction status if the account is forwarded.

Field	Type	Required	Description
TRANSACTION	XML Element	Yes	The root level element containing 1 or more DETAIL elements
DETAIL	XML Element	Yes	The detail record containing the transaction details
DATE	Date	Yes	The date the transaction event occurred in GMT
TIME	Time	Yes	The time the transaction event occurred in GMT
REFERENCEID	Number	Yes	The unique reference id issued by the toll facility
LOCATION	LocationType	Yes	The location of the transaction event; if 2 location fields are provided then this is a Closed

Field	Type	Required	Description
			Barrier System
CLASSIFICATION	ClassificationType	Yes	The classification of the vehicle for the transaction
TAG	TagType	No	The tag details for the transaction
PLATE	PlateType	No	The plate details for the transaction
VEHICLE	VehicleType	No	The vehicle details for the transaction
FARES	XML Element	Yes	Element containing 1 or more TOLL elements
TOLL	TollType	Yes	Element containing fare details

The XML Schema file is listed in Appendix C Transaction XSD.

13.4 **Reconciliation File**

The Reconciliation file is a collection of detailed reconciliation events from an OBU Provisioner or the Clearing Organization. The Clearing Organization will store and forward the reconciliation records received from an OBU Provisioner.

Field	Type	Required	Description
RECONCILIATION	XML Element	Yes	The root level element containing 1 or more DETAIL elements
DETAIL	XML Element	Yes	The detail record containing the transaction details
DATE	Date	Yes	The date the transaction event occurred in GMT
TIME	Time	Yes	The time the transaction event occurred in GMT
REFERENCEID	Number	Yes	The unique reference id issued by the toll facility
OBUID	Number	Yes	The unique id issued by OBU for the transaction
LOCATION	LocationType	Yes	The location of the transaction event; if 2 location fields are provided then this is a Closed Barrier System
CLASSIFICATION	ClassificationType	Yes	The classification of the vehicle for the transaction
TAG	TagType	No	The tag details for the transaction
PLATE	PlateType	No	The plate details for the transaction
VEHICLE	VehicleType	No	The vehicle details for the transaction
DISPOSITION	XML Element	Yes	An XML Element containing the PROCESS element and 1 or more account ACTIVITY elements
PROCESS	DispositionType	Yes	The current transaction status
ACTIVITY	TransactionType	Yes	The account activity for the transaction

The XML Schema file is listed in Appendix D Reconciliation XSD.

13.5 **Adjustment File**

The Adjustment file is a collection of adjustments to be made to transactions already submitted the Clearing Organization or OBU Provisioner. They may include changes to the transaction details such as the toll amount or a status change such as a cancellation.

Field	Type	Required	Description
ADJUSTMENT	XML Element	Yes	The root level element containing 1 or more DETAIL elements or 1 or more CHANGE elements
DETAIL	XML Element	Yes	The detail record containing the transaction details
DATE	Date	Yes	The date the transaction event occurred in GMT
TIME	Time	Yes	The time the transaction event occurred in GMT
REFERENCEID	Number	Yes	The unique reference id issued by the toll facility
LOCATION	LocationType	Yes	The location of the transaction event
CLASSIFICATION	ClassificationType	Yes	The classification of the vehicle for the transaction
TAG	TagType	No	The tag details for the transaction
PLATE	PlateType	No	The plate details for the transaction
VEHICLE	VehicleType	No	The vehicle details for the transaction
FARES	XML Element	Yes	Element containing 1 or more TOLL elements
CHANGE	XML Element	Yes	The record containing a status change command
OBUID	Number	Yes	The unique id issued by OBU for the transaction
STATUS	String	Yes	The status command submitted to the payment processor

The XML Schema file is listed in Appendix E Adjustment XSD.

13.6 **Acknowledgement File**

The Acknowledgement file contains a list of one or more XML files that have been processed or been rejected.

Field	Type	Required	Description
ACKNOWLEDGEMENT	XML Element	Yes	The root level element containing 1 or more FILE elements
FILE	FileType	Yes	The file status returned from the receiver

The XML Schema file is listed in Appendix F Acknowledgement XSD.

13.7 **Settlement File**

The Settlement file is a collection of bank transfers made to transactions already submitted the Clearing Organization or OBU Provisioner. They may include changes to the transaction details such as the toll amount or a status change such as a cancellation.

Field	Type	Required	Description
SETTLEMENT	XML Element	Yes	The root level element containing 1 or more TRANSFER elements
TRANSFER	XML Element	Yes	The detail record containing the bank transfer details
SETTLEMENTDATE	Date	Yes	The date the bank transfer should post by
POSTEDDATE	Date	Yes	The date the transactions were posted on the source system
TRANSACTIONS	Number	Yes	The number of transactions processed
DEBIT	Float	Yes	The amount debited from the account
CREDIT	Float	Yes	The amount credited to the account
DISPOSITION	DispositionType	Yes	The disposition type of the transfer

The XML Schema file is listed in Appendix G Settlement XSD.

Appendix A Common XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns="http://www.omniair.org" targetNamespace="http://www.omniair.org">
  <xs:complexType name="FileIdentifier">
    <xs:all>
      <xs:element name="ORIGINATOR" type="xs:string" minOccurs="1"/>
      <xs:element name="DESTINATION" type="xs:string" minOccurs="1"/>
      <xs:element name="FILENAME" type="xs:string" minOccurs="1"/>
      <xs:element name="FILEKEY" type="xs:hexBinary" minOccurs="1"/>
    </xs:all>
  </xs:complexType>
  <xs:complexType name="AccountType">
    <xs:all>
      <xs:element name="ACCOUNTID" type="xs:string"/>
      <xs:element name="GUARANTEED" minOccurs="0">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:enumeration value="Y"/>
            <xs:enumeration value="N"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="ACCOUNTTYPE" type="xs:string" minOccurs="0"/>
      <xs:element name="RESIDENTTYPE" type="xs:string" minOccurs="0"/>
      <xs:element name="NONREVENUE" type="xs:string" minOccurs="0"/>
      <xs:element name="STATUS">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:enumeration value="V"/>
            <xs:enumeration value="B"/>
            <xs:enumeration value="Z"/>
            <xs:enumeration value="L"/>
            <xs:enumeration value="S"/>
            <xs:enumeration value="R"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
    </xs:all>
  </xs:complexType>
  <xs:complexType name="AgencyAccountType">
    <xs:all>
      <xs:element name="VEHICLE" type="VehicleType" minOccurs="0"/>
      <xs:element name="PLATE" type="PlateType" minOccurs="0"/>
    </xs:all>
  </xs:complexType>
</xs:schema>
```

```

    <xs:element name="TAG" type="TagType" minOccurs="0"/>
    <xs:element name="DETAILS" type="AccountType"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="LocationType">
  <xs:all>
    <xs:element name="PLAZA" type="xs:string"/>
    <xs:element name="LANE" type="xs:int"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="ClassificationType">
  <xs:all>
    <xs:element name="OPREGION" type="xs:string"/>
    <xs:element name="VEHCLASS" type="xs:string"/>
    <xs:element name="HEIGHT" type="xs:int" minOccurs="0"/>
    <xs:element name="WEIGHT" type="xs:int" minOccurs="0"/>
    <xs:element name="FWWCLASS" type="xs:int" minOccurs="0"/>
    <xs:element name="SHAPE" type="xs:string" minOccurs="0"/>
    <xs:element name="TAGCLASS" type="xs:string" minOccurs="0"/>
    <xs:element name="FORWARDAXLES" type="xs:int" minOccurs="0"/>
    <xs:element name="REVERSEAXLES" type="xs:int" minOccurs="0"/>
    <xs:element name="INDICATEDAXLES" type="xs:int" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="TagType">
  <xs:all>
    <xs:element name="TAGID" type="xs:string"/>
    <xs:element name="PROTOCOL" type="xs:string" minOccurs="0"/>
    <xs:element name="AGENCY" type="xs:integer" minOccurs="0"/>
    <xs:element name="VEHICLECLASS" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="PlateType">
  <xs:all>
    <xs:element name="COUNTRY" type="xs:string"/>
    <xs:element name="STATE" type="xs:string"/>
    <xs:element name="NUMBER" type="xs:string"/>
    <xs:element name="STYLE" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="VehicleType">
  <xs:all>
    <xs:element name="MAKE" type="xs:string" minOccurs="0"/>
    <xs:element name="MODEL" type="xs:string" minOccurs="0"/>
    <xs:element name="YEAR" type="xs:gYear" minOccurs="0"/>
    <xs:element name="VIN" type="xs:string" minOccurs="0"/>
  </xs:all>

```

```

    <xs:element name="VII" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="TollType">
  <xs:all>
    <xs:element name="TYPE">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="E"/>
          <xs:enumeration value="C"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
    <xs:element name="AMOUNT" type="xs:float"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="ProcessRule">
  <xs:all>
    <xs:element name="TYPE" type="xs:string"/>
    <xs:element name="DETAILS" type="xs:string"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="DispositionType">
  <xs:all>
    <xs:element name="STATUS">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="PAID"/>
          <xs:enumeration value="INVALID LOCATION"/>
          <xs:enumeration value="INVALID TAG"/>
          <xs:enumeration value="INVALID PLATE"/>
          <xs:enumeration value="INVALID CLASS"/>
          <xs:enumeration value="NOT FUNDED"/>
          <xs:enumeration value="UNKNOWN TAG"/>
          <xs:enumeration value="DUPLICATE"/>
          <xs:enumeration value="XLANE DUPLICATE"/>
          <xs:enumeration value="IMPROPER FORMAT"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
    <xs:element name="SUBCODE" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="TransactionType">
  <xs:all>
    <xs:element name="ACCOUNT" type="xs:string"/>
  </xs:all>
</xs:complexType>

```

```

<xs:element name="POSTED" type="xs:date"/>
<xs:element name="CREDIT" type="xs:float" minOccurs="0"/>
<xs:element name="DEBIT" type="xs:float" minOccurs="0"/>
</xs:all>
</xs:complexType>
<xs:complexType name="FileType">
<xs:all>
<xs:element name="FILENAME" type="xs:string"/>
<xs:element name="ERRORS" maxOccurs="1">
<xs:complexType>
<xs:sequence>
<xs:element name="ERROR" minOccurs="1" maxOccurs="unbounded">
<xs:complexType>
<xs:all>
<xs:element name="NUMBER" minOccurs="1">
<xs:simpleType>
<xs:restriction base="xs:int">
<xs:enumeration value="1000"/>
<xs:enumeration value="1001"/>
<xs:enumeration value="1002"/>
<xs:enumeration value="1003"/>
<xs:enumeration value="1004"/>
<xs:enumeration value="1011"/>
<xs:enumeration value="1012"/>
<xs:enumeration value="1013"/>
<xs:enumeration value="1014"/>
<xs:enumeration value="1015"/>
<xs:enumeration value="1101"/>
<xs:enumeration value="2001"/>
<xs:enumeration value="2002"/>
<xs:enumeration value="2003"/>
<xs:enumeration value="2004"/>
<xs:enumeration value="2005"/>
<xs:enumeration value="2006"/>
<xs:enumeration value="2007"/>
<xs:enumeration value="2008"/>
<xs:enumeration value="2009"/>
<xs:enumeration value="2010"/>
<xs:enumeration value="2011"/>
<xs:enumeration value="2012"/>
<xs:enumeration value="2013"/>
<xs:enumeration value="3001"/>
</xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="LINE" type="xs:int" minOccurs="0"/>

```

```
</xs:all>  
</xs:complexType>  
</xs:element>  
</xs:sequence>  
</xs:complexType>  
</xs:element>  
</xs:all>  
</xs:complexType>  
</xs:schema>
```

Appendix B Vehicle Status List XSD

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="VEHICLESTATUSLIST">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="AGENCY" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="NAME" type="xs:string"/>
              <xs:element name="CODE" type="xs:int"/>
              <xs:sequence>
                <xs:element name="ACCOUNT" type="cmn:AgencyAccountType"
maxOccurs="unbounded"/>
              </xs:sequence>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix C Transaction XSD

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="TRANSACTION">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="DETAIL" maxOccurs="unbounded">
          <xs:complexType>
            <xs:all>
              <xs:element name="DATE" type="xs:date"/>
              <xs:element name="TIME" type="xs:time"/>
              <xs:element name="REFERENCEID" type="xs:long"/>
              <xs:element name="LOCATION" type="cmn:LocationType"/>
              <xs:element name="CLASSIFICATION" type="cmn:ClassificationType"/>
              <xs:element name="RULE" type="cmn:ProcessRule" minOccurs="0"/>
              <xs:element name="TAG" type="cmn:TagType" minOccurs="0"/>
              <xs:element name="PLATE" type="cmn:PlateType" minOccurs="0"/>
              <xs:element name="VEHICLE" type="cmn:VehicleType" minOccurs="0"/>
              <xs:element name="FARES">
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="TOLL" type="cmn:TollType"
maxOccurs="unbounded"/>
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:all>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>

```

Appendix D Reconciliation XSD

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="RECONCILIATION">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="DETAIL" maxOccurs="unbounded">
          <xs:complexType>
            <xs:all>
              <xs:element name="DATE" type="xs:date"/>
              <xs:element name="TIME" type="xs:time"/>
              <xs:element name="REFERENCEID" type="xs:int"/>
              <xs:element name="OBUID" type="xs:int"/>
              <xs:element name="LOCATION" type="cmn:LocationType"/>
              <xs:element name="TAG" type="cmn:TagType" minOccurs="0"/>
              <xs:element name="PLATE" type="cmn:PlateType" minOccurs="0"/>
              <xs:element name="VEHICLE" type="cmn:VehicleType" minOccurs="0"/>
              <xs:element name="DISPOSITION">
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="PROCESS" type="cmn:ProcessRule" minOccurs="0"/>
                    <xs:element name="ACTIVITY" type="cmn:TransactionType"
minOccurs="0" maxOccurs="unbounded"/>
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:all>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix E Adjustment XSD

