Detailed Software Design
ITSIQA
Intelligent Transportation Systems Integration Quality and Analysis

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List of Acronyms and Abbreviations

API ....Application Program Interface
C2C ....Center to Center
CFX... Central Florida Expressway Authority
ConOps .... Concept of Operations
FDOT .... Florida Department of Transportation
FHP CAD...Florida Highway Patrol Computer Aided Dispatch
FTP.. File Transfer Protocol
HTTP.. Hypertext Transfer Protocol
LOS ....Level of Service
MIMS ....Maintenance and Inventory Management System
ITS.. Intelligent Transportation Systems
ITSIQA ....Intelligent Transportation Systems Integration Quality and Analysis
TMC...Turning Movement Count
TSM&O .... Transportation Systems Management and Operations
TSS.. Traffic Sensor Subsystem
WSDL ....Web Service Definition Language
XML.. Extensible Markup Language

1. Overview

1.1 Document Overview

The purpose of this document is to describe the Detailed Software Design for the Intelligent Traffic Systems Integration Quality and Analysis (ITSIQA) project. This includes describing the current issues, what changes are desired, and how this new system fits into long range plans for a fully integrated traffic management system.

Based on concepts and desired functionality described this document, functional requirements should be developed. Final system testing should reference this ConOps to ensure that the intended goals outlined in this document have been fully realized.

The intended audience of this document includes the end users of the ITSIQA system, including stakeholders who may benefit from this system as well as related engineering staff who seek an understanding of FDOT goals when designing the final system.

1.2 System Overview

The overarching objectives of the ITSIQA system include:

1. Receive real-time traffic information via three interfaces, SunGuide's Databus, the Center-to-Center Software, and Waze

2. Perform quality checks and analysis on the traffic information

3. Report the cleaned data to multiple systems including the SunGuide Software

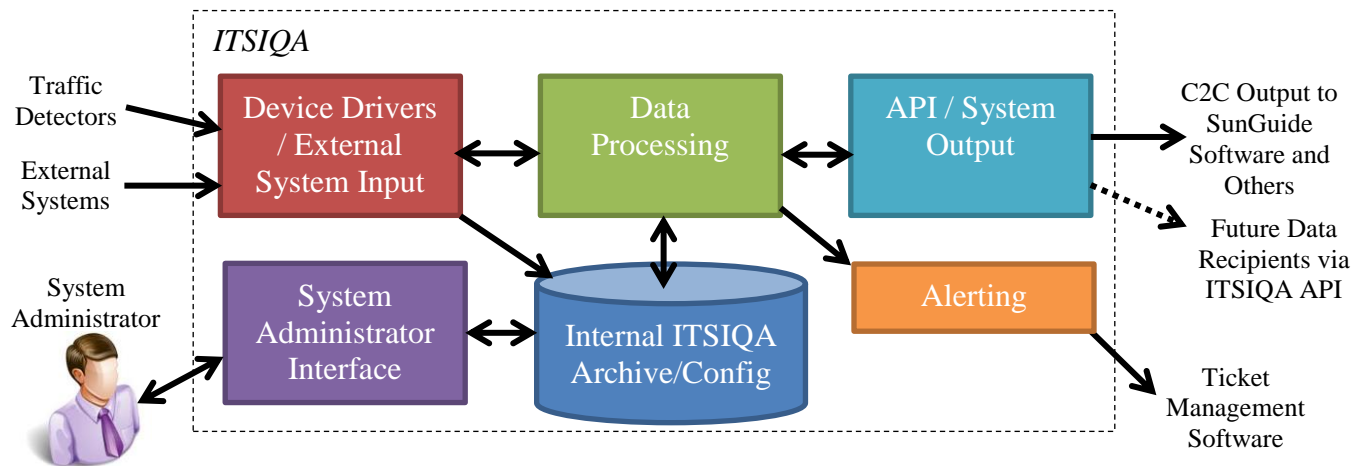Figure 1 depicts a high level description of ITSIQA.

Figure 1: High Level Description of ITSIQA

The traffic detectors encompass all legacy and known future traffic detectors within FDOT District 5's system. Third-party traffic data feeds encompass services that provide real-time traffic information from their own traffic information collection systems. Examples of third party traffic feeds are Central Florida Expressway Authority (CFX) and HERE.com. Traffic information encompasses all traffic detectors and traffic data feeds. ITSIQA houses a working database to be used to store raw and processed real-time traffic information for internal data processing and system configuration. This configuration is handled via a simple System Administration Interface. ITSIQA provides processed data via a standard Application Program Interface (API) that allows multiple systems to acquire consolidated traffic information. A Center-to-Center (C2C) plug-in converts the API into a format that allows the SunGuide Software to read and use this information for traffic management purposes. An alerting functionality identifies potential issues with detectors and external systems and submits this information into an FDOT-licensed external Maintenance and Inventory Management System (MIMS).

Although developed by FDOT District 5, the fully functional ITSIQA can be made available to other FDOT districts and local agencies, including CFX.

2.   Referenced Documentation

The primary referenced document for the ITSIQA Detailed Software Design is the ITSIQA Concept of Operations, which describes how ITSIQA should function and the overall goals of the system as it relates to the overall system concept.

As part of the ITSIQA development, a number of technical documents were reviewed to determine the best approach for addressing the project needs. Each document provides in depth perspectives on various strategies to ingest traffic information from various sources, filter through this data, and fuse it together to form the most accurate picture of current traffic conditions.

Table 1 lists the documents reviewed.

<div align="center">Table 1: List of Documents Reviewed for ITSIQA Development</div>

Publication	Author / Publisher	Date	Useful Subject Matter
Evaluation of a cellular phone-based system for measurements of traffic speeds and travel times: A case study from Israel	Department of Industrial Engineering and Management, Ben-Gurion University of the Negev, Israel	Jun-2007	Travel Time Verification
Traffic Data Quality Measurement	FHWA, Cambridge Systematics Inc., Texas Transportation Institute	Sep-2004	Data Quality Metrics Data Quality Calculations