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="ADJUSTMENT">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:choice>
          <xs:element name="DETAIL" maxOccurs="unbounded">
            <xs:complexType>
              <xs:all>
                <xs:element name="DATE" type="xs:date"/>
                <xs:element name="TIME" type="xs:time"/>
                <xs:element name="REFERENCEID" type="xs:long"/>
                <xs:element name="LOCATION" type="cmn:LocationType"/>
                <xs:element name="CLASSIFICATION" type="cmn:ClassificationType"/>
                <xs:element name="TAG" type="cmn:TagType" minOccurs="0"/>
                <xs:element name="PLATE" type="cmn:PlateType" minOccurs="0"/>
                <xs:element name="VEHICLE" type="cmn:VehicleType" minOccurs="0"/>
                <xs:element name="FARES">
                  <xs:complexType>
                    <xs:sequence>
                      <xs:element name="TOLL" type="cmn:TollType"
maxOccurs="unbounded"/>
                    </xs:sequence>
                  </xs:complexType>
                </xs:element>
              </xs:all>
            </xs:complexType>
          </xs:element>
          <xs:element name="CHANGE" maxOccurs="unbounded">
            <xs:complexType>
              <xs:all>
                <xs:element name="DATE" type="xs:date"/>
                <xs:element name="TIME" type="xs:time"/>
                <xs:element name="REFERENCEID" type="xs:long"/>
                <xs:element name="OBUID" type="xs:long"/>
                <xs:element name="LOCATION" type="cmn:LocationType"/>
                <xs:element name="STATUS" type="xs:string"/>
              </xs:all>
            </xs:complexType>
          </xs:element>
        </xs:choice>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

```

</xs:choice>
</xs:sequence>
</xs:complexType>
</xs:element>
</xs:schema>

Appendix F Acknowledgement XSD

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="ACKNOWLEDGEMENT">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="FILE" type="cmn:FileType" maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix G Settlement XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="SETTLEMENT">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="TRANSFER" maxOccurs="unbounded">
          <xs:complexType>
            <xs:all>
              <xs:element name="POSTEDDATE" type="xs:date"/>
              <xs:element name="DISPOSITION" type="cmn:DispositionType"/>
              <xs:element name="TRANSACTIONS" type="xs:integer"/>
              <xs:element name="DEBIT" type="xs:float"/>
              <xs:element name="CREDIT" type="xs:float"/>
            </xs:all>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix H Error Codes

Error Number	Description
1000	File already processed
1001	No root element, file type unknown
1002	Invalid element or attribute name
1003	Duplicate attribute name found
1003	No close tag
1011	Invalid characters for data type STRING
1012	Invalid characters for data type NUMBER
1013	Invalid characters for data type HEX STRING
1014	Invalid characters for data type DATE
1015	Invalid characters for data type TIME
1101	Internal parser error.
2001	Constraint violation
2002	Invalid date
2003	Invalid time
2004	ID not unique
2005	Account number not recognized
2006	Business rule not recognized
2007	Account type not recognized
2007	Agency not recognized
2009	IOP Region not recognized
2010	Originator not recognized or invalid
2011	Destination invalid
2012	Invalid currency format or value
2013	Invalid value
3001	Invalid OmniAir Key

Electronic Payment Systems National Interoperability Specification Test Development Test Plan

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

Prepared for:



OMNIAIR CONSORTIUM, INC
105. N. Virginia Avenue, Suite 206
Falls Church, Virginia 22046

Prepared by:



SOUTHWEST RESEARCH INSTITUTE®
Automation and Data Systems Division
Post Office Drawer 28510, 6220 Culebra Road
San Antonio, Texas 78228-0510

September 30, 2011

EPSNIS-TP-1.0

Electronic Payment Systems National Interoperability Specification Test Development Test Plan

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

September 30, 2011



Author – Ted Wilmes

September 30, 2011

Date



Manager – Josh Johnson

September 30, 2011

Date

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APPENDIX A –	ACRONYMS

REVISION NOTICE

Version Identifier	Date of Issue	Summary of Changes
1.0-Draft	May 19, 2010	Initial draft release for OmniAir EPSNIS Committee review.
1.0	September 30, 2011	Final release of completed test plan.

This document contains information that is as complete as possible. Where final numerical values or specification references are not available, best estimates are given and noted To Be Reviewed (**TBR**). Items which are not yet defined are noted To Be Determined (**TBD**). The following table summarizes the TBD/TBR items in this revision of the document, and supplements the revision notice above.

Section	Description

1. PROJECT INFORMATION

The following subsections provide project information, a document overview, and identify related documents.

1.1 Project Identification

Project Title:	OmniAir EPSNIS Test Implementation
Project Number:	10-15517
Abbreviation:	EPSNIS-TP
Version Number:	1.0
Release Number:	1

1.2 Document Overview

This document defines the test procedures to evaluate the OmniAir Electronic Payment Services National Interoperability Specification (EPSNIS).

1.3 Related Documents

- BancPass System Technical Design Specification Version 0.2 July 7, 2009
- BancPass System Technical Design Specification Version 0.1 May 11, 2009
- EPSNIS Technical Specification – Interoperability Test Plan Draft Version 3.2 December 9, 2009
- NYSBA EPSNIS Transaction Simulation Test Version 1.0 April 15, 2010

2. TEST BACKGROUND

2.1 Identification

This test plan outlines the steps to verify and validate the OmniAir EPSNIS Technical Specification.

2.2 Purpose of Testing

The purpose of this testing is to test the EPSNIS specification, not the software that implements the specification. To this end, test failures related to failures of the software will not imply a failure of the specification. If a test case fails due to the software not supporting a portion of the specification, this will be noted.

2.3 Test Component Criteria

The Onboard Unit (OBU) provisioner, tolling facility, and clearing house software and hardware systems must be baselined before the initiation of this test plan. It is understood that modifications may be made to these components during the testing process. Component modification will trigger the rerunning of the appropriate test steps to verify that no regressions have occurred.

2.4 Baseline Requirements

The following table identifies the requirements from the EPSNIS Technical Design Specification and EPSNIS Specification Interoperability Test Plan and indicates which test case verifies that the requirement is met.

ID	Requirement	Test Case
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These Extensible Markup Language (XML) files are then transmitted in their entirety using File Transfer Protocol Secure (FTPS) over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.	Test 1
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using Secure FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.	Test 2
EPSNIS-TP-15-6	Parties providing Vehicle Status Files (VSF) shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.	Test 3
EPSNIS-TP-15-7	Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly.	Test 4
EPSNIS-TP-16-2	Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.	Test 5

ID	Requirement	Test Case
EPSNIS-TP-16-3	Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly.	Test 6
EPSNIS-TP-16-4	Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File	Test 7
EPSNIS-TP-16-5	Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.	Test 8
EPSNIS-TP-16-6	Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed.	Test 9
EPSNIS-TP-16-7	The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure.	Test 10
EPSNIS-TP-16-8	If the second attempt fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.	Not applicable - Operational Requirement
EPSNIS-TP-17-1	The Transaction File describes transactions and is effectively an invoice for payment.	Test 11
EPSNIS-TP-17-2	A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.	Test 11
EPSNIS-TP-17-3	This posting concurrently creates a demand for payment directly from the Clearing Organization to the Toll Facility Operator.	Test 11
EPSNIS-TP-17-4	The Clearing Organization processes this information and creates its own (offsetting) transactions.	Test 11
EPSNIS-TP-17-5	The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.	Test 11
EPSNIS-TP-17-6	This posting creates a demand for payment directly from the OBU Provisioner to the Clearing Organization.	Test 11
EPSNIS-TP-17-9	All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.	Test 12
EPSNIS-TP-17-10	The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them.	Test 12
EPSNIS-TP-17-11	Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification.	Test 12
EPSNIS-TP-17-12	To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File and sends the file to the Clearing Organization.	Test 12
EPSNIS-TP-17-13	Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.	Test 12

ID	Requirement	Test Case
EPSNIS-TP-17-14	The Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated.	Test 12
EPSNIS-TP-17-15	To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File and sends the file to the Toll Facility Operator.	Test 12
EPSNIS-TP-18-3	A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.	Test 13
EPSNIS-TP-18-4	A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.	Test 13
EPSNIS-TP-18-5	Settlement Files detail which transactions, disputes, and adjustments one network member's bank deposit account has paid to another member's bank deposit account. The following information types are supported by the Settlement File: <ul style="list-style-type: none"> • The transaction amount with all associated discounts, payment guarantees, and adjustments factored in. • Fees, if any 	Test 14
EPSNIS-TP-18-8	An OBU Provisioner reports the deposits that its bank makes into the Clearing Organization's bank. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.	Test 15
EPSNIS-TP-18-9	A Clearing Organization reports the deposits that its bank makes into the Toll Facility Operator's bank. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.	Test 15
EPSNIS-TP-18-10 thru EPSNIS-TP-26-1	The XML complex types are unique named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and have multiple instances defined at each level.	Test 16

3. TESTING PREPARATION

3.1 Test Location/Environment

The test will be conducted at the Newburgh-Beacon Bridge Toll Plaza over a test period no shorter than 30 days. A test lane and necessary tag-read equipment will be used for this testing.

3.1.1 Hardware

The following hardware will be used for this testing.

NYSBA	NA
BancPass	Dell Intel Xeon @ 200GHz 8 gigs of RAM
FIS	NA
Southwest Research Institute	Dell PowerEdge 2950 server

3.1.2 Software

The following software will be used for this testing.

NYSBA	Perl, rsync, ssh
BancPass	Python, Bourne Shell, Oracle Database, PL/SQL, SQL
FIS	FIS Clearway
Southwest Research Institute	Java, eXist XML database and XQuery test scripts

3.1.3 SwRI EPSNIS Test Tools

The Southwest Research Institute® (SwRI) EPSNIS Test Tool is made up of a number of different components. Figure 1 illustrates these components. The SwRI EPSNIS File Retriever runs on a SwRI server and periodically retrieves new EPSNIS files from the BancPass EPSNIS server via SFTP transfer. These files are inserted into an eXist XML hierarchical data store. SwRI test scripts are then executed against the eXist database to produce results for the test cases. These test scripts are written using the XQuery programming language which robustly supports native, in-language XML querying and transformation.

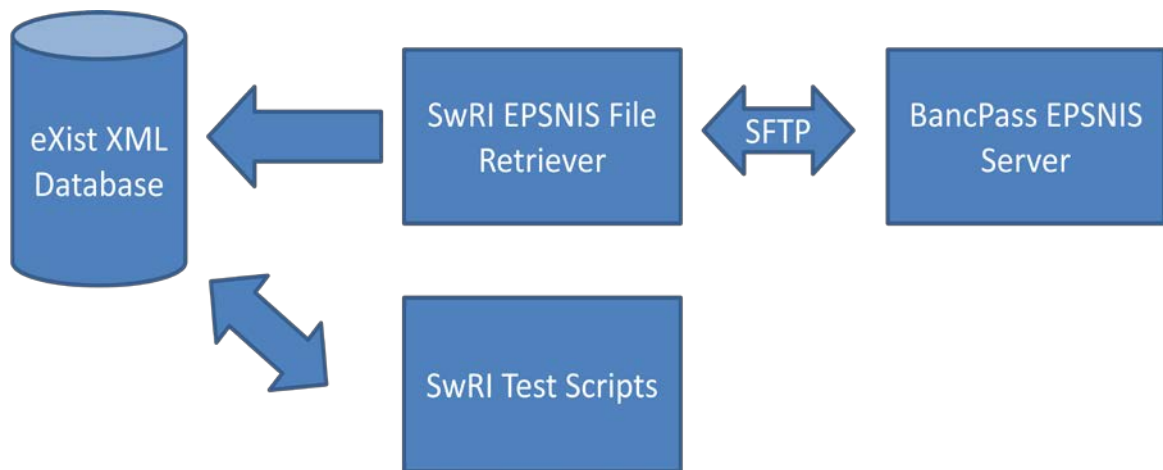


Figure 1 High level SwRI Test Tool architecture

3.2 Hardware Preparation

SwRI requires that a Windows XP+ or Linux client machine is available. This machine must have access to the OBU Provisioner, Clearing House, and Tolling Facility FTP locations.

3.3 Software Preparation

Install the EPSNIS Tester software on a system that will have read/write access to the EPSNIS FTP locations. The software required for the simulation steps outlined in the New York State Bridge Authority (NYSBA) EPSNIS Transaction Simulation Test must also be installed and functional.

3.4 Test Schedule

The following sections describe the test schedule.

3.4.1 Dry Test Run Schedule

Dry runs of these test steps will occur prior to official functional testing to help ensure issues that would result in test failures will be discovered and resolved prior to the formal testing.

3.4.2 Formal Test Schedule

Formal testing of the EPSNIS Test Implementation will occur as follows:

- Functional Testing: All of the test cases identified in the test plan below will be executed with the exception of the extended test.
- Extended Test: After successful completion of the test cases, the extended day test will be initiated. Monitoring and final analysis of the extended testing will occur remotely.

3.5 Test Stakeholders

Test stakeholders include the following organizations with the defined roles:

- OmniAir - Responsible for overall EPSNIS test specification and test implementation.
- NYSBA – Test sponsor and host site. Responsible for providing the test tolling facility system.
- BancPass – Responsible for providing the test clearing house and OBU provisioner system.

- Southwest Research Institute – Responsible for performing the specification testing and documenting the results.
- Jafa Technologies – Responsible for project oversight of the EPSNIS Test Implementation project. Will witness specification testing.
- OmniAir EPSNIS Committee

3.6 Test Personnel

Test personnel include the following:

- Southwest Research Institute – Responsible for performing the specification testing and documenting the results.

3.7 Test Unique Identifier Format

Each test will have a unique identifier in the format of T# where # is the number of the test.

3.8 Requirement Unique Identifier Format

This document was not based upon a formal requirements document so requirements are labeled in the following format for these tests:

EPSNIS-<Doc>-<Page>-<Section/Row>

<Doc> is either TDS for Technical Design Specification or TP for Interoperability Test Plan. <Page> is the page number the requirement was found on in the document. <Section/Row> is either the section, in the case of the Technical Design Specification, or table row, in the case of the Interoperability Test Plan, that the requirement was found or derived from.

3.9 Test Exception Handling

Test failures will be reported to the Test Manager. Since this testing is focused on verifying the specification, changes to the hardware and software will be acceptable during testing. If hardware and/or software changes are needed, the effected test cases will be rerun.

3.10 Completion Criteria

Testing will be completed when all test cases have been passed.

3.11 Test Results

The test results will be stored in this test plan document.

3.12 Defect Tracking

Defects shall be recorded in an issue tracking log.

3.13 Test Data Collection

The EPSNIS test is meant to be performed in two phases; data collection and verification. During the data collection phase, the EPSNIS Tester will be monitoring and injecting test transactions into the EPSNIS workflow. All EPSNIS traffic will be captured by the EPSNIS Tester and used during the testing phase.

The EPSNIS Tester will not only capture traffic but also inject Files into the test system environment. These injections will be pre-scripted and designed to test specific portions of EPSNIS.

The simulation tool described in the NYSBA EPSNIS Transaction Simulation Test document will also be injecting transactions into the system during the test when needed. For example, the NYSBA code is not capable of generating an adjustment file so the EPSNIS Tester will be used to generate these. The EPSNIS Tester will also collect these transactions for later review and verification.

3.13.1 Data Collection Steps

The following steps describe the process that must be followed to collect data from the EPSNIS system. The data collection portion of this test will run for four hours.

1. Stop the EPSNIS test systems.
2. Start the EPSNIS Tester and load the Test Specification test script.
3. Start the EPSNIS Tester.
4. Start the EPSNIS test systems.
5. At the end of the four hour test period, stop the EPSNIS Tester. ¹

Upon stopping the EPSNIS Tester, the totality of the data generated during the test will be available for analysis. The data will be archived by the EPSNIS Tester in both its original XML format and as discrete data elements in the EPSNIS Tester's database for later analysis. Section 4 outlines the steps for performing tests using that data.

¹ Note that the following test steps may actually be applied to an arbitrarily long data collection period. Consequently, these same test steps will be run against the data collected during the 30 day or greater test period.

4. TEST PROCEDURES

The following sections contain the test cases to perform the OmniAir EPSNIS Specification testing.

4.1 Test 1: XML Format Validation

Test Unique Identifier:	T1
Tester:	Ted Wilmes

4.1.1 Test Description

This test case verifies that the EPSNIS systems are producing valid Vehicle Status, Transaction, Reconciliation, Adjustment, Settlement, and Acknowledgement files.

4.1.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

4.1.3 Prerequisite Conditions

- EPSNIS Tester database has been populated with Test EPSNIS data.
- XML Schema Definition (XSD) files for Vehicle Status, Transaction, Reconciliation, Adjustment, Acknowledgement, and Settlement have been provided.

4.1.4 Test Results Evaluation

The user will confirm that all Vehicle Status, Transaction, Reconciliation, Adjustment, Settlement, and Acknowledgement files produced by the OBU Provisioner, Clearing House, and Tolling Facility conform to the EPSNIS specification file transfer formats.

4.1.5 Test Procedures

The user will execute the following steps:

1. Sample 1 file of each type.
2. Validate each file against the EPSNIS XSD files.

4.1.6 Notes

The BancPass acknowledgement files did not pass the schema validation due to an extra <detail> element. It was determined that this was due to a limitation of the Oracle XML generation tools. Since this was not due to a specification deficiency, this test case is still marked as passed.

4.1.7 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.2 Test 2: FTPS Connection

Test Unique Identifier:	T2
Tester:	Ted Wilmes

4.2.1 Test Description

This test case verifies the presence and operation of all required EPSNIS FTP locations.

4.2.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

4.2.3 Test Results Evaluation

The user will confirm that the EPSNIS Tester can connect to the OBU Provisioner, Clearing Organization, and Toll Facility Operator FTP locations.

4.2.4 Test Procedures

The user will execute the following steps:

1. Enter FTP connection information in the table below.

FTP Server OBU Provisioner	
Host	99.41.66.244
Username	fisuser
Path	/export/fisuser/filedrop
FTP Server Clearing Organization	
Host	99.41.66.244
Username	bpuser
Path	/export/nysba/filedrop
FTP Server Toll Facility Operator	
Host	99.41.66.244
Username	nysba
Path	/export/nysba/filedrop

2. Configure the EPSNIS file loader with the FTP connection information for both FTP servers.
3. Start the EPSNIS file loader and confirm that all FTP connections are made successfully.

4.2.5 Notes

None.

4.2.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.3 Test 3: Vehicle Status File Delivery Frequency

Test Unique Identifier:	T3
Tester:	Ted Wilmes

4.3.1 Test Description

This test case verifies that VSF are delivered at the proper frequency to all necessary parties.

4.3.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-6	Parties providing VSF shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.

4.3.3 Test Results Evaluation

The user will confirm that the OBU Provisioner sends at least one Vehicle Status File per hour to the Clearing House. The user will then confirm that the reception of a Vehicle Status File from the OBU Provisioner will result in the transmittal of a corresponding Vehicle Status File to the Toll Facility Operator.

4.3.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Enter "Validation" mode.
3. Run the "Delivery Frequency Validator".
4. Verify the "Delivery Frequency Validator" test indicates success.

4.3.5 Notes

The accounts for this test stayed the same for the duration so the VSL file was only exchanged between parties once at the beginning of the testing.

4.3.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.4 Test 4: Transaction File Delivery Frequency

Test Unique Identifier:	T4
Tester:	Ted Wilmes

4.4.1 Test Description

This test case verifies the frequency of Transaction File delivery from the Tolling Facility to the Clearing House operator.

4.4.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-7	Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly.

4.4.3 6.5.3 Test Results Evaluation

The user will confirm that the Toll Facility Operator sends at least one Transaction File per hour to the Clearing House. The user will then confirm that the reception of a Transaction File from the Toll Facility Operator will trigger the transmittal of a corresponding Transaction File to the OBU Provisioner.

4.4.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator".
3. Verify the "Delivery Frequency Validator" test indicates success.

4.4.5 Notes

None.

4.4.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.5 Test 5: Reconciliation File Delivery Frequency

Test Unique Identifier:	T5
Tester:	Ted Wilmes

4.5.1 Test Description

This test case verifies the frequency of Reconciliation File delivery.

4.5.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-2	Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.

4.5.3 Test Results Evaluation

The user will confirm that the OBU Provisioner sends at least one Reconciliation File per hour to the Clearing Organization. The user will then confirm that the reception of a Reconciliation File from the OBU Provisioner will trigger the transmittal of a corresponding Reconciliation File to the Toll Facility Operator.

4.5.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator".
3. Verify the "Delivery Frequency" test indicates success.

4.5.5 Notes

None.

4.5.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.6 Test 6: Adjustment File Delivery Frequency

Test Unique Identifier:	T6
Tester:	Ted Wilmes

4.6.1 Test Description

This test case verifies that Adjustment Files are delivered at the proper frequency to all necessary parties.

4.6.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-3	Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly.
EPSNIS-TP-16-4	Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File

4.6.3 Test Results Evaluation

The user will confirm that the Toll Facility Operator sends at least one Adjustment File per hour to the Clearing House. The user will then confirm that the reception of an Adjustment File from the Toll Facility Operator will trigger the transmittal of a corresponding Adjustment File to the Toll Facility Operator.

4.6.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator" task.
3. Verify the "Delivery Frequency Validator" task indicates success.

4.6.5 Notes

None.

4.6.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.7 Test 7: Settlement File Delivery Frequency

Test Unique Identifier:	T7
Tester:	Ted Wilmes

4.7.1 Test Description

This test case verifies that Settlement Files are delivered to the proper parties at the correct interval.

4.7.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-5	Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.

4.7.3 Test Results Evaluation

The user will confirm that the OBU Provisioner sends at least one Settlement File per hour to the Clearing House. The user will then confirm that the reception of a Settlement File from the OBU Provisioner will trigger the transmittal of a corresponding Settlement File to the Toll Facility Operator.

4.7.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator".
3. Verify the "Delivery Frequency Validator" test indicates success.

4.7.5 Notes

None.

4.7.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.8 Test 8: Acknowledgement File Generation

Test Unique Identifier:	T8
Tester:	Ted Wilmes

4.8.1 Test Description

This test case verifies that Acknowledgement Files are generated in response to each transmitted file.

4.8.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-6	Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed.

4.8.3 Test Results Evaluation

The user will confirm that each transmitted file results in the delivery of an Acknowledgement File.

4.8.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Delivery Frequency Validator" test script.
3. Verify the "Delivery Frequency Validator" test indicates success.

4.8.5 Notes

None.

4.8.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.9 Test 9: Acknowledgement File Resend

Test Unique Identifier:	T9
Tester:	Ted Wilmes

4.9.1 Test Description

This test case verifies the systems' response to the transmittal of invalid files.

4.9.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-16-7	The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure.
EPSNIS-TP-16-8	If the second attempt fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.

4.9.3 Test Results Evaluation

The user will confirm that in the cases where no acknowledgement was received upon initial transmittal of a File, the File was resent.

4.9.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate a malformed transaction file from NYSBA.
3. Verify that BancPass generates an acknowledgement file indicating failure.
4. Send a properly formed transaction file from NYSBA.

4.9.5 Notes

None.

4.9.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.10 Test 10: Malformed XML Generates Error Acknowledgement File

Test Unique Identifier:	T10
Tester:	Ted Wilmes

4.10.1 Test Description

This test case verifies that the delivery of a file containing improperly formatted XML generates an Acknowledgement File containing error information.

4.10.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-15-5	During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 6 through 11. These XML files are then transmitted in their entirety using FTPS over the network described in Section 5.1. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

4.10.3 Test Results Evaluation

The user will confirm that the delivery of a partial Vehicle Status File will result in the generation of an Acknowledgement File containing error information.

4.10.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate a malformed transaction file and send from NYSBA.
3. Verify that BancPass generates an acknowledgment file indicating an error.

4.10.5 Notes

None.

4.10.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.11 Test 11: Transaction Validation

Test Unique Identifier:	T11
Tester:	Ted Wilmes

4.11.1 Test Description

This test case verifies that all disputes Transaction demands for payment are handled appropriately by the system.

4.11.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-17-1	The Transaction File describes transactions and is effectively an invoice for payment.
EPSNIS-TP-17-2	A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.
EPSNIS-TP-17-3	This posting concurrently creates a demand for payment directly from the Clearing Organization to the Toll Facility Operator.
EPSNIS-TP-17-4	The Clearing Organization processes this information and creates its own (offsetting) transactions.
EPSNIS-TP-17-5	The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.
EPSNIS-TP-17-6	This posting creates a demand for payment directly from the OBU Provisioner to the Clearing Organization.

4.11.3 Test Results Evaluation

The user will confirm that all Transaction Files result in the correct demand for payment and necessary transmittal of Transaction Files between organizations.

4.11.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Transaction Timeline" test.
3. Verify the "Transaction Timeline" indicates success.

4.11.5 Notes

None.

4.11.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.12 Test 12: Dispute Validation

Test Unique Identifier:	T12
Tester:	Ted Wilmes

4.12.1 Test Description

This test case verifies that all disputes result in the correct generation and delivery of Reconciliation Files.

4.12.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-17-9	All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.
EPSNIS-TP-17-10	The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them.
EPSNIS-TP-17-11	Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification.
EPSNIS-TP-17-12	To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File and sends the file to the Clearing Organization.
EPSNIS-TP-17-13	Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.
EPSNIS-TP-17-14	The Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated.