Publication	Author / Publisher	Date	Useful Subject Matter
Travel Time Data Collection Handbook	FHWA, Texas Transportation Institute	Mar-1998	Error Checking Data Reduction Reporting
Methods for Floating Car Sampling Period Optimization	Journal of Transportation Systems Engineering and Information Technology ITS Center, Wuhan University of Technology School of Traffic and Transportation, Tongji University	Jun-2007	Data Sample Period
Guide to Establishing Monitoring Programs for Travel Time Reliability	TRB Institute for Transportation Research and Education, North Carolina State University	2014	Data Aggregation
Evaluation of Traffic Data Obtained via GPS-Enabled Mobile Phones: the Mobile Century Field Experiment	UC Berkeley Center for Future Urban Transport	Aug-2009	AVL System Accuracy
Analytical Delay Models for Signalized Intersections	Kirikkale University University of Pittsburgh		Intersection Delay
A Traffic Data Warehousing and Visualization Scheme	University of Minnesota, Thesis Paper	Jul-2004	Data Processing
Integration of Probe Vehicle and Induction Loop Data - Estimation of Travel Times and Automatic Incident Detection	University of Technology, Netherlands	Jan-1996	Data Aggregation Incident Detection
Measuring real-time traffic data quality based on floating car data	ATEC ITS France Congress	Jan-2014	Data Aggregation Data Quality
Quality Management Methods for Real-Time Traffic Information	15th meeting of the EURO Working Group on Transportation University of Federal Armed Forces Munich, Department of Traffic Engineering		Data Quality
Validation and augmentation of Inrix Arterial Travel Time Data using Independent Sources	MDOT State Highway Administration	Feb-2015	Data Aggregation Data Quality Arterial Travel Time
Use of Multiple Data Sources for Monitoring Mobility Performance	FDOT Transportation Statistics Office	Jan-2015	Data Quality segment mapping
Data Fusion Based Hybrid Approach for the Estimation of Urban Arterial Travel Time	Journal of Applied Mathematics	Jul-2012	Arterial Travel Time

Publication	Author / Publisher	Date	Useful Subject Matter
Comparison of Methods for Measuring Travel Time at Florida Freeways and Arterials	FDOT Systems Planning Office	Jul-2014	Roadway Segment Correlation Data Accuracy
REGIONAL TRANSPORTATION DATA WAREHOUSE – Phase I, II, III	Texas Transportation Institute	Aug-2008	Data Aggregation Data Quality Data Filtering Data Fusion Data Warehousing
Classifiers and Distance-Based Evidential Fusion for Road Travel Time Estimation	Laboratoire d'Ingénierie Circulation Transports Laboratoire d'Informatique et d'Automatique de l'Artois	2006	Data Fusion
OOCEA Data Server Travel Time Filtering and Fusion Data Flow	Central Florida Expressway Authority	2005	Data Fusion
Bluetooth Sensor Data and Ground Truth Testing of Reported Travel Times	Department of Civil and Environmental Engineering, University of Maryland	2012	Data Fusion Data Accuracy
Road network spatial segmentation	FDOT, Clay Packard	2016	Spatial Issues

3. Current System Situation

The SunGuide Software is used as FDOT District 5's Supervisory Control and Data Acquisition (SCADA) system for traffic operations. Owned, customized, and maintained by FDOT Central Office, the SunGuide Software is a suite of services and interfaces intended to accomplish all software ITS control, archiving, and reporting functions required for an FDOT district or local agency to carry out its traffic operations.

Figure 2 depicts a graphical view of the SunGuide Release 6.2 Software.
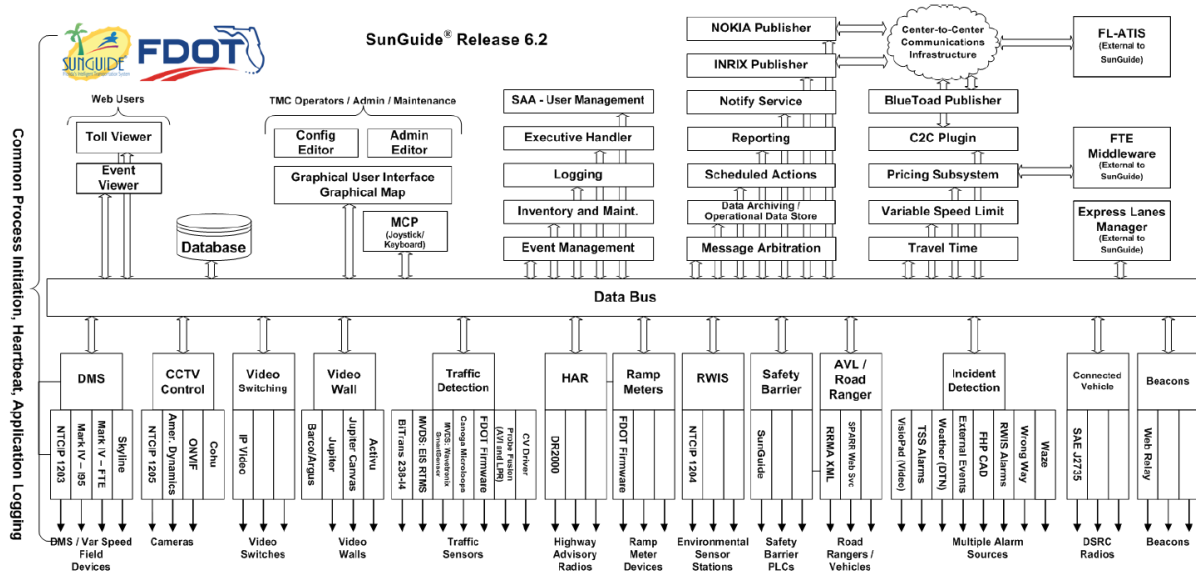
Figure 2: SunGuide Release 6.2 Software Design Diagram

As shown in the diagram above, the SunGuide Software includes a wide range of software drivers that allow FDOT districts and local agencies to view and control their ITS devices using this single suite of software, rather than supporting multiple vendor-specific software packages.

The SunGuide Software integrates district- and agency-owned and maintained equipment throughout the state of Florida. The SunGuide Software is actively used by the operations and engineering staff of all FDOT districts, two tolling agencies, and multiple local municipalities. In most cases, it operates 24/7/365. Staff operates this software with as little downtime as possible.

In addition to interfacing with a district and agency's ITS field equipment, the SunGuide Software also interfaces with external third party and FDOT systems, including the Florida 511 Traveler Information system and the Florida Highway Patrol Computer Aided Dispatch (FHP CAD) system. Each of these interfaces are monitored and maintained by traffic operations and SunGuide system administrative staff.

3.1   Background, Objectives, and Scope

FDOT District 5 has been architecting long range plans for a fully integrated traffic management system. ITSIQA is intended to be an integrated portion of these plans. Figure 3 is FDOT District 5's Transportation Systems Management and Operations (TSM&O) Data Fusion Architecture Road Map, which shows the planned high level data flow of this fully integrated system.