EPSNIS-TP-17-15	To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File and sends the file to the Toll Facility Operator.

4.12.3 Test Results Evaluation

The user will confirm that the all disputed transaction result in the delivery of the necessary Reconciliation Files.

4.12.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate a NYSBA adjustment file with a duplicate transaction entry and send to BancPass.
3. Verify that BancPass correctly removes the duplicate transaction from the end of day settlement totals.

4.12.5 Notes

None.

4.12.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.13 Test 13: Adjustment Validation

Test Unique Identifier:	T13
Tester:	Ted Wilmes

4.13.1 Test Description

This test case verifies that all disputes result in the correct adjustments.

4.13.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-18-3	A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.
EPSNIS-TP-18-4	A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.

4.13.3 Test Results Evaluation

The user will confirm that the proper nullification and/or adjustment of transactions is made when adjustments are made.

4.13.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Generate an adjustment with a duplicate transaction entry from BancPass to FIS.
3. Verify that FIS correctly removes the duplicate transaction from the daily settlement total.

4.13.5 Notes

None.

4.13.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.14 Test 14: Settlement Validation

Test Unique Identifier:	T14
Tester:	Ted Wilmes

4.14.1 Test Description

This test case verifies that all transactions result in the proper settlements.

4.14.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-18-5	Settlement Files detail which transactions, disputes, and adjustments one network member's bank deposit account has paid to another member's bank deposit account. The following information types are supported by the Settlement File: <ul style="list-style-type: none">• The transaction amount with all associated discounts, payment guarantees, and adjustments factored in.• Fees, if any
EPSNIS-TP-18-8	An OBU Provisioner reports the deposits that its bank makes into the Clearing Organization's bank. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.
EPSNIS-TP-18-9	A Clearing Organization reports the deposits that its bank makes into the Toll Facility Operator's bank. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.

4.14.3 Test Results Evaluation

The user will confirm that all accepted transactions result in the delivery of the proper Settlement Files.

4.14.4 Test Procedures

The user will execute the following steps:

1. Start EPSNIS Tester.
2. Run the "Summary Report" test.
3. Verify the settlement transaction numbers match the daily transaction counts for both parties with adjustments taken into account.

4.14.5 Notes

None.

4.14.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.15 Test 15: XML Schema Validation Test

Test Unique Identifier:	T15
Tester:	Ted Wilmes

4.15.1 Test Description

This test case verifies that all XML files conform to the EPSNIS Specification schema definitions.

4.15.2 Requirements Addressed

ID	Requirement
EPSNIS-TP-18-10 thru EPSNIS-TP- 26-1	The XML complex types are unique named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and have multiple instances defined at each level.

4.15.3 Test Results Evaluation

The user will confirm that all XML files conform to the EPSNIS Specification schema definitions.

4.15.4 Test Procedures

The user will execute the following steps:

1. Sample one example of each file type.
2. Validate each file against the EPSNIS XSD files.

4.15.5 Notes

None.

4.15.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.16 Test 16: Vehicle Duplicate Processing

Test Unique Identifier:	T16
Tester:	Ted Wilmes

4.16.1 Test Description

This test case verifies that the clearing house organization will correctly reject any duplicate vehicle transactions.

4.16.2 Requirements Addressed

ID	Requirement
EPSNIS-TDS-3.2	The clearing house organization will reject any duplicate vehicle identified through the account cross check and propagate the rejection back to the toll facility.

4.16.3 Test Results Evaluation

The user will confirm that duplicate vehicle transactions are rejected by the clearing house and the toll facility is notified.

4.16.4 Test Procedures

The user will execute the following steps:

3. Start the EPSNIS Tester.
4. Run the "Duplicate Vehicle" test.
5. Verify that the "Duplicate Vehicle" test indicates success.

4.16.5 Notes

None.

4.16.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

4.17 Test 17: 30-Day Test

Test Unique Identifier:	T17
Tester:	Ted Wilmes

4.17.1 Test Description

This test case verifies that the transactions generated during the 30-Day Test conform to the EPSNIS Specification.

4.17.2 Requirements Addressed

This test case addresses all of the previously mentioned requirements by referring to the previously executed test steps.

4.17.3 Test Results Evaluation

The user will confirm that transactions collected during the 30-Day Test conform to the EPSNIS Specification. If they do not for certain periods, the user will confirm that the issues causing these discrepancies have been fixed.

4.17.4 Test Procedures

The user will execute the following steps:

1. Start the EPSNIS Tester.
2. Run the “30-Day” test. This test will inject transactions into the system over a 30-day period and the steps outlined in the NYSBA EPSNIS Transaction Simulation Test. This will inject a combination of synthetic and real-world transactions into the test system.
3. Upon completion of the “30-Day” test script, run tests T1 thru T16 of this document to verify that transactions conform to the EPSNIS Specification.

4.17.5 Notes

None.

4.17.6 Test Results

PASS FAIL SwRI: Ted Wilmes Date: 9/26/2011

5. NOTES

None.

APPENDIX A

List of Acronyms

EPSNIS	Electronic Payment Services National Interoperability Specification
FTPS	File Transfer Protocol Secure
NYSBA	New York State Bridge Authority
OBU	Onboard Unit
SwRI	Southwest Research Institute
TBD	To Be Determined
TBR	To Be Reviewed
TDS	Technical Design Specification
VSF	Vehicle Status Files
XML	Extensible Markup Language
XSD	XML Schema Definition

Electronic Payment Systems National Interoperability Specification Test Development Report of Findings

Version 1.0

for the

OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

Prepared for:



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September 30, 2011

EPSNIS-Rpt-1.0

Electronic Payment Systems National Interoperability Specification Test Development Report of Findings

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OmniAir EPSNIS Test Development Project
SwRI® Project No. 10.15517

September 30, 2011



September 30, 2011

Author – Ted Wilmes

Date



September 30, 2011

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Date

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APPENDIX A –	ACRONYMS

REVISION NOTICE

Version Identifier	Date of Issue	Summary of Changes
1.0	September 30, 2011	Initial Release

This document contains information that is as complete as possible. Where final numerical values or specification references are not available, best estimates are given and noted To Be Reviewed (**TBR**). Items which are not yet defined are noted To Be Determined (**TBD**). The following table summarizes the TBD/TBR items in this revision of the document, and supplements the revision notice above.

Section	Description

1. Project Information

The following subsections provide project information, a document overview, and identify related documents.

1.1 Project Identification

Project Title:	OmniAir EPSNIS Test Implementation
Project Number:	10-15517
Abbreviation:	EPSNIS-RPT
Version Number:	1.0
Release Number:	1

1.2 Document Overview

This document details the findings produced by Southwest Research Institute from the period before, during, and after the OmniAir Electronic Payment service National Interoperability Specification (EPSNIS) 30-day test.

1.3 Related Documents

- OmniAir EPSNIS Test Ready Working Version 0.6, September 2010
- EPSNIS Technical Specification Test Plan_v1.2, January 25, 2010
- SwRI EPSNIS Test Development Test Plan v1.0, September 30, 2011

2. Test Overview

2.1 Purpose

The purpose of this report is to compile the findings produced while evaluating the EPSNIS specification and running the 30 day EPSNIS test development test. The purpose of this report is not to evaluate the software used during testing, but to review EPSNIS specification. Southwest Research Institute (SwRI), an independent non-for-profit research and development firm, was responsible for conducting the testing and documenting the test findings in this report.

2.2 Test Period

The EPSNIS test development test was initially scheduled for 30 days but ended up running longer than expected due to interfacing and scheduling issues not related to the specification itself. The test period ended up being from July 19, 2011 thru September 26, 2011, for a total of 69 days.

2.3 Test Architecture

Figure 1 illustrates the system architecture utilized for this test. This test differed slightly from the example architecture described in the specification document in that there was no separate OBU provisioner. Instead, two clearing organizations, BancPass and FIS were used. BancPass received transactions from the toll facility, NYSBA, and transferred the FIS transaction accounts to FIS.

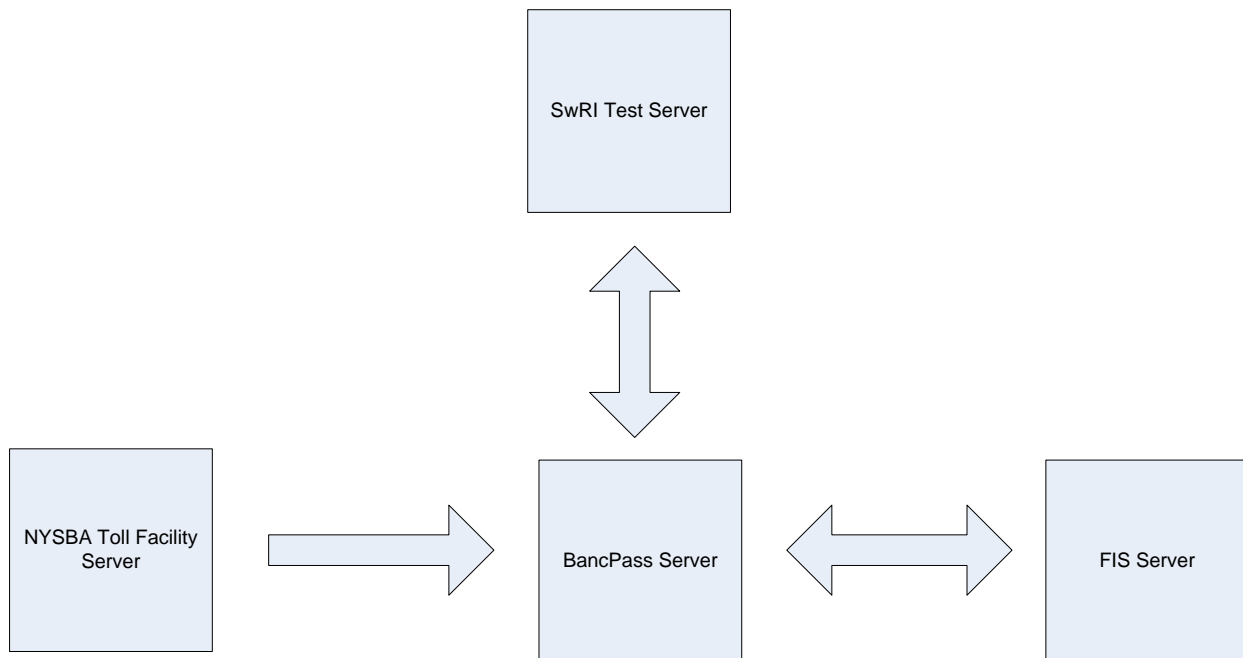


Figure 1. High Level Test Architecture

2.4 Transactions Generation Methods

Transactions for the test were derived from a number of methods. Existing 9.15MHz E-ZPass non-revenue tag read events were captured and assigned a toll amount and then used to create test transactions. This allowed testing in operational lanes without interference with the existing toll collection and audit system. Borrowed 5.9GHz equipment was also installed in the same operational lanes and read events were collected and used to create additional test transactions. Fully synthetic test transactions, generated by SwRI, were also used in cases where the NYSBA software was not capable of producing a specific file type, such as adjustments.

2.5 Analysis Tools

A number of tools were employed to analyze the transactional data generated during the EPSNIS Specification test. Transaction, Reconciliation, Acknowledgement, Settlement, and Adjustment files were copied off of the BancPass server and inserted into an instance of the eXist database. eXist is a hierarchical XML database which allows direct querying and reporting off of XML formatted documents through the use of XQuery. XQuery scripts were written to verify the steps from the test plan and to retrieve additional data required for the evaluation.

3. Test Results

A long term test was performed as part of the EPSNIS specification evaluation. Descriptions of the test procedures and the individual test results can be found in the accompanying SwRI EPSNIS Test Development Test Plan. The test plan was completed successfully for the long term test and all test cases passed.

3.1 Test Statistics

Figure 2 shows the breakdown of processed transactions, by party and file type, for each day of the 30 day test.

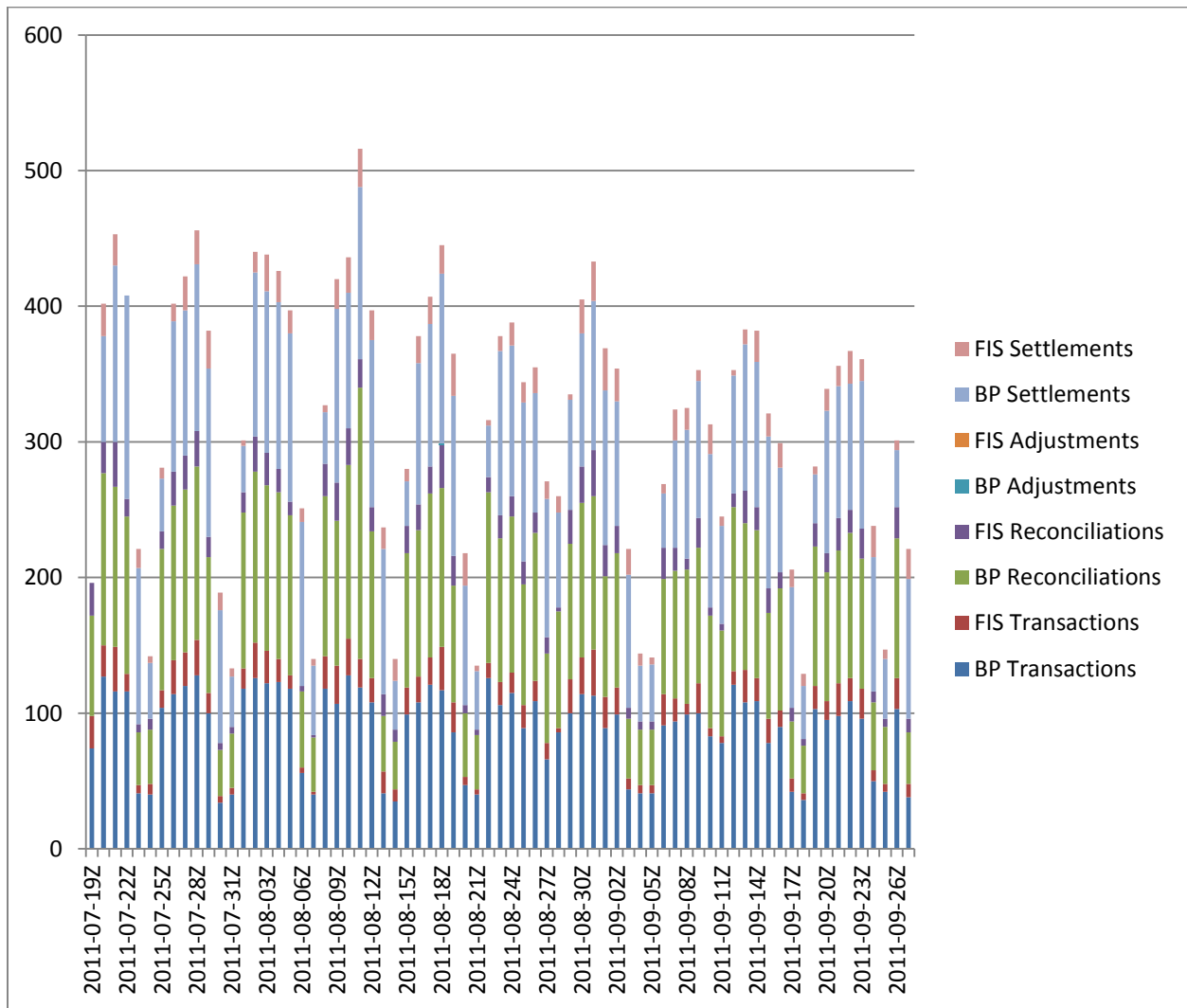


Figure 2. Transactions Processed by BancPass and FIS

Table 1 shows the file counts for each file type exchanged. These counts tally the total files sent by each party for each file type and do not represent transaction counts. The Vehicle Status List is not included because it was exchanged between parties once at the beginning of the test. This was done because the account list did not change throughout the test period.

Table 1. File counts

	Transaction	Reconciliation	Adjustment	Settlement
NYSBA	1422	-	1	-
BP	1422	1424	1	70
FIS	-	1684	-	70

Table 2 shows the total number of transactions sent and settled for BancPass and FIS. The disparity in numbers is related to a number of development issues that were resolved during the first two weeks of testing and was not a result of a specification deficiency.

Table 2. Transaction counts

FIS Transactions	Settled
1159	1100
BancPass Transactions	Settled
6399	6166

4. Findings

The following sections note items discovered before and during the execution of the 30 day test. Many of these findings came as a result of working through the integration process with BancPass and FIS and noting areas of confusion that arose due to ambiguities in the specification text. For the purpose of the long term test, certain assumptions were made and the issue of confusion was noted as a finding and included below.

ID	Finding	Severity	Comment
EPSNIS-RPT-1	Version 0.5 of the EPSNIS specification specified the format of the xml file names for transfer. Version 0.6 removed this format requirement. Having a predetermined file name format will ease implementation and should not adversely affect the flexibility of the specification to different business scenarios.	LOW	
EPSNIS-RPT-2	The file schemas do not include elements that define the originator and sender of the file. While this information is known because the parties agree upon exchange locations of the files, it may be beneficial to include them in the files also so that the files, when pulled out of the context of a specific file location, can still have their origination and destination points identified.	LOW	
EPSNIS-RPT-3	<p>In the appendices, the complex type definitions are repeated for each file type. It would be beneficial to define complex types in one file instead of duplicating their definitions throughout the schemas.</p> <ul style="list-style-type: none"> • This will simplify keeping the XSD files consistent. • Modern code generation tools for Java and C# have trouble generating code for duplicate types in the same namespace. 	LOW	
EPSNIS-RPT-4	Unclear if it is ok to send empty files if no activity occurred during period of interest or if file should have empty xml tags in it, i.e. <TRANSACTION></TRANSACTION> versus an empty file.	LOW	
EPSNIS-RPT-5	In general, many of the fields accept free text and do not have any restrictions. A stricter schema definition may provide less flexibility on the surface but save time down the road because implementers will have a clear, documented example of valid values. Even in cases where free text is needed such as a license place, it may be beneficial to limit the length of the field. The following fields may benefit from greater specificity in their type definitions.	MEDIUM	

ID	Finding	Severity	Comment
EPSNIS-RPT-5.1	AccountType - STATUS has a set of acceptable values listed, this could be defined as an enumeration in the schema so that schema validation will detect unacceptable values.	MEDIUM	