Figure 3: TSM&O Data Fusion Architecture Road Map

Note that the ITSIQA system is showed as the green "SIQA Data Cleansing" boxes. Also note that initially, this system is planned to be deployed within FDOT District's TSM&O Operations and CFX's Freeway Data Center. Each deployment will be configured appropriately to acquire data from legacy detectors and systems and provide processed information to the SunGuide Software. Alerting information will also be provided into FDOT District 5's ticketing management software, called MIMS.
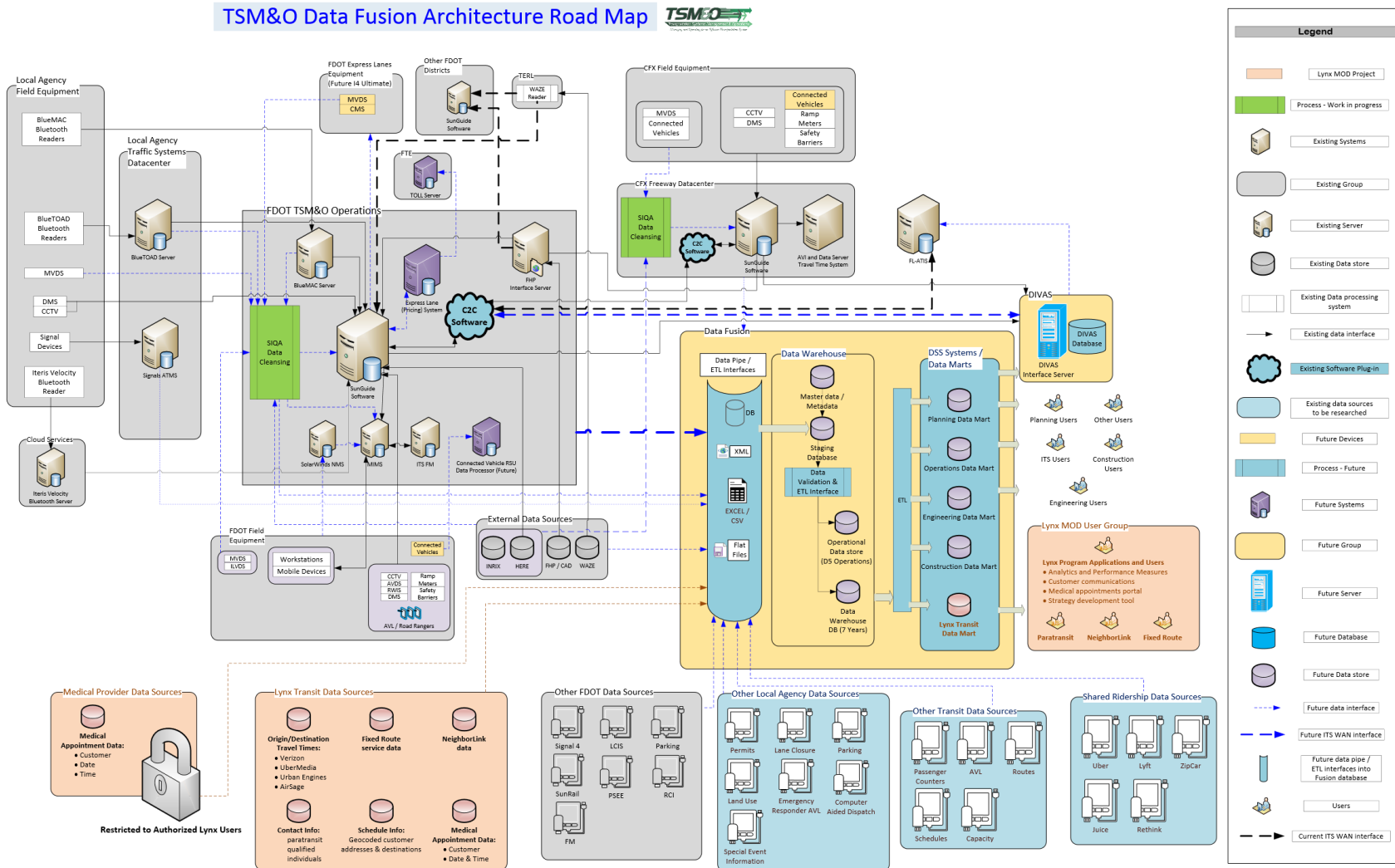
4.   Software Design Goals

This section includes a summary of overall goals to be accomplished with ITSIQA software. This includes capabilities, functions, processes, interfaces, and other changes needed to respond to the justifications previously identified.

- *Traffic Detector/Third Party Data Interfaces*: Rather than reporting traffic data to SunGuide or other operations systems directly, traffic data is routed into ITSIQA.

- *System Processing Changes*: ITSIQA provides a new layer of quality controls and algorithms that determines a truer picture of actual traffic conditions.

- *Device and Data Source Management*: ITSIQA depends on the SunGuide software for the configuration of the FDOT detectors. ITSIQA automatically ingests this configuration information from the SunGuide software in order to facilitate processing of the data. ITSIQA has a configuration management interface to manage various parameters related to the multiple sets of data retrieved into the ITSIQA system.

- *Standardized Output Interface*: ITSIQA provides an Application Program Interface (API) for any external system that requires traffic condition data.

- *Standardized Reporting*: ITSIQA reports a standardized list of road segments. Although this list will be configurable to allow future changes, it is envisioned to make infrequent changes to the list, to ensure consistent reporting from month to month and year to year. This list will initially use segments defined within the HERE data, which is based on roadway geometry and traffic flows and will not be directly tied to detector locations or reporting standards of third party vendors.

- *Automatic Detector Issue Reporting*: ITSIQA flags potential issues with system interfaces and traffic detectors and automatically generate trouble tickets within FDOT District 5's MIMS issue tracking system.

5.   Detailed Software Design

5.1   Description of Software Components

The ITSIQA system consists of a suite of components that operates on a Windows Server 2015 operating system on a Microsoft .NET 4.0 Framework. Figure 4 depicts the components that make up the entire ITSIQA system.
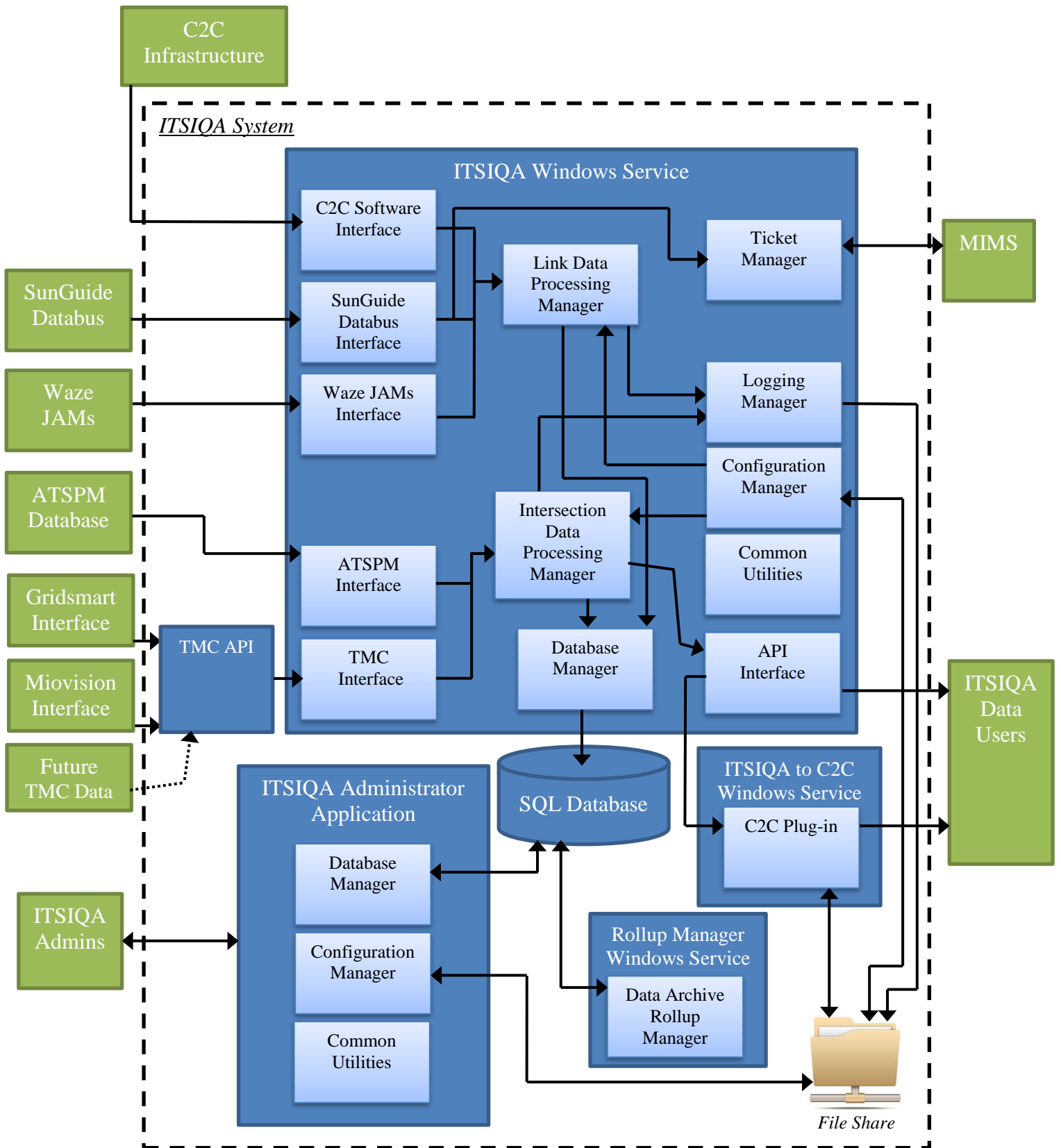
Figure 4: ITSIQA Detailed Software Design

As shown above, ITSIQA receives data from five different interfaces; C2C, SunGuide, Waze, ATSPM, and TMC. The following sections provide details of each of these interfaces.

5.2   *System Configuration*

ITSIQA provides configuration controls at a system-level and at a per interface-level. All configuration is controlled via the ITSIQA Administrator Application—see Section 5.6 of this document for more information about this application.

Tables 2 through 8 below describes each grouping of configuration settings, each setting, and what the setting controls. Note that in most cases, a change to any of these settings requires a restart of the ITSIQA primary Windows service.

Table 2: ITSIQA System Configuration Settings

Configuration Field	Description	Example Value
Processing Interval (in seconds)	The frequency in seconds in which incoming status data is processed within ITSIQA. During each processing cycle, all incoming data is read, interpreted, and disseminated. **Based on design constraints, this value should not be set to less than 60 seconds**.	60
Roadway Normalization Interval (in minutes)	The frequency in minutes in which incoming roadway and link configuration is mapped to ITSIQA's master link configuration. This linking process associates the incoming configuration with ITSIQA's standardized mapped links. Because this linking processing is time-consuming and flushes out previous associations, it is recommended only performing this once per day, i.e. setting this to once every 1440 minutes.	1440
Valid Time Horizon (in seconds)	This defines the age in seconds of the oldest data ITSIQA will accept incoming data. For example, if data is being processed at 2:00:00 AM and this value is set to 180 seconds, then ITSIQA will accept data timestamped 1:57:00 AM or newer. All incoming data older than this is discarded.	180
Maintain Logs (in days)	The number of days log files are kept. Log files older than this value are automatically deleted.	7

Configuration Field	Description	Example Value
Maintain Incoming Data (in hours)	ITSIQA writes all incoming data to disk, primarily intended for troubleshooting purposes. Data older than this value in hours is automatically deleted. This value only affects data written to disk and does not affect the actively processed and reported data.	2
Maintain API Data (in days)	ITSIQA writes all output data to disk, with a timestamp built into the file names. These files can be accessed by external systems – see the ITSIQA Output section of this document. This value specifies how much of this archived output is kept on disk. Files older than this value is automatically deleted.	7
Web Shared URL	The URL where ITSIQA output is made available.	http://localhost
Minimum Quality Value for Valid Data	When ITSIQA compares current data with other current data or previously report data, these comparisons depend on whether or not the data is valid. If data is not valid, the comparisons are not performed. This value defines what data is valid. This value must be an integer between 0 and 10.	4
Enable Filtering	When enabled, ITSIQA will analyze all incoming detector data from SunGuide against all enabled filtering checks. This value must be either True or False.	True
Enable Filter Logging	When enabled, ITSIQA will log additional information related to the filtering process. This is intended to troubleshoot the filtering checks and/or the filtering process. This value must be either True or False.	True
Perform AADT Rollup	When enabled, ITSIQA will calculated daily volume counts for all reported roadway links and archive these values in the ITSIQA database. This value must be either True or False.	True
Perform Traffic Info Table Cleanup	When enabled, ITSIQA will automatically delete old data from the ITSIQA database. Old data is defined by "Number of Days to Archive Traffic Info Tables". This value must be either True or False.	True