EPSNIS-RPT-5.2	VehicleType - YEAR is listed as a string but could be a 4 digit number.	MEDIUM	
EPSNIS-RPT-5.3	TagType - PROTOCOL – if there is a standard list of protocols, these should be enumerated here (keep in mind that as protocols change, it will still be a simple matter to update the spec to accommodate new valid protocols.)	MEDIUM	
EPSNIS-RPT-5.4	PlateType - STATE – this could be an enumeration of state abbreviations.	MEDIUM	
EPSNIS-RPT-5.5	ClassificationType - SHAPE - if there are specific shapes, these could be enumerated.	MEDIUM	
EPSNIS-RPT-5.6	ClassificationType - CLASS – same as shape, if there are specific classes, these could be enumerated.	MEDIUM	
EPSNIS-RPT-5.7	TollType – the specific values such as E & C could be enumerated.	MEDIUM	
EPSNIS-RPT-5.8	DispositionType - STATUS – these values could be enumerated.	MEDIUM	
EPSNIS-RPT-5.9	TransactionType - Credit and Debit can be limited to two decimals of precision.	MEDIUM	
EPSNIS-RPT-5.10	FileType - STATUS – these values could be enumerated.	MEDIUM	
EPSNIS-RPT-5.11	ProcessRule – there does not appear to be a definition of what a process rule is in the documentation. If there are standard rules, they should be defined in the spec.	MEDIUM	
EPSNIS-RPT-6	Transaction Type is in the Adjustment file XSD but not in body of document. It appears that Transaction Type would need to be specified so that the adjustment could note what credit or debit should be made to the transaction.	MEDIUM	
EPSNIS-RPT-7	Reconciliation File - It is not specified if after an adjustment occurs on a transaction, if a corresponding reconciliation shall be generated and sent.	MEDIUM	

ID	Finding	Severity	Comment
EPSNIS-RPT-8	Acknowledgement File - The FileType does not provide enough error information to figure exactly what may have caused a problem. For example, 'F – Failed to process for bad record' is listed as a possible value. In this case, there does not appear to be any place to describe which particular record was bad such as a specific transaction ID.	MEDIUM	
EPSNIS-RPT-9	The minimum interval for file delivery is stated for each file type. In addition, it would be good to specify a maximum interval such as the Transaction File shall be delivered no less than once per hour and no more than 10 times per hour. As it is written now, a toll facility operator could generate a transaction file for each transaction and deliver it and still fall within the specification. This could potentially cause performance issues.	LOW	
EPSNIS-RPT-10	The specification briefly mentions the clearinghouse to clearinghouse scenario in the executive summary but never again. The included sequence diagrams do not make it clear that this is a valid architecture. It may be beneficial to briefly describe the clearinghouse to clearinghouse in the specification so that it is clear that it is a valid architecture.	MEDIUM	
EPSNIS-RPT-11	Section 10.0 Settlement File does not describe the use of DispositionType within the Transfer element of a settlement. The schema includes a disposition type with a transfer element but it is unclear how this should be used with the different statuses. For example, shall all duplicates that come across in adjustments be included in a duplicate transfer section?	MEDIUM	
EPSNIS-RPT-12	Test date needs to be changed in last paragraph of Section 2.0 Executive Summary.	LOW	
EPSNIS-RPT-13	Section 4.0 Information Flow references an "Account" file in an example. The specification does not define an Account file type.	LOW	
EPSNIS-RPT-14	Section 5.1 Network – a VPN was not used for the 30 day test. Files were exchanged via SFTP and authentication was facilitated through the use of pre-shared keys.	LOW	

ID	Finding	Severity	Comment
EPSNIS-RPT-15	Section 5.3 File Formats – states that functional requirements are detailed in later sections of the document. This document does not contain functional requirements. It is possible Functional requirements means something different here.	LOW	
EPSNIS-RPT-16	Section 5.4 Information Exchange Sequencing – Bullet two mixes Account and VSL file. Is Account file a synonym for VSL file?	LOW	
EPSNIS-RPT-17	Section 5.4 Information Exchange Sequencing – first bullet in second section – leaves decision open to full vs. incremental. This should be defined clearly by the specification and not left up to the user.	LOW	
EPSNIS-RPT-18	Section 5.4 Information Exchange Sequencing – loosely defines ACK file delivery, this would benefit from being set to within an hour.	LOW	

5. Conclusions

The extended test of the EPSNIS was completed on September 23, 2011. All test cases described in the EPSNIS Test Development Test Plan passed. Table 3 shows the total counts for all files involved with the test. There were a number of instances where files were not transmitted on schedule or were not constructed correctly. These were development related issues and not considered deficiencies of the specification. Since the purpose of the test was to evaluate the specification and not the software itself, these development issues were not counted as negative results against the specification.

Table 3. File counts

	Transaction	Reconciliation	Adjustment	Settlement
NYSBA	1422	-	1	-
BP	650	1424	1	70
FIS	-	1684	-	70

Table 4 shows the total number of transactions that were created and settled by BancPass and FIS. Because of the previously mentioned development issues, total transaction, reconciliation, adjustment, and settlement counts did not always clear out as they would have in a production system.

Table 4. Transaction counts

FIS Transactions	Settled
1159	1100
BancPass Transactions	Settled
6399	6166

As with any fledgling specification, there were a number of recommendations that came out of this process. These recommendations were made with the intent to make the specification as easy and straightforward as possible to implement by a developer. With this in mind, there are a number of areas of the specification that would benefit from further clarification and detail. In addition, it is recommended that the XSD documents themselves be constrained more tightly when it comes to data types. Many of these recommendations came out of the process of preparing for and running the long term test.



Electronic Payment Services National Interoperability Specification

“EPSNIS”

Specification
Version 1

Created by the OmniAir Consortium
Electronic Payment Services Committee with
funding from OmniAir and the I-95 Corridor
Coalition and oversight by the Port Authority
of New York & New Jersey

Version as of November 2011

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Disclosures and Acknowledgements

This material is based upon work supported by an I-95 Corridor Coalition funding award and under sponsorship and contract oversight by the Port Authority of New York & New Jersey. Any opinions, findings, and conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of I-95 or PA. This material was prepared by the OmniAir Electronic Payment Services Committee of the OmniAir Consortium and is published by it.

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Rationale for protection of the EPSNIS

OmniAir is a membership organization and its deliverables result in great part from work generously *contributed* by members. In deference to the member companies, committee members, and the Board of Directors of OmniAir, the Consortium establishes rights of intellectual property for some work. IP rewards creativity, stimulates innovation and contributes to the development of superior products – while safeguarding the public interest.

The EPSNIS is a standard meant to be used widely to support national payments interoperability. Toll facility operators and others who provide transportation services for payment will ideally specify the EPSNIS in Requests for Proposals. The private sector will offer the EPSNIS. OmniAir will test suppliers' compliance to it to ensure interoperability across suppliers and facilities – interoperability that encourages innovation, competition and lower costs.

Interoperability must be constantly defended! Copyright protection doesn't preclude use of the specification. It prevents the *fraudulent* use of the standard by entities that claim EPSNIS compliance but who in fact may not be compliant and thus NOT interoperable with other 'certified' users of the EPSNIS. Copyright also keeps the EPSNIS in the hands of the OmniAir membership who can evolve the standard over time to meet *their* needs, as *they* define them.

The EPSNIS is a product of many individuals and companies. Special thanks go to:

- *The New York State Bridge Authority* for providing the test location and engineer and site support at the Newburgh Beacon Bridge.
- *BancPass, Inc.* which provided crucial experience and significant content for the specification and who fully support what standards offer: interoperability, competition & innovation.
- *The Port Authority of New York & New Jersey* staff who provided complete oversight and offered sponsorship that gave the project credibility and buy-in from a key community.
- *The OmniAir EPS Committee* who contributed hundreds of hours of technical expertise and significant direct costs, and who also showed great stamina.
- *The I-95 Corridor Coalition* and its EPS Program Track Committee. In their goal to improve mobility through technology, they realized the value in the proposal and funded it.

Revision History

Version	Date	Revision Summary	Author
Final, Version 1	11/28/2011	Recommended changes as a result of the EPSNIS Test and Findings	OmniAir

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2.0 **Executive Summary**

The Electronic Payment Services National Interoperability Specification for Next Generation ETC Services (EPSNIS) technical standard is written to control a financial transaction network for electronic processing of vehicle transactions. The primary purpose of an EPSNIS controlled financial transaction network is to process toll payments; however, other categories of payments are not intentionally precluded.

This EPSNIS employs a set of Extensible Markup Language (XML) file definitions for information exchange. XML is a general purpose specification that is well suited for describing structured data and validating format. XML file definitions are described using an XML Schema file which describes the required and optional structural elements. Each Clearing Organization that uses the EPSNIS will define and control the process that checks files for compliance with the Clearing Organization's business rules and serializes the information in those files for transmission to and from the Clearing Organization.

The vision is for Clearing Organizations to interoperate in a financial network to process transactions for their clients. File transfers can also occur between two different Clearing Organizations in this financial network with each serving their own OBU Provisioners and Toll Facility Operators. It is also possible for an organization to provide the services of both an OBU Provisioner and a Clearing Organization, a Clearing Organization and Toll Facility Operator, or all three. The purpose of the EPSNIS Technical Specification is to provide the data standard between any two organizations in an EPSNIS network.

Toll Facility Operators, Clearing Organizations, and OBU Provisioners are responsible for creating their own files using the XML schemas described by this specification. These file creation responsibilities and their corresponding transmission are summarized in Figure 1 - EPSNIS Information Flow.

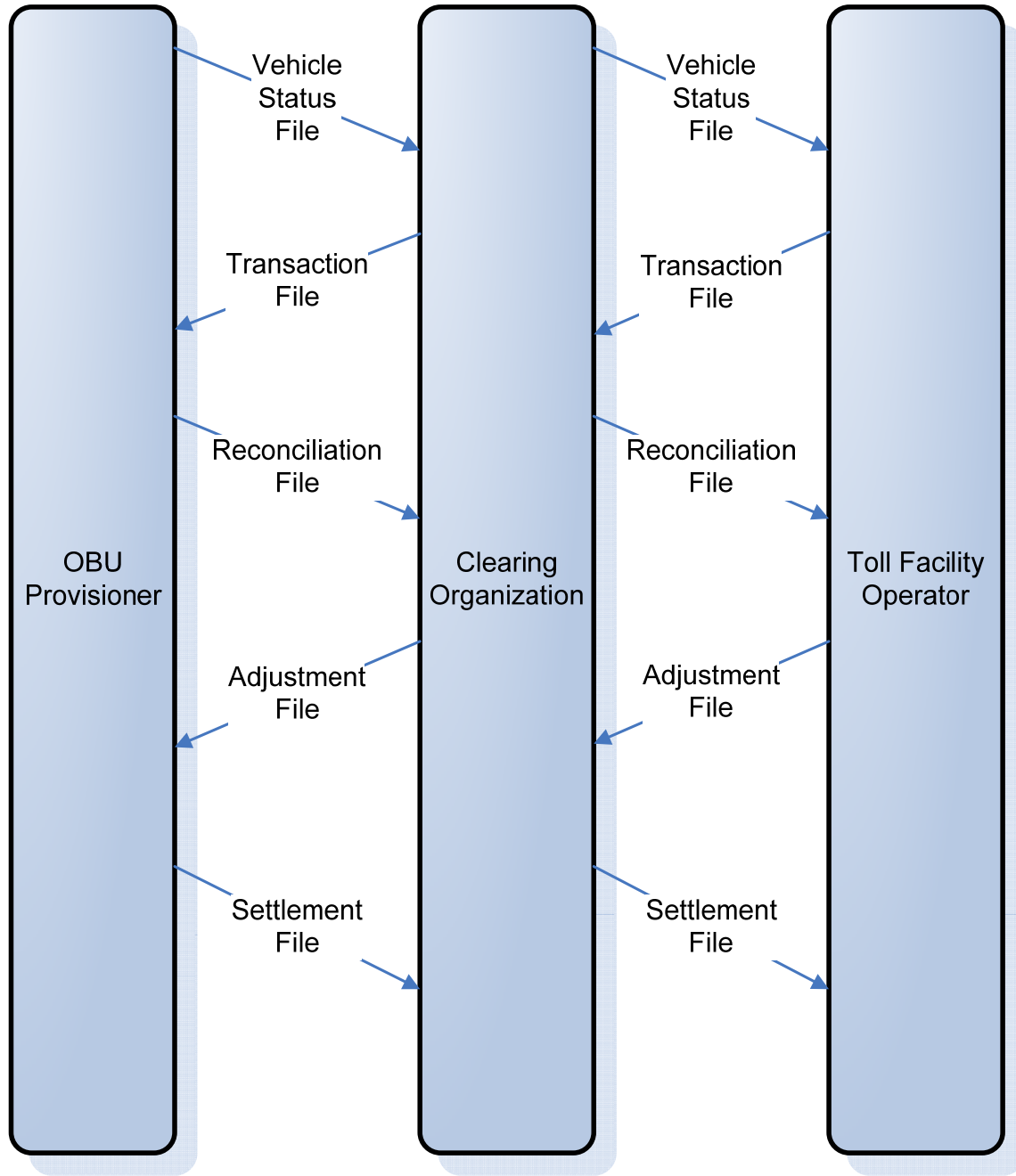


Figure 1 - EPSNIS Information Flow

This version of the EPSNIS has been developed to completely support OmniAir’s 2011 testing at the New York State Bridge Authority’s Newburgh-Beacon Bridge and to determine what is required next to use the EPSNIS in a production environment to facilitate revenue collection.

3.0 Objectives

The purpose of the Technical Specification document is to describe the file exchange process and proposed file structures for information exchange of ETC services. This document is not intended to describe the internal processes used to utilize the files or manage the tolling process within each organization.

3.1 Definitions

Clearing Organization: A legal entity that performs all of the Clearing Organization functions described by this document and provides/operates EPSNIS compliant Clearing Organization systems using the legal entity's own employees or vendors/contractors that the legal entity hires are responsible for.

Information is exchanged between a Toll Facility Operator and a Clearing Organization and between a Clearing Organization and an OBU Provisioner. Each is responsible for creating their own files using the XML schemas described by this Specification. File transfers can also occur between two different Clearing Organizations in this financial network with each serving their own OBU Provisioners and Toll Facility Operators. Each Clearing Organization that uses the EPSNIS defines and controls the process that checks files for compliance with the Clearing Organization's business rules and serializes the information in those files for transmission to and from the Clearing Organization.

Among other functions performed by a Clearing Organization, the Clearing Organization:

- Provides/operates the system(s) on one side of each systems interface controlled by the EPSNIS.
- Is one of the two parties involved in each information exchange controlled by the EPSNIS.

Closed Barrier System: A method of toll collection in which the toll amount is based on where each individual vehicle enters and exits (a "ticket" system)

Deposit Account: A current account at a banking institution that allows money to be deposited withdrawn by the bank account holder.

DSRC: Dedicated Short Range Communications

EPS: Electronic Payment Services. The EPS Committee is a formal committee of OmniAir.

EPSNIS: The Electronic Payment Services National Interoperability Specification for Next Generation ETC Services

ETC: Electronic Toll Collection

FHWA: Federal Highway Administration

FTPS: File Transfer Protocol Secure, also known as FTP Secure and FTP-SSL, is one of the common schemas of the application layer (layer 7) in the OSI Model.

GMT: Greenwich Mean Time

IEEE: The Institute of Electrical and Electronics Engineers

Internet: The global network that uses packet switching via TCP/IP for exchanging information between most personal, commercial, non-profit (including educational institutions), and government networks.

IP: Internet Protocol, a standard commonly used to provide network function (layer 3) for the Internet in an OSI Model.