Configuration Field	Description	Example Value
Number of Days to Archive Traffic Info Tables	The number of days of data that ITSIQA will maintain Traffic Info data within the ITSIQA database. This value is only used if "Perform Traffic Info Table Cleanup" is set to True.	120
Google Chrome Executable Path	This the path of the Chrome executable, which should be able to host Google Maps. This is only used when displaying the ITSIQA master link configuration onto Google Maps via the ITSIQA Administrative Manager. Chrome and this path are not necessary for ITSIQA to operate.	C:\Program Files (x86)\Google\ Chrome\ Application\ chrome.exe
Map Links TimeOut (in seconds)	This value is the number of seconds the ITSIQA Administrative Manager waits to receive SunGuide linking configuration data from SunGuide. This is only used when ITSIQA Administrative Manager retrieves link configuration from SunGuide and presents this information into Google Maps for the user to view.	10
Map Source Selection	The name of the mapping source used that defines the ITSIQA master link configuration. Note that multiple ITSIQA master link configurations can be stored in ITSIQA's database, but only one can be selected. These names are stored in ITSIQA's database and should match the name of the map source exactly.	ARBM 2016
SMTP Enabled	When enabled, ITSIQA will send out email alerts for critical interface or system errors. This value must be either True or False.	True
SMTP Host IP	The IP address of the SMTP server that will relay email alerts that are automatically generated from ITSIQA.	1.1.1.1
SMTP Host Port	The IP Port of used to push SMTP traffic to the SMTP Host server for handling ITSIQA email alerts. This is typically set to 25.	25
SMTP From Address	The "From" email address used for ITSIQA email alerts. Note that ITSIQA does not handle incoming email. Therefore, replies to this address are not handled within ITSIQA.	donotreply@ email.com
SMTP To Addresses (separated by ;)	This is the list of email recipients for all ITSIQA email alerts. Each email address in this list should be separated by a semicolon.	u1@email.com; u2@email.com

Table 3: ITSIQA Database Interface Configuration Settings

Configuration Field	Description	Example Value
Database ID	The name of the ITSIQA SQL Server database.	ITSIQA
Database Server Name	The name or IP where the ITSIQA database is hosted.	1.1.1.1
User Name	The local SQL Server username that ITSIQA should use to log into the ITSIQA database. This user account should have full read/write permissions.	ITSIQA
Password	The user password used when ITSIQA establishes a connection and logs into the ITSIQA database.	password
Bulk Insert Base Path	The folder path that bulk inserts will reference when ITSIQA pushes a large amount of data into the ITSIQA database. **Note that this path must be accessible from the ITSIQA database using the local account that is specified in User Name.**	\\1.1.1.1\Data
Days of Detector Link Data	The number of days of data that ITSIQA will archive raw detector data. This is used for the AADT detector filtering check. One month of data, about 30 days, is recommended.	30

Table 4: ITSIQA SunGuide Interface Configuration Settings

Configuration Field	Description	Example Value
Enabled	When enabled, ITSIQA will connect to and request data from the specified SunGuide system. When disabled, ITSIQA will not perform any SunGuide-related functions. This value must be either True or False.	True
Databus IP	The IP of the Databus for the selected SunGuide system. This is the only connection with SunGuide that ITSIQA will have.	1.1.1.1
Databus Port	The IP Port that ITSIQA will connect on when connecting to the SunGuide Databus. This is typically set to 8009.	8009
SunGuide User ID	The SunGuide user account ID that ITSIQA should use to log in and request data. Note that this should have full access to request all TSS data from SunGuide.	ITSIQA
SunGuide User Password	The password for the SunGuide user account that ITSIQA uses to log in and request data.	password

Configuration Field	Description	Example Value
Connection Failure Retries	The number of sequential times ITSIQA should attempt to log into SunGuide. If ITSIQA fails to connect to SunGuide after this many times, ITSIQA will send out an email alert, log the error, and no longer try to reconnect to SunGuide until it requests SunGuide configuration data. For example, if the Request Config Interval (minutes) parameter is set to 60 and the connection fails to connect Connection Failure Retries times, then ITSIQA will not try again until up to 60 minutes later, at which point it will try again Connection Failure Retries times.	5
Request Config Interval (minutes)	The frequency in minutes in which ITSIQA will request and process detector and link configuration information from SunGuide. Once it receives this, the old configuration information is dumped and the new configuration will be used. Old configuration information received from SunGuide is not stored or used in ITSIQA.	60
Request Data Interval (seconds)	The frequency in seconds in which ITSIQA requests detector status data, which includes detector speeds and traffic volumes. **Note that this frequency should match exactly the update frequency of the SunGuide detectors.** Otherwise, traffic volumes will not be correctly read or interpreted. ITSIQA assumes all detectors within SunGuide use the same update interval.	30
Maximum Number of Queued Data	As SunGuide data is requested and received, ITSIQA queues the incoming data until the primary processing interval is reached. Queued data is removed from the queue as it is processed. This limit prevents the queue from building indefinitely. For example, if the Request Data Interval is set to 30 seconds and the ITSIQA Processing Interval is set to 60 seconds, this queue will typically have 2 data elements queued. In this case, this value should be set to at least 3, to account for slippages in server clocks.	10

Configuration Field	Description	Example Value
Default Quality Value	This is the starting Data Quality Value for all data ITSIQA receives from SunGuide. As filtering checks are triggered, this value is degradated. Assuming a fully-functional detectors are trusted, this value should be set to 10. This value should only range between 0 and 10.	10
Test Mode Enabled	When enabled, ITSIQA will not request data from SunGuide. Rather, it will read static XML data from a file which should be in the same format as the XML ITSIQA would normally receive from SunGuide. This value must be either True or False.	False
Test Mode XML File Path	This is the file path of the XML file ITSIQA will read when Test Mode Enabled is set to True.	C:\TestData.xml

Table 5: ITSIQA C2C Input Interface Configuration Settings

Configuration Field	Description	Example Value
Enabled	When enabled, ITSIQA will connect to and request data from the C2C Infrastructure. When disabled, ITSIQA will not ingest any C2C data. This value must be either True or False.	True
C2C Extractor Host	The IP or hostname where the C2C Extractor is hosted from which ITSIQA will subscribe to C2C data. This is the only connection with the C2C infrastructure that ITSIQA will have.	1.1.1.1
C2C Extractor Port	The IP Port that ITSIQA will connect on when connecting to the C2C Extractor. This is typically set to 8011.	8011
C2C Extractor Web Service	The web service path of the C2C Extractor, excluding the host name or IP.	C2C\Extractor
C2C Extractor Data Types	The space-delimited list of C2C data types that ITSIQA will subscribe to from the C2C Extractor. To acquire link-based travel speed and volume data, this should be set to: networkData trafficCondData	networkData trafficCondData

Configuration Field	Description	Example Value
Default Quality Values	The comma-delimited list of C2C network IDs and the default data quality values for each network ID. Each element in this list should be formatted: {Network ID}={Quality Value} There should be at least one network specified with the name DEFAULT. This network quality value will be used if ITSIQA receives a network that not specified in this list. For example, if ITSIQA subscribes to two networks from C2C called Net1 and Net2 and the default quality value of Net1 should be 9, the default quality value of Net2 should be 7, and the default quality value of DEFAULT should be 10, then this list should contain the following: Net1=10,Net2=7, DEFAULT=10 Note that the quality values should range from 0 to 10. There is no limit to how many networks are listed, but there should be at minimum one network called DEFAULT in this list.	Net1=10,Net2=7, DEFAULT=10
C2C Extractor Timeout (in minutes)	When ITSIQA subscribes to C2C data, ITSIQA will queue any data that the C2C Extractor to pushes data to ITSIQA. If ITSIQA does not receive any data from C2C for C2C Extractor Timeout number of minutes or longer, ITSIQA will disconnect from the C2C Extractor, kill the connection, reconnect, and re-subscribe to C2C data.	5

Configuration Field	Description	Example Value
C2C Extractor Max Reconnect Attempts	The maximum number of times that ITSIQA will attempt to reconnect to the C2C Extractor before giving up. Connecting but not receiving data is considered a connection failure and will count toward this count once the C2C Extractor Timeout is reached. For example, if the C2C Extractor Max Reconnect Attempts is set to 20 and the C2C Extractor Timeout is set to 5, and ITSIQA does not receive updating data for 20 x 5 = 60 minutes, then ITSIQA will give up after 60 minutes. Giving up will prompt an email alert.	20
Age of Persisting Data (in minutes)	The maximum number of minutes ITSIQA will continue to use the same data for multiple data processing intervals. For example, if the ITSIQA Processing Interval is set to 60 seconds and the Age of Persisting Data is set to 15 minutes, ITSIQA will use the same data received from C2C up to 15 times, unless it receives more frequently from C2C.	15
Test Mode Enabled	When enabled, ITSIQA will not request data from C2C. Rather, it will read static XML data from a file which should be in the same format as the XML ITSIQA would normally receive from C2C. This value must be either True or False.	False
Test Mode XML File Path	This is the file path of the XML file ITSIQA will read when Test Mode Enabled is set to True.	C:\TestData.xml

Table 6: ITSIQA ATSPM Interface Configuration Settings

Configuration Field	Description	Example Value
Enabled	When enabled, ITSIQA will connect to and request data from the ATSPM interface. When disabled, ITSIQA will not ingest any ATSPM data. This value must be either True or False.	True
Database ID	The name of the ATSPM SQL Server database.	MOE
Database Server Name	The name or IP where the ATSPM database is hosted.	1.1.1.1

Configuration Field	Description	Example Value
User Name	The local SQL Server username that ITSIQA should use to log into the ATSPM database. This user account should have full read permissions.	ITSIQA
Password	The user password used when ITSIQA establishes a connection and logs into the ATSPM database.	password
Read Signal Config Interval (in minutes)	The frequency in which ITSIQA will read and interpret signal configuration information from the ATSPM database. It is recommended to only perform this between once per hour or once per day, i.e. 60 to 1440 minutes.	1440
Detection Type	The type of detection that ITSIQA should read within the ATSPM event codes. These detection types are defined within the ATSPM database. ITSIQA is designed to only use advanced counts, which has detector type value of 2.	2
Data Latency (in minutes)	The number of minutes in the past ITSIQA will query the ATSPM database for intersection controller event codes. This is necessary because the ATSPM database and the ATSPM data insertion process introduces latency between when the event codes are reported by the intersection controller and when the codes are available for ITSIQA to query. This configuration value should be adjusted based on this latency. If this value is too small, ITSIQA will fail to receive all event codes and traffic calculated volumes will be lower than actual conditions. A recommended value is between 4 to 10 minutes, although this will vary if the ATSPM latency changes. **This value should be reevaluated periodically by system administrators.**	5

Configuration Field	Description	Example Value
Calc Lane Volumes from Approach Volumes	When enabled, the approach volumes reported from ATSPM's advanced counts will be used to report volumes at the lane level. The distribution of the approach volumes is based on the turn type configuration of each lane. The following turn type weights are used to perform this distribution process. When not enabled, then lane level volumes are not reported, only approach volumes. This field must have a value of True or False.	True
Turn Type Weight Through (integer percent)	The percent of vehicles that should be distributed to lanes based on the turn type of Through. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	68
Turn Type Weight Right (integer percent)	The percent of vehicles that should be distributed to lanes based on the turn type of Right. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	15
Turn Type Weight Left (integer percent)	The percent of vehicles that should be distributed to lanes based on the turn type of Left. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	15
Turn Type Weight UTurn (integer percent)	The percent of vehicles that should be distributed to lanes based on the turn type of UTurn. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	2

Table 7: ITSIQA MIMS Interface Configuration Settings

Configuration Field	Description	Example Value
Enabled	When enabled, ITSIQA will connect to, request data from, and push data to MIMS via the MIMS interface. When disabled, ITSIQA will not communicate with MIMS. This value must be either True or False.	True
MIMS URL	The URL of the MIMS ticket interface.	http://1.1.1.1
MIMS Username	The username used to log into MIMS. This user account should have rights to read, create new tickets, and modify existing tickets.	username
MIMS Password	The password used to log into MIMS.	password