ISP: Internet Service Provider

Issuing Bank: A bank issuing a credit card, debit card, or similar general-purpose payment account and responsible for the underlying financial relationship with the consumer, business, or non-profit to which it was issued.

LCL: Local time of the tolling lane/zone

Merchant Bank: The bank contracted by the OBU Provisioner to process credit card, debit, and other electronic payment transactions for the purpose of funding the customer toll accounts maintained by the OBU Provisioner.

OBU: On Board Unit, the device installed in a vehicle, associated with a payment account, and used to help identify that payment account when a vehicle incurs a toll in a Toll Facility Operator.

OBU Provisioner: A legal entity that performs all of the OBU Provisioner functions described by this document and provides/operates EPSNIS compliant OBU Provisioner systems using the legal entity's own employees or vendors/contractors that the legal entity hires and is responsible for. Some of the functions performed exclusively by an OBU Provisioner include provisioning, activation, and maintenance of OBUs, and setting up, holding, and managing the associated customer payment accounts.

Open Barrier System: A method of toll collection in which the toll amount is independent upon where each individual vehicle enters and exits.

OSI Model: Open Systems Interconnection Reference Model, a construct commonly used to describe the various network layers and their respective functions

RSU: Road Side Unit, the device installed in a Toll Facility Operator for communicating with OBUs

TLS: Transport Layer Security, a standard commonly used to provide transport layer (layer 4) functions for the Internet in an OSI Model

Toll Facility Operator: A legal entity that performs all of the Toll Facility Operator functions described by this document and provides/operates EPSNIS compliant Toll Facility Operator systems using the legal entity's own employees or vendors/contractors that the legal entity hires and is responsible for. Some of the functions performed exclusively by a Toll Facility Operator include assessing, receiving payment for, and settling tolls for a vehicle's travel on a road, bridge, or tunnel.

TCP: Transmission Control Protocol, a standard commonly used to provide transport layer (layer 4) and possibly some session layer (layer 5) functions for the Internet in an OSI Model.

USDOT: United States Department Of Transportation

VPN: Virtual Private Network, a logical network established within a larger network to provide certain special attributes. Special attributes include authentication, encryption, quality of service, protection from denial of service, and others.

XML: Extensible Mark-up Language, a general purpose specification for describing structured information.

XSLT: Extensible Stylesheet Language Transformations, a XML based standard for describing the transformation of XML into other document formats.

3.2 **Background**

3.2.1 **Existing ETC Systems**

Electronic Toll Collection is a common practice today. In some regions of the United States, there are technical, financial, and other arrangements that have been established that allow a single OBU to be used for paying tolls elsewhere within the region where it was issued. Arguably, the better known "brands" of such regional arrangements are:

- E-ZPass (in the northeastern quadrant of the continental United States)
- FasTrak (in California)
- SunPass (in Florida)
- TxTag (in Texas)

There are no known arrangements in place between any of these brands that would enable an OBU to electronically pay tolls outside the region where it was issued.

3.2.2 **FHWA**

In September 2007, the Federal Highway Administration (FHWA) issued a Notice of Proposed Rule Making pertaining to "Interoperability Requirements, Standards, or Performance Specifications for Automated Toll Collection Systems." Arguably, adoption of such a rule could produce interoperability across two or more regions of the

United States that are not interoperable today and/or could result in the nationwide adoption of a single tolling interoperability standard.

3.2.3 **USDOT**

The USDOT launched the VII initiative. Arguably, this initiative could result in the deployment of OBUs and associated roadside equipment utilizing the 5.9GHz (DSRC) frequency licensed by the Federal Communications Commission for the exclusive use of the transportation industry and/or could result in the nationwide adoption of a single tolling interoperability standard.

3.2.4 **Related Documents**

IEEE 802.11p – Wireless Access for the Vehicular Environments (WAVE)

4.0 **Information Flow**

The EPSNIS Information Flow illustrated earlier in Figure 1 includes five information exchanges that occur on the left side of Figure 1 and five similar exchanges that occur on the right side. An information exchange on the left side of Figure 1 contains the same information types as the corresponding information exchange on the right side, resulting in five sets of file type “twins”. These similarities enable this EPSNIS to fully specify all of the information exchanges in Figure 1 using just five file structures (and an Acknowledgement File), specifically the:

- Vehicle Status File structure as detailed in Section 7.0.
- Transaction File structure as detailed in Section 8.0.
- Reconciliation File structure as detailed in Section 9.0.
- Adjustment File structure as detailed in Section 10.0.
- Acknowledgement File structure as detailed in Section 11.0.
- Settlement File structure as detailed in Section 0.

The Clearing Organization processes information. Any information the Clearing Organization sends may purposefully not be identical to the information it receives. Clearing Organizations may alter data (e.g. to provide value-added services such as financial surety) or remove data (e.g. to convert a violation into a toll transaction without disclosing the relationship between a license plate and a customer account). Because the information contained in any file will probably not be identical to that of its twin, the terms A-File and B-File are used to differentiate the two:

- A-File appropriately connotes original information and an initial transmission. Only OBU Provisioners and Toll Facility Operators create A-Files and transmit A-Files.
- B-File appropriately connotes both a derivative of an A-File and subsequent transmission. Only Clearing Organizations create B-Files and transmit B-Files.

As an example:

1. A Vehicle Status A-File is created by the OBU Provisioner.
2. The OBU Provisioner then transmits this Vehicle Status A-File to the Clearing Organization.
3. The information in the Vehicle Status A-File is processed by the Clearing Organization and used with other information by the Clearing Organization to create a Vehicle Status B-File.
4. The Clearing Organization then transmits this Vehicle Status B-File to the Toll Facility Operator.

The contents of the five file structures are further defined in Sections 7.0 through 0 with the XML Schema descriptions presented in Section 13.0. The current XML Schemas are provided in Appendix A Common XSD through Appendix G Settlement XSD.

5.0 Money Flow

EPSNIS has been developed to allow every Clearing Organization to set up its own policies and business rules when it comes to the payments to be made by the OBU Provisioner to the Toll Facility Operator. In this manner, Clearing Organizations with different Service Levels can coexist in the EPSNIS network.

The standard supports offerings where all payments to be made by several OBU Provisioners to one Toll Service Provider are consolidated by the Clearing Organization (so payments are made from the OBU Provisioner to the Clearing Organization and then from the Clearing Organization to the Toll Service Provider), while other Clearing Organizations may request payments to be made directly by the OBU Provisioner to the Toll Service Provider, accordingly to the Settlement files.

6.0 Architecture

6.1 Network

A Clearing Organization may provide generic services and/or premium value-added services (e.g. fraud control, financial surety, disaster recovery, etc.) and have special/specific network requirements to support each of these.

- Detailed specifications for the various network layers used for the connection between each Clearing Organization and each OBU Provisioner will be mutually decided and agreed to by these respective parties for production environments.
- Similarly, detailed specifications for the various network layers used for the connection between each Toll Facility Operator and their contracted Clearing Organization will be mutually decided and agreed to by these respective parties for production environments.

6.2 **Information Exchange Mechanisms**

During initial testing, all EPSNIS controlled information is packaged into the files described in Sections 7.0 through 0. These XML files are then transmitted in their entirety using File Transfer Protocol Secure (FTPS) over the network described in Section 6.4. The associated server passwords and directory paths for each system will be set by the respective system administrators prior to this testing.

After the initial testing, Clearing Organizations may make private arrangements with OBU Provisioners and/or Toll Facility Operators for:

- Extracting, reducing, transmitting, and re-assembling information in EPSNIS controlled XML files
- Authentication
- Security
- Performance monitoring
- Network traffic management and bandwidth allocation
- Disaster recovery
- Any other functions the Clearing Organization may use in providing value-added services

6.3 **File Formats**

The XML Schema files are presented in Appendix A Common XSD through Appendix G Settlement XSD. In the case where a party does not have any data for the last time period to send, they shall send a file containing only an empty root element. Zero length files shall not be exchanged.

6.4 **Information Exchange Sequencing**

Data file exchange between Clearing Organization and Toll Facility is illustrated in Figure 2 - Data File Exchange between Clearing Organization and Toll Facility.

During initial testing of the EPSNIS, the information exchange sequencing requirements are as follows:

- Parties providing Vehicle Status Files (VSF) shall provide an incremental VSF to each of their counterparties no less often than hourly and a full replacement VSF no less often than every business day. The full replacement VSF shall contain the same information as would result from the proper processing of the previous full replacement VSF and all of its subsequent incremental VSF.
- Parties providing Transaction Files shall provide a Transaction File to each of their counterparties no less often than hourly. All transactions must reflect the account status, payment guarantee, and other information of the latest full replacement VSF and any incremental update VSF that were received prior to the time of each transaction.

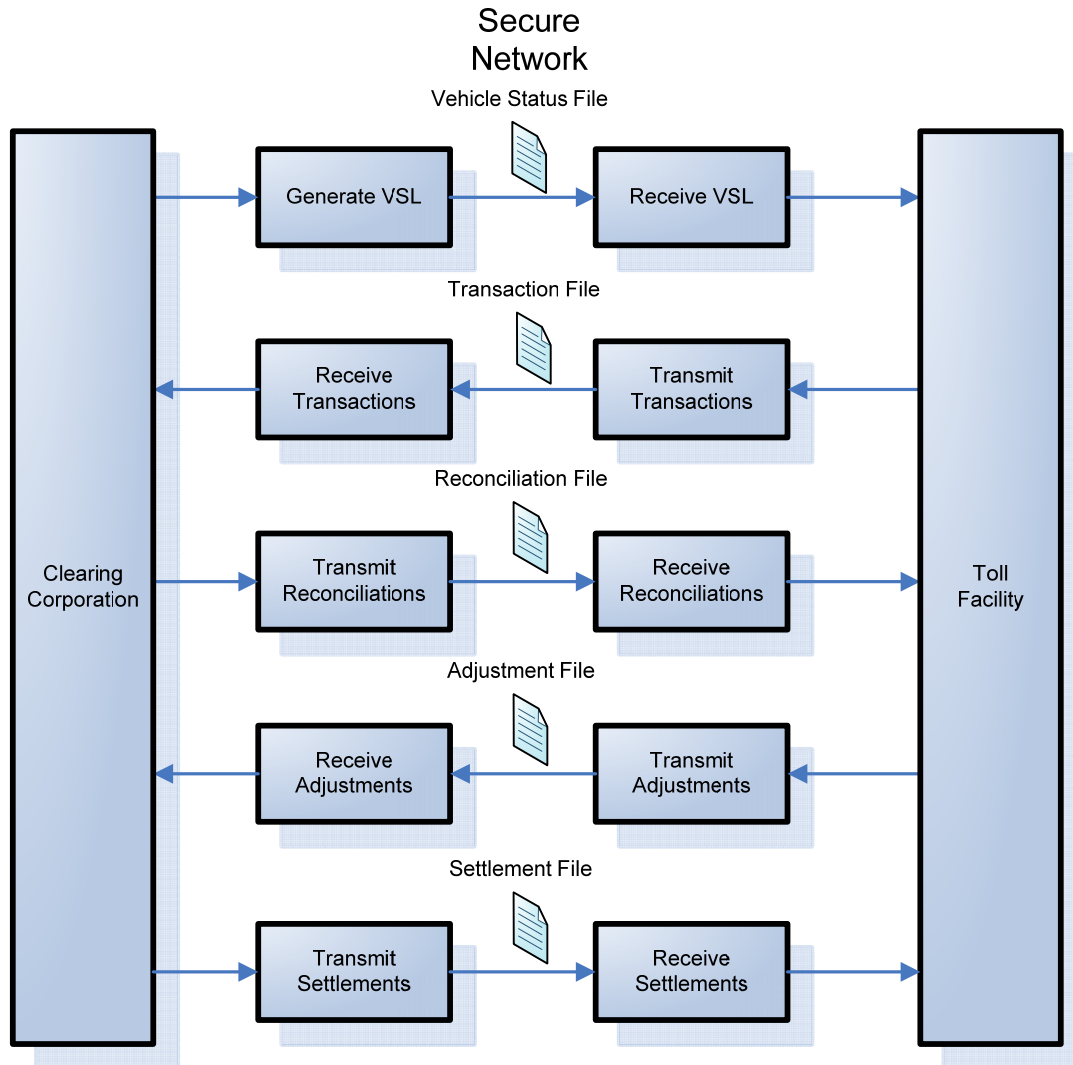


Figure 2 - Data File Exchange between Clearing Organization and Toll Facility

- Parties providing Reconciliation Files shall provide a Reconciliation File to each of their counterparties no less often than hourly.
- Parties providing Adjustment Files shall provide an Adjustment File to each of their counterparties no less often than hourly. Resolution of all dispute transactions must be provided via an Adjustment File within 10 business days after receiving the Reconciliation File.
- Parties providing Settlement Files shall provide a Settlement File to each of their counterparties no less often than once every business day.

After the initial testing, the price a Toll Facility Operator pays and the financial risks the Toll Facility Operator retains will be affected by the sequencing of their information exchanges with their contracted Clearing Organization. This price and retained risk are also affected by the sequencing of information exchanged by their contracted Clearing Organization and the various OBU Provisioners. To maximize the breadth of business

models supported by the EPSNIS and the number of pricing options offered by Clearing Organizations after the initial testing, each:

- VSL Lists may be either full or incremental. The Toll Facility Operator will have the ability to configure how frequently they wish to receive incremental updates during the day. At a minimum, the Clearing Organization will make available: 1) Daily full updates, 2) Incremental updates hourly. If the Operator chooses to receive incremental updates less frequently, no information will be lost, and each incremental will fully supplement the last incremental the Operator received.
- Non-VSL files can be sent as soon as the receiver has acknowledged the previous file. The receiver must be able to receive multiple file-types simultaneously; but the receiver will not be required to receive and process multiple files of the same type simultaneously.
- OBU Provisioner and each Clearing Organization may mutually set the frequency of their file exchanges, the range of permissible timeliness for all data in each file, and the conditions under which a full vs. an incremental file exchange is required.

Following receipt of the transmitted file, there should be a transmission of an acknowledgement file to inform the sender that the file was received and processed. There is normally a time limit of 1 hour on receipt of an acknowledgement, but this may be adjusted based on the Toll Facility's or OBU Provisioner's requirements. The file will be resent if no acknowledgement is received or if an acknowledgement file is received indicating a failure. If the second attempt also fails to receive a successful acknowledgement, then the issue will be escalated to the receiving organization's support team.

7.0 **Vehicle Status File**

The Vehicle Status File is descriptive of customer accounts, vehicles, tolling devices, payers, and the relationship between them. The Vehicle Status File also provides a summary of any associated payment guarantees, non-revenue details and discount plans as optional fields.

Each OBU Provisioner describes its customers' accounts to a Clearing Organization via Vehicle Status A-Files. The Clearing Organization aggregates this information and provides customer account information to a Toll Facility Operator via Vehicle Status B-Files.

The example in Figure 3 - Sample Vehicle Status File shows a Vehicle Status File with several optional entries:

1. An account with a license plate and no transponder
2. An account with an optional account type
3. An account with a specific protocol code (determined by OBU)

```

<?xml version="1.0" encoding="UTF-8"?>
<VEHICLESTATUSLIST xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:noNamespaceSchemaLocation="file:/E:/XMLProjects/OmniAir-Spec1/VSL.xsd">
  <AGENCY>
    <NAME>Test Agency</NAME>
    <CODE>100</CODE>
    <ACCOUNT>
      <DETAILS>
        <ACCOUNTID>1000</ACCOUNTID>
        <STATUS>G</STATUS>
      </DETAILS>
      <PLATE>
        <STATE>TX</STATE>
        <NUMBER>ABC123</NUMBER>
      </PLATE>
    </ACCOUNT>
    <ACCOUNT>
      <DETAILS>
        <ACCOUNTID>1001</ACCOUNTID>
        <STATUS>G</STATUS>
        <ACCOUNTTYPE>Commercial</ACCOUNTTYPE>
      </DETAILS>
      <PLATE>
        <STATE>TX</STATE>
        <NUMBER>XYZ123</NUMBER>
      </PLATE>
      <TAG>
        <TAGID>12345678</TAGID>
        <PROTOCOL>5900</PROTOCOL>
      </TAG>
    </ACCOUNT>
  </AGENCY>
</VEHICLESTATUSLIST>

```

License Plate Account with No Transponder

Optional AccountType

Optional Tag Protocol

Figure 3 - Sample Vehicle Status File

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix B Vehicle Status List XSD.

8.0 Transaction File

The Transaction File describes transactions and is effectively an invoice for payment.

A Toll Facility Operator posts transactions by sending a Transaction A-File to a Clearing Organization.

The Clearing Organization processes this information and creates its own (offsetting) transactions. The Clearing Organization then posts its own transactions by sending Transaction B-Files to the corresponding OBU Provisioners.

Posting of Transaction Files by the Toll Service Provider create a demand for payment, either directly or through the Clearing Organization.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix C Transaction XSD.

9.0 Reconciliation File

After receiving a Transaction B-File from the Clearing Organization, an OBU Provisioner posts the enclosed transactions to their respective customer accounts. Customer account holders may then dispute a transaction. All transactions must be reconciled with the Toll Facility to enable proper closing of the business cycle.

The OBU Provisioner can then either resolve the issue internally or dispute the transaction to the Clearing Organization that sent it to them. Disputes could involve the adjustment of toll amounts based on toll equipment or account issues or the cancellation of a transaction through improper account identification. To dispute the transaction to the Clearing Organization that sent it to them, the OBU Provisioner creates a status entry in the Reconciliation A-File as described below and sends the file to the Clearing Organization. Transactions will post to an account normally following the Clearing Organization or OBU Provisioners business rules.

Similarly, the Clearing Organization can either resolve a dispute internally or begin a separate adjustment process with the Toll Facility Operator where the transaction originated. To dispute a transaction with the Toll Facility Operator that sent it to them, the Clearing Organization creates a Reconciliation B-File as described below and sends the file to the Toll Facility Operator. Reconciliation information is used to prepare the Settlement File.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix D Reconciliation XSD.

10.0 Adjustment File

A Toll Facility Operator can adjust/nullify (via an Adjustment A-File) the transactions they sent to their contracted Clearing Organization. These adjustments can be a result of an investigation triggered by a Reconciliation B-File or any other mechanism allowed by the contract between this Clearing Organization and this Toll Facility Operator.

A Clearing Organization can adjust/nullify (via an Adjustment B-File) the transactions they sent to an OBU Provisioner. These adjustments can be a result of an investigation triggered by a Reconciliation A-File or any other mechanism allowed by the contract between this Clearing Organization and this OBU Provisioner.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix E Adjustment XSD.

11.0 Acknowledgement File

Each party will be responsible for generating an Acknowledgement File upon receipt of the other EPSNIS message types. The Acknowledgement File will confirm that the file was successfully retrieved and processed or that it was received and there was one or more errors found. In the case of errors, the Acknowledgement File will contain EPSNIS specific error numbers and if applicable, the line number where the error occurred. These errors are listed in Appendix H Error Codes of this document.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix F Acknowledgement XSD.

12.0 Settlement File

Settlement Files detail which transactions, disputes, and adjustments one network member's bank deposit account has paid to another member's bank deposit account. The following information types are supported by the Settlement File:

- The transaction amount with all associated discounts, payment guarantees, and adjustments factored in.
- Fees, if any

An OBU Provisioner reports the deposits to the Clearing Organization that its bank makes. The OBU Provisioner accomplishes this by sending a Settlement A-File to the Clearing Organization.

A Clearing Organization reports the deposits made into the Toll Facility Operator's bank either by itself or directly by the OBU Provisioner. The Clearing Organization accomplishes this by sending a Settlement B-File to the Toll Facility Operator.

The XML field descriptions are described in Section 13.0 and the XML Schema file is presented in Appendix G Settlement XSD.

13.0 XML File Structure

Each XML file consists of a root element which contains a sequence of child elements that make up the set of data. Each child element may contain additional child elements to create a hierarchy. To simplify the XML definition, an XML schema is provided for each root element and a set of XML simple types and complex types. The complex types represent functional entities such as a transponder mounted in a vehicle, a set of AVC parameters or transaction posting details. This allows updates to a functional element to be made independently and makes the format more easily read. The complex types may be reused as necessary throughout the schema definition. Definitions of the shared complex types are provided in Appendix A Common XSD of this document.

13.1 **Complex Types**

The XML complex types are uniquely named and will be defined in each XML schema where they are used. Complex types define a specific functional area of the data set and can have multiple instances defined at each level.

Each XML file consists of a root element which contains a sequence of child elements that make up the set of data. Each child element may contain additional child elements to create a hierarchy. The complex types represent functional entities such as a transponder mounted in a vehicle, a set of AVC parameters or transaction posting details

13.1.1 **AccountType**

The AccountType is an XML complex type describing the type of vehicle account and the current account status.

Field	Type	Required	Description
ACCOUNTID	String	Yes	The account owners unique ID
GUARANTEED	String	No	The guaranteed status of the account. Allowed values are: Y for yes N for no (default) <i>Note: custom values as well</i>
ACCOUNTTYPE	String	No	The type of account defined by file originator
RESIDENTTYPE	String	No	The type of resident discount specific to the ETC provisioner
NONREVENUE	String	No	The Non-Revenue status
STATUS	String	Yes	The type of account defined by file originator, typically: V for valid B for low balance Z for no balance L for lost S for stolen R for returned

13.1.2 **VehicleType**

The VehicleType is an XML complex type describing the detailed features of the vehicle.

Field	Type	Required	Description
MAKE	String	No	The make of the vehicle
MODEL	String	No	The model of the vehicle
YEAR	String	No	The model year of the vehicle
VIN	String	No	The Vehicle Identification Number
VII	String	No	The Vehicle Infrastructure Identification number

13.1.3 TagType

The TagType is an XML complex type containing the ETC transponder information.

Field	Type	Required	Description
TAGID	String	Yes	The tag id for the transponder
PROTOCOL	String	No	The protocol used for the transponder in a multiprotocol system
AGENCY	Number	No	The agency id of the transponder used by some protocols
VEHICLECLASS	String	No	The issuers classification level for the tagged vehicle

13.1.4 PlateType

The PlateType is an XML complex type containing the license plate information for the vehicle.

Field	Type	Required	Description
STATE	String	Yes	The code for the governing entity that issued the license plate
NUMBER	String	Yes	The license plate number
STYLE	String	No	The license plate style used by the governing entity

13.1.5 AgencyAccountType

The AgencyAccountType is an XML complex type containing the detailed account information for a single vehicle.

Field	Type	Required	Description
VEHICLE	VehicleType	No	The vehicle details
PLATE	PlateType	No	The license plate details
TAG	TagType	No	The ETC transponder details
DETAILS	AccountType	Yes	The account details

13.1.6 LocationType

The LocationType is an XML complex type containing the location of the toll event.

Field	Type	Required	Description
PLAZA	String	Yes	The plaza name or code for the toll transaction
LANE	Number	Yes	The lane number for the toll transaction

13.1.7 ClassificationType

The ClassificationType is an XML complex type containing the vehicle classification from the toll facility.

Field	Type	Required	Description
IOPREGION	String	Yes	The Interoperability Region used to determine the Vehicle Class (below) e.g. TxTAG, SunPass, IAG, PikePass, KTAG, GoToGo, FasTrak.
VEHCLASS	Number	Yes	The Vehicle Class as defined by the IOP Region
HEIGHT	Number	No	The height of the vehicle in feet
WEIGHT	Number	No	The weight of the vehicle in pounds
FHWAClass	Number	No	1-8 The FHWA defined shape of the vehicle expected by the provisioner http://en.wikipedia.org/wiki/Truck_classification
TAGCLASS	String	No	The vehicle class from the provisioner
FORWARDAXLES	Number	No	The forward axle count from the AVC
REVERSEAXLES	Number	No	The reverse axle count from the AVC
INDICATEDAXLES	Number	No	The collector indicated number of axles

13.1.8 TollType

The TollType is an XML complex type containing the vehicle classification from the toll facility.

Field	Type	Required	Description
TYPE		Yes	The type of toll for the transaction which typically includes: E - ETC fare C - Cash fare
AMOUNT	Number	Yes	The amount in US Dollars for the transaction

13.1.9 DispositionType

The DispositionType is an XML complex type containing the processing status.

Field	Type	Required	Description
STATUS	String	Yes	The status of the transaction which includes: PAID – Transaction paid INVALID LOCATION – Location not recognized INVALID TAG – Tag provided is not valid INVALID PLATE – Plate account is not valid INVALID CLASS – Vehicle classification not recognized NOT FUNDED – Account not funded UNKNOWN TAG – Tag not recognized on VSL DUPLICATE – Transaction is a duplicate XLANE DUPLICATE – Transaction appears

Field	Type	Required	Description
			at additional location in close time proximity IMPROPER FORMAT – Record failed formatting check or other validation error
SUBCODE	String	No	An detailed code if the transaction status has fine grained details, such as an OBU specific description

13.1.10 TransactionType

The TransactionType is an XML complex type containing the transaction posting details.

Field	Type	Required	Description
Account	String	Yes	The account posted for this transaction from the provisioner of the account
Posted	Date	Yes	The date the account posted
Credit	Number	No	The amount credited to the account
Debit	Number	No	The amount debited from the account

13.1.11 Error

The Error is an XML complex type containing error information.

Field	Type	Required	Description
NUMBER	Number	Yes	One of the error numbers specified in Appendix H of this document.
LINE	Number	No	The line number in the file where the error occurred.

13.1.12 FileType

Field	Type	Required	Description
FILENAME	String	Yes	The name of the file that was received
ERRORS	ERROR	NO	The ERRORS element contains a list of errors detected during the processing of any of the EPSNIS documents.

13.1.13 ProcessRule

Field	Type	Required	Description
TYPE	String	Yes	The type of processing rule applied to the transaction
DETAILS	String	Yes	Details of the processing rule such as number of trips for a trip based discount

13.1.14 FileIdentifier

Field	Type	Required	Description
FILEKEY	Hex String	Yes	OmniAir 256 bit Hex PKI key used to verify file originates from an

Field	Type	Required	Description
			authenticated sender
ORIGINATOR	String	Yes	The unique string assigned to the file originator
DESTINATION	String	Yes	The unique string assigned to the intended recipient of the file

13.2 **Vehicle Status List (VSL)**

The Vehicle Status List (VSL) is a collection of accounts for one or more agencies. A single VSL transmitted from the Clearing Organization will typically contain all agencies supported by the Clearing Organization while a VSL received by the Clearing Organization from an OBU Provisioner will contain only the accounts supported by that provisioner.

Field	Type	Required	Description
VEHICLESTATUSLIST	XML Element	Yes	The root level element containing 1 or more AGENCY elements
AGENCY	XML Element	Yes	Contains a vehicle accounts for a single agency such as an ETC provisioner containing 1 or more ACCOUNT elements
NAME	String	Yes	The name of the agency
CODE	Number	Yes	The numeric code used for this agency
ACCOUNT	AgencyAccountType	Yes	An agency account entry for a single vehicle

The XML Schema file is listed in Appendix B Vehicle Status List XSD.

13.3 **Transaction File**

The Transaction file is a collection of detailed transaction events from one or more toll facilities. Files may be processed against a Clearing Organization account but may also be forwarded to an OBU Provisioner for processing. The Clearing Organization will store the transaction status if the account is forwarded.

Field	Type	Required	Description
TRANSACTION	XML Element	Yes	The root level element containing 1 or more DETAIL elements
DETAIL	XML Element	Yes	The detail record containing the transaction details
DATE	Date	Yes	The date the transaction event occurred in GMT
TIME	Time	Yes	The time the transaction event occurred in GMT
REFERENCEID	Number	Yes	The unique reference id issued by the toll facility
LOCATION	LocationType	Yes	The location of the transaction event; if 2 location fields are provided then this is a Closed

Field	Type	Required	Description
			Barrier System
CLASSIFICATION	ClassificationType	Yes	The classification of the vehicle for the transaction
TAG	TagType	No	The tag details for the transaction
PLATE	PlateType	No	The plate details for the transaction
VEHICLE	VehicleType	No	The vehicle details for the transaction
FARES	XML Element	Yes	Element containing 1 or more TOLL elements
TOLL	TollType	Yes	Element containing fare details

The XML Schema file is listed in Appendix C Transaction XSD.

13.4 **Reconciliation File**

The Reconciliation file is a collection of detailed reconciliation events from an OBU Provisioner or the Clearing Organization. The Clearing Organization will store and forward the reconciliation records received from an OBU Provisioner.

Field	Type	Required	Description
RECONCILIATION	XML Element	Yes	The root level element containing 1 or more DETAIL elements
DETAIL	XML Element	Yes	The detail record containing the transaction details
DATE	Date	Yes	The date the transaction event occurred in GMT
TIME	Time	Yes	The time the transaction event occurred in GMT
REFERENCEID	Number	Yes	The unique reference id issued by the toll facility
OBUID	Number	Yes	The unique id issued by OBU for the transaction
LOCATION	LocationType	Yes	The location of the transaction event; if 2 location fields are provided then this is a Closed Barrier System
CLASSIFICATION	ClassificationType	Yes	The classification of the vehicle for the transaction
TAG	TagType	No	The tag details for the transaction
PLATE	PlateType	No	The plate details for the transaction
VEHICLE	VehicleType	No	The vehicle details for the transaction
DISPOSITION	XML Element	Yes	An XML Element containing the PROCESS element and 1 or more account ACTIVITY elements
PROCESS	DispositionType	Yes	The current transaction status
ACTIVITY	TransactionType	Yes	The account activity for the transaction

The XML Schema file is listed in Appendix D Reconciliation XSD.

13.5 **Adjustment File**

The Adjustment file is a collection of adjustments to be made to transactions already submitted the Clearing Organization or OBU Provisioner. They may include changes to the transaction details such as the toll amount or a status change such as a cancellation.

Field	Type	Required	Description
ADJUSTMENT	XML Element	Yes	The root level element containing 1 or more DETAIL elements or 1 or more CHANGE elements
DETAIL	XML Element	Yes	The detail record containing the transaction details
DATE	Date	Yes	The date the transaction event occurred in GMT
TIME	Time	Yes	The time the transaction event occurred in GMT
REFERENCEID	Number	Yes	The unique reference id issued by the toll facility
LOCATION	LocationType	Yes	The location of the transaction event
CLASSIFICATION	ClassificationType	Yes	The classification of the vehicle for the transaction
TAG	TagType	No	The tag details for the transaction
PLATE	PlateType	No	The plate details for the transaction
VEHICLE	VehicleType	No	The vehicle details for the transaction
FARES	XML Element	Yes	Element containing 1 or more TOLL elements
CHANGE	XML Element	Yes	The record containing a status change command
OBUID	Number	Yes	The unique id issued by OBU for the transaction
STATUS	String	Yes	The status command submitted to the payment processor

The XML Schema file is listed in Appendix E Adjustment XSD.

13.6 **Acknowledgement File**

The Acknowledgement file contains a list of one or more XML files that have been processed or been rejected.

Field	Type	Required	Description
ACKNOWLEDGEMENT	XML Element	Yes	The root level element containing 1 or more FILE elements
FILE	FileType	Yes	The file status returned from the receiver

The XML Schema file is listed in Appendix F Acknowledgement XSD.

13.7 **Settlement File**

The Settlement file is a collection of bank transfers made to transactions already submitted the Clearing Organization or OBU Provisioner. They may include changes to the transaction details such as the toll amount or a status change such as a cancellation.

Field	Type	Required	Description
SETTLEMENT	XML Element	Yes	The root level element containing 1 or more TRANSFER elements
TRANSFER	XML Element	Yes	The detail record containing the bank transfer details
SETTLEMENTDATE	Date	Yes	The date the bank transfer should post by
POSTEDDATE	Date	Yes	The date the transactions were posted on the source system
TRANSACTIONS	Number	Yes	The number of transactions processed
DEBIT	Float	Yes	The amount debited from the account
CREDIT	Float	Yes	The amount credited to the account
DISPOSITION	DispositionType	Yes	The disposition type of the transfer

The XML Schema file is listed in Appendix G Settlement XSD.

Appendix A Common XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns="http://www.omniair.org" targetNamespace="http://www.omniair.org">
  <xs:complexType name="FileIdentifier">
    <xs:all>
      <xs:element name="ORIGINATOR" type="xs:string" minOccurs="1"/>
      <xs:element name="DESTINATION" type="xs:string" minOccurs="1"/>
      <xs:element name="FILENAME" type="xs:string" minOccurs="1"/>
      <xs:element name="FILEKEY" type="xs:hexBinary" minOccurs="1"/>
    </xs:all>
  </xs:complexType>
  <xs:complexType name="AccountType">
    <xs:all>
      <xs:element name="ACCOUNTID" type="xs:string"/>
      <xs:element name="GUARANTEED" minOccurs="0">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:enumeration value="Y"/>
            <xs:enumeration value="N"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
      <xs:element name="ACCOUNTTYPE" type="xs:string" minOccurs="0"/>
      <xs:element name="RESIDENTTYPE" type="xs:string" minOccurs="0"/>
      <xs:element name="NONREVENUE" type="xs:string" minOccurs="0"/>
      <xs:element name="STATUS">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:enumeration value="V"/>
            <xs:enumeration value="B"/>
            <xs:enumeration value="Z"/>
            <xs:enumeration value="L"/>
            <xs:enumeration value="S"/>
            <xs:enumeration value="R"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
    </xs:all>
  </xs:complexType>
  <xs:complexType name="AgencyAccountType">
    <xs:all>
      <xs:element name="VEHICLE" type="VehicleType" minOccurs="0"/>
      <xs:element name="PLATE" type="PlateType" minOccurs="0"/>
    </xs:all>
  </xs:complexType>
</xs:schema>
```

```

    <xs:element name="TAG" type="TagType" minOccurs="0"/>
    <xs:element name="DETAILS" type="AccountType"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="LocationType">
  <xs:all>
    <xs:element name="PLAZA" type="xs:string"/>
    <xs:element name="LANE" type="xs:int"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="ClassificationType">
  <xs:all>
    <xs:element name="OPREGION" type="xs:string"/>
    <xs:element name="VEHCLASS" type="xs:string"/>
    <xs:element name="HEIGHT" type="xs:int" minOccurs="0"/>
    <xs:element name="WEIGHT" type="xs:int" minOccurs="0"/>
    <xs:element name="FWWCLASS" type="xs:int" minOccurs="0"/>
    <xs:element name="SHAPE" type="xs:string" minOccurs="0"/>
    <xs:element name="TAGCLASS" type="xs:string" minOccurs="0"/>
    <xs:element name="FORWARDAXLES" type="xs:int" minOccurs="0"/>
    <xs:element name="REVERSEAXLES" type="xs:int" minOccurs="0"/>
    <xs:element name="INDICATEDAXLES" type="xs:int" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="TagType">
  <xs:all>
    <xs:element name="TAGID" type="xs:string"/>
    <xs:element name="PROTOCOL" type="xs:string" minOccurs="0"/>
    <xs:element name="AGENCY" type="xs:integer" minOccurs="0"/>
    <xs:element name="VEHICLECLASS" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="PlateType">
  <xs:all>
    <xs:element name="COUNTRY" type="xs:string"/>
    <xs:element name="STATE" type="xs:string"/>
    <xs:element name="NUMBER" type="xs:string"/>
    <xs:element name="STYLE" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="VehicleType">
  <xs:all>
    <xs:element name="MAKE" type="xs:string" minOccurs="0"/>
    <xs:element name="MODEL" type="xs:string" minOccurs="0"/>
    <xs:element name="YEAR" type="xs:gYear" minOccurs="0"/>
    <xs:element name="VIN" type="xs:string" minOccurs="0"/>
  </xs:all>