Configuration Field	Description	Example Value
Retrieve Device List Window in (minutes)	The frequency in minutes when device information should be queried from MIMS.	60
Trouble Ticket Contract Group	The trouble ticket contract group associated with the ITSIQA user allowed to read, create new tickets, and modify existing tickets for all detectors being monitored within ITSIQA. This should be the numeric ID of the contract group as defined by MIMS.	49
Trouble Ticket Issue Description	The default description used for all trouble tickets created by ITSIQA. This should be the numeric ID of the description as defined by MIMS.	8
Trouble Ticket Weather Condition	The default weather condition used for all trouble tickets created by ITSIQA. This should be the numeric ID of the weather condition as defined by MIMS.	5
Load Previous Tickets	When enabled, ITSIQA will first load existing tickets from MIMS to ensure multiple tickets are not created for a detector. This value must be either True or False.	True
Do MIMS Push	When True, ITSIQA will create and update tickets within MIMS. When False, ITSIQA will perform all steps in the ticket generation process, per all other configuration settings, except for pushing ticket creation and updates to MIMS.	True
Start Sending Tickets to MIMS	Time of the day in which ITSIQA will begin pushing tickets and updates to MIMS. Before this time, ITSIQA will perform as if "Do MIMS Push" is set to False. This time is formatted HH:MM where HH is the two-digit 24-hour value and MM is the two-digit minute value.	05:00
Stop Sending Tickets to MIMS	Time of the day in which ITSIQA will stop pushing tickets and updates to MIMS. After this time, ITSIQA will perform as if "Do MIMS Push" is set to False. This time is formatted HH:MM where HH is the two-digit 24-hour value and MM is the two-digit minute value.	22:00

Configuration Field	Description	Example Value
Test Mode Enabled	When enabled, rather than interfacing with MIMS, ITSIQA will read device and troubleticket JSON files from static files that should be in the same format as reported from MIMS. This value must be either True or False.	False
Test Mode Device Json File Path	The full file path of the static test JSON file containing device data that will be read when Test Mode is enabled.	C:\D1.json
Test Mode Trouble Ticket Json File Path	The full file path of the static test JSON file containing trouble ticket data that will be read when Test Mode is enabled.	C:\TT1.json
Filter Roads List	Comma-delimited list of roadway names and ticketing values for which ITSIQA will generate MIMS trouble tickets. Only detectors located on the roadways in this list (as defined by SunGuide) will trigger a MIMS ticket. If no filtering is desired, this field should be blank, in which case all detectors within SunGuide may trigger a MIMS ticket. Each element separated by commas should have the following format: {ROAD}:{Tickets/NoTickets} The above format consists of the name of the roadway (as defined by SunGuide) followed by a colon followed by one of two terms: Tickets or NoTickets. If "Tickets" is used, then ITSIQA will send ticket updates to MIMS. If "NoTickets" is used, then ITSIQA will not send ticket updates to MIMS. For example, consider the following configuration: I-95:Tickets,I-4:NoTickets For the above configuration, ITSIQA will perform quality checks for detectors on both I-95 and I-4, but will only send ticket updates to MIMS for detectors on I-95.	I-95:Tickets,I-4:NoTickets,US-92:NoTickets

Table 8: ITSIQA WAZE Interface Configuration Settings

Configuration Field	Description	Example Value
Enabled	When enabled, ITSIQA will connect to and request data from WAZE via the WAZE interface. When disabled, ITSIQA will not communicate with WAZE. This value must be either True or False.	True
Web Service URL	Full URL of the web service hosting the output of WAZE data. This web service is hosted by FDOT Central Office.	http://1.1.1.1
District Filter	Used to filter incoming WAZE events based on the FDOT district reported from the WAZE output. If no filtering is desired, this field should be blank, in which case no filtering is performed.	D5
Endpoint Name	Name of the SOAP endpoint used when communicating to the WAZE web service via SOAP.	WazeReaderSoap
Default Quality Value	Default quality value for travel times derived from incoming WAZE data. This value should range from 0 to 10.	10
Default Expired Data (in seconds)	The maximum age in seconds of the incoming data. If data is reported from WAZE older than this value minus the current ITSIQA server time, the data is discarded.	1800
Test Mode Enabled	When enabled, ITSIQA will read a static XML file instead of requesting data from the WAZE web service. This value must be either True or False.	False
Test Mode XML File Path	The file path of the static XML file that will be read of test mode is enabled. File should be in the same format as data reported from the WAZE web service.	C:\test.xml

Table 9: ITSIQA TMC Interface Configuration Settings

Configuration Field	Description	Example Value
Enabled	When enabled, ITSIQA will data from the TMC interface. When disabled, ITSIQA will not read TMC data. Note that a second piece of the TMC Interface is a web service that writes received data to comma-delimited files. The web service runs in IIS and will continue to operate as long as IIS is operable. After ITSIQA reads these files, they are deleted. When this parameter is disabled, the files are not read and files are not deleted. **Disabling this for a prolonged period may result in a large number of files written to disk.** This value must be either True or False.	True
Delete TMC Files After Read	When enabled, ITSIQA will delete TMC files after they are read. No other process deletes these files, so normally, this parameter should always be set to True, unless activity troubleshooting the system. This value must be either True or False.	True
TMC Data Priority List	Indication of how ITSIQA should rank incoming TMC data for the same intersection from different sources. This parameter contains a comma-delimited list with the name of data source and its priority. In the example to the right, ATSPM has a priority of 10 and Miovision a priority of 5. In the example on the right, if both sources report TMC data for the same intersection, then Miovision's data would be used instead of ATSPM's since Miovision has a higher priority. There is no limit to the number of priorities or data sources listed. Priorities are positive integer values in which 1 is the highest priority.	ATSPM=10, Miovision=5
Calculate Lane Data from Approach	When enabled, the approach volumes reported from the TMC interface will be used to report volumes at the lane level. The distribution of the approach volumes is based on the default turn percentage configuration of each lane. The following default turn percentages are used to perform this distribution process. This field must have a value of True or False.	True

Configuration Field	Description	Example Value
Default Through Traffic Percentage (0-100)	The percent of vehicles that should be distributed to lanes based on the turn type of Through. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	68
Default Left Traffic Percentage (0-100)	The percent of vehicles that should be distributed to lanes based on the turn type of Right. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	15
Default Right Traffic Percentage (0-100)	The percent of vehicles that should be distributed to lanes based on the turn type of Left. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	15
Default UTurn Traffic Percentage (0-100)	The percent of vehicles that should be distributed to lanes based on the turn type of UTurn. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100.	2