```

```

    <xs:element name="VII" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="TollType">
  <xs:all>
    <xs:element name="TYPE">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="E"/>
          <xs:enumeration value="C"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
    <xs:element name="AMOUNT" type="xs:float"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="ProcessRule">
  <xs:all>
    <xs:element name="TYPE" type="xs:string"/>
    <xs:element name="DETAILS" type="xs:string"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="DispositionType">
  <xs:all>
    <xs:element name="STATUS">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="PAID"/>
          <xs:enumeration value="INVALID LOCATION"/>
          <xs:enumeration value="INVALID TAG"/>
          <xs:enumeration value="INVALID PLATE"/>
          <xs:enumeration value="INVALID CLASS"/>
          <xs:enumeration value="NOT FUNDED"/>
          <xs:enumeration value="UNKNOWN TAG"/>
          <xs:enumeration value="DUPLICATE"/>
          <xs:enumeration value="XLANE DUPLICATE"/>
          <xs:enumeration value="IMPROPER FORMAT"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
    <xs:element name="SUBCODE" type="xs:string" minOccurs="0"/>
  </xs:all>
</xs:complexType>
<xs:complexType name="TransactionType">
  <xs:all>
    <xs:element name="ACCOUNT" type="xs:string"/>
  </xs:all>
</xs:complexType>

```

```

<xs:element name="POSTED" type="xs:date"/>
<xs:element name="CREDIT" type="xs:float" minOccurs="0"/>
<xs:element name="DEBIT" type="xs:float" minOccurs="0"/>
</xs:all>
</xs:complexType>
<xs:complexType name="FileType">
<xs:all>
<xs:element name="FILENAME" type="xs:string"/>
<xs:element name="ERRORS" maxOccurs="1">
<xs:complexType>
<xs:sequence>
<xs:element name="ERROR" minOccurs="1" maxOccurs="unbounded">
<xs:complexType>
<xs:all>
<xs:element name="NUMBER" minOccurs="1">
<xs:simpleType>
<xs:restriction base="xs:int">
<xs:enumeration value="1000"/>
<xs:enumeration value="1001"/>
<xs:enumeration value="1002"/>
<xs:enumeration value="1003"/>
<xs:enumeration value="1004"/>
<xs:enumeration value="1011"/>
<xs:enumeration value="1012"/>
<xs:enumeration value="1013"/>
<xs:enumeration value="1014"/>
<xs:enumeration value="1015"/>
<xs:enumeration value="1101"/>
<xs:enumeration value="2001"/>
<xs:enumeration value="2002"/>
<xs:enumeration value="2003"/>
<xs:enumeration value="2004"/>
<xs:enumeration value="2005"/>
<xs:enumeration value="2006"/>
<xs:enumeration value="2007"/>
<xs:enumeration value="2008"/>
<xs:enumeration value="2009"/>
<xs:enumeration value="2010"/>
<xs:enumeration value="2011"/>
<xs:enumeration value="2012"/>
<xs:enumeration value="2013"/>
<xs:enumeration value="3001"/>
</xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="LINE" type="xs:int" minOccurs="0"/>

```

```
</xs:all>  
</xs:complexType>  
</xs:element>  
</xs:sequence>  
</xs:complexType>  
</xs:element>  
</xs:all>  
</xs:complexType>  
</xs:schema>
```

Appendix B Vehicle Status List XSD

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="VEHICLESTATUSLIST">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="AGENCY" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="NAME" type="xs:string"/>
              <xs:element name="CODE" type="xs:int"/>
              <xs:sequence>
                <xs:element name="ACCOUNT" type="cmn:AgencyAccountType"
maxOccurs="unbounded"/>
              </xs:sequence>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix C Transaction XSD

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="TRANSACTION">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="DETAIL" maxOccurs="unbounded">
          <xs:complexType>
            <xs:all>
              <xs:element name="DATE" type="xs:date"/>
              <xs:element name="TIME" type="xs:time"/>
              <xs:element name="REFERENCEID" type="xs:long"/>
              <xs:element name="LOCATION" type="cmn:LocationType"/>
              <xs:element name="CLASSIFICATION" type="cmn:ClassificationType"/>
              <xs:element name="RULE" type="cmn:ProcessRule" minOccurs="0"/>
              <xs:element name="TAG" type="cmn:TagType" minOccurs="0"/>
              <xs:element name="PLATE" type="cmn:PlateType" minOccurs="0"/>
              <xs:element name="VEHICLE" type="cmn:VehicleType" minOccurs="0"/>
              <xs:element name="FARES">
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="TOLL" type="cmn:TollType"
maxOccurs="unbounded"/>
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:all>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix D Reconciliation XSD

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="RECONCILIATION">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="DETAIL" maxOccurs="unbounded">
          <xs:complexType>
            <xs:all>
              <xs:element name="DATE" type="xs:date"/>
              <xs:element name="TIME" type="xs:time"/>
              <xs:element name="REFERENCEID" type="xs:int"/>
              <xs:element name="OBUID" type="xs:int"/>
              <xs:element name="LOCATION" type="cmn:LocationType"/>
              <xs:element name="TAG" type="cmn:TagType" minOccurs="0"/>
              <xs:element name="PLATE" type="cmn:PlateType" minOccurs="0"/>
              <xs:element name="VEHICLE" type="cmn:VehicleType" minOccurs="0"/>
              <xs:element name="DISPOSITION">
                <xs:complexType>
                  <xs:sequence>
                    <xs:element name="PROCESS" type="cmn:ProcessRule" minOccurs="0"/>
                    <xs:element name="ACTIVITY" type="cmn:TransactionType"
minOccurs="0" maxOccurs="unbounded"/>
                  </xs:sequence>
                </xs:complexType>
              </xs:element>
            </xs:all>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>

```

Appendix E Adjustment XSD

```

<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="ADJUSTMENT">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:choice>
          <xs:element name="DETAIL" maxOccurs="unbounded">
            <xs:complexType>
              <xs:all>
                <xs:element name="DATE" type="xs:date"/>
                <xs:element name="TIME" type="xs:time"/>
                <xs:element name="REFERENCEID" type="xs:long"/>
                <xs:element name="LOCATION" type="cmn:LocationType"/>
                <xs:element name="CLASSIFICATION" type="cmn:ClassificationType"/>
                <xs:element name="TAG" type="cmn:TagType" minOccurs="0"/>
                <xs:element name="PLATE" type="cmn:PlateType" minOccurs="0"/>
                <xs:element name="VEHICLE" type="cmn:VehicleType" minOccurs="0"/>
                <xs:element name="FARES">
                  <xs:complexType>
                    <xs:sequence>
                      <xs:element name="TOLL" type="cmn:TollType"
maxOccurs="unbounded"/>
                    </xs:sequence>
                  </xs:complexType>
                </xs:element>
              </xs:all>
            </xs:complexType>
          </xs:element>
          <xs:element name="CHANGE" maxOccurs="unbounded">
            <xs:complexType>
              <xs:all>
                <xs:element name="DATE" type="xs:date"/>
                <xs:element name="TIME" type="xs:time"/>
                <xs:element name="REFERENCEID" type="xs:long"/>
                <xs:element name="OBUID" type="xs:long"/>
                <xs:element name="LOCATION" type="cmn:LocationType"/>
                <xs:element name="STATUS" type="xs:string"/>
              </xs:all>
            </xs:complexType>
          </xs:element>
        </xs:choice>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

```

</xs:choice>
</xs:sequence>
</xs:complexType>
</xs:element>
</xs:schema>

Appendix F Acknowledgement XSD

```
<?xml version="1.0" encoding="utf-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org" elementFormDefault="qualified">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="ACKNOWLEDGEMENT">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="FILE" type="cmn:FileType" maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix G Settlement XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:cmn="http://www.omniair.org">
  <xs:import namespace="http://www.omniair.org" schemaLocation="common.xsd"/>
  <xs:element name="SETTLEMENT">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="FILEIDENTIFIER" type="cmn:FileIdentifier"/>
        <xs:element name="TRANSFER" maxOccurs="unbounded">
          <xs:complexType>
            <xs:all>
              <xs:element name="POSTEDDATE" type="xs:date"/>
              <xs:element name="DISPOSITION" type="cmn:DispositionType"/>
              <xs:element name="TRANSACTIONS" type="xs:integer"/>
              <xs:element name="DEBIT" type="xs:float"/>
              <xs:element name="CREDIT" type="xs:float"/>
            </xs:all>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Appendix H Error Codes

Error Number	Description
1000	File already processed
1001	No root element, file type unknown
1002	Invalid element or attribute name
1003	Duplicate attribute name found
1003	No close tag
1011	Invalid characters for data type STRING
1012	Invalid characters for data type NUMBER
1013	Invalid characters for data type HEX STRING
1014	Invalid characters for data type DATE
1015	Invalid characters for data type TIME
1101	Internal parser error.
2001	Constraint violation
2002	Invalid date
2003	Invalid time
2004	ID not unique
2005	Account number not recognized
2006	Business rule not recognized
2007	Account type not recognized
2007	Agency not recognized
2009	IOP Region not recognized
2010	Originator not recognized or invalid
2011	Destination invalid
2012	Invalid currency format or value
2013	Invalid value
3001	Invalid OmniAir Key