Table 10: ITSIQA to C2C Interface Configuration Settings

Configuration Field	Description	Example Value
LinkConfig Interval	The frequency in minutes defining how often roadway network information is pushed out the C2C. The same interval is used for all data output streams.	1440
TrafficData Interval	The frequency in seconds defining how often traffic speed and volume data is pushed out to C2C. The same interval is used for all data output streams.	30
Process Lane Data	When enabled, lane data will be pushed out to C2C from ITSIQA. If enabled or disabled, traffic data will always be pushed. Lane data is pushed at the same frequency as traffic data. This value should be either True or False.	True
C2C Can Publish	C2C publishes a flag indicating if the data should be published to a public website. This setting indicates if all ITSIQA-generated data should be reported as Can Publish. This value should be either True or False.	True

Configuration Field	Description	Example Value
XML Max Age	All data pushed to C2C is also written to disk as XML files. This parameter indicates how long these XML files should be kept before they are automatically deleted. The parameter is in hours.	1
Logs Max Age	This parameter indicates how long log files generated by the ITSIQA to C2C external service should be kept before they are automatically deleted. The parameter is in hours.	1

Table 11: ITSIQA SPS Data Conversion Interface Configuration Settings

Configuration Field	Description	Example Value
Survey Type Vehicle Count	Survey Type Vehicle Count parameter included in the SPS file output. This should be an integer value and depends on SPS's configuration.	2
Survey Type Class Count	Survey Type Class Count parameter included in the SPS file output. This should be an integer value and depends on SPS's configuration.	3
Survey Program	Survey Program parameter included in the SPS file output. This should be an integer value and depends on SPS's configuration.	1
Data Suffix	When SPS files are generated, the suffix appended to each data record.	0 C

5.3   Data Inputs

ITSIQA receives information from the C2C Infrastructure, SunGuide Databus, Waze JAMs, ATSMP, and TMC as shown in Figure 4 above. The data reported from the various inputs has information pertaining to network configurations, link mapping coordinates, and traffic conditions. All data input is standardized into common ITSIQA data structures, normalized temporally, and spatially.

The following sections describe each data input and the expected fields and field values. Any data received outside of expected ranges is discarded, logged as erroneous, and not used by ITSIQA.

5.3.1 C2C Interface

The C2C Interface culminates data from various data sources. ITSIQA ingests and attempts to use all data reported from C2C R7.0, regardless of the data source, i.e. the network identifier. However, all data is expected to follow C2C schema standards. Of the various datatypes C2C

allows to be reported, ITSIQA subscribes to and ingests only two, Traffic Condition Data and Network Data. Tables 2 and 3 below describe the expected Traffic Condition Data and Network Data ITSIQA expects to receive from C2C.

Note that not all fields within the Traffic Condition Data are reported from all data sources. ITSIQA will consider non-reported data as invalid. Note that the fields listed in the following tables are the only ones that ITSIQA ingests – any additional fields are ignored.

Table 12: C2C Traffic Condition Data Descriptions

Data Field	Data Description	Example Value
trafficCondData / net / id	Unique alpha-numeric identifier of the data's source, known in C2C as the network. Should match exactly the network identifier reported in Network Data.	CFX
trafficCond / id	Unique alpha-numeric identifier of the reported link. Should match exactly the link identifier reported in Network Data.	102+07225
trafficCond / travelTime	The reported integer travel time in seconds of traffic traversing the reported roadway link for all travel lanes. This should have a limited range of 0 to 32,767, although a reported value of 0 is considered a no data condition.	82
trafficCond / speed	The reported average speed in MPH of traffic traversing the reported roadway link for all travel lanes. This should have a limited range of 0 to 32,767.	65
trafficCond / occupancy	The reported occupancy integer value of traffic traversing the reported roadway link for all travel lanes. This percentage should have a limited range of 0 to 100.	20

Data Field	Data Description	Example Value
trafficCond / volume	The reported number of vehicles counted within the reporting period for the roadway link for all travel lanes. This should have a limited range of 0 to 32,767.	25
trafficCond / timestamp	Date and time when the reported data was last updated. Format should be "YYYY-MM-DDTHH:MM:SS{Hour Offset}", where YYYY is the four-digit year, MM is the two-digit month, DD is the two-digit day, HH is the two-digit hour (24-hour based), MM is the two-digit minute, and SS is the two-digit seconds. The Hour Offset is the number of hours from GMT. For example, "2017-12-24T21:52:00-05:00" is negative five hours off of GMT.	2017-12-24T21:52:00-05:00

Table 13: C2C Network Data

Data Field	Data Description	Example Value
network / id	Unique alpha-numeric identifier of the data's source, known in C2C as the network. Should match exactly the network identifier reported in Traffic Condition Data.	CFX
node / id	The alpha-numeric name of starting or ending point of a reported roadway link. This name should be unique for the link. This name does not have to correlate with the name of a link. Also, multiple links may reference this node, especially if the ending point of one link is the starting point of the next contiguous link.	102+04792Start
node / lat	The latitude coordinate of the node's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	28547300
node / lon	The longitude coordinate of the node's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	-81252800
link / id	Unique alpha-numeric identifier of the reported link. Should match exactly the link identifier reported in Traffic Condition Data.	102+05192
link / lat	The latitude coordinate of the node's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	28548924
link / lon	The longitude coordinate of the node's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	-81357648

Data Field	Data Description	Example Value
link / name	This field should contain the name of the roadway that the link spans. This field is formatted differently with different sources of data. ITSIQA interprets this field based on the source of the data. By default, ITSIQA assumes this field matches the name of the roadway as it is configured within ITSIQA's link configuration.	From CFX: AVI-0408E-ConwayRd From BrevCoBT: BrevCoBT - US-192 EB from Wickham Rd to Dayton Blvd From Others: I-10
link / displayName	The alpha-numeric name of the roadway link. This name should include the roadway of the link, direction of travel, and a point of references such as a cross street. This is used for troubleshooting purposes only since ITSIQA reports its own link display names independently of what is reported to ITSIQA.	US-17 Northbound - Bermuda Ave/N John Young Pkwy
link / startNodeId	The alpha-numeric node identifier of the link's upstream node. This should match a node / id exactly.	102+04792Start
link / endNodeId	The alpha-numeric node identifier of the link's downstream point for the link. This should match a node / id exactly.	102+04792End
link / dir	The link's direction of travel. The only valid values of this field include: East, West, North, or South. By default, ITSIQA assumes a link's direction of travel is North.	East

Data Field	Data Description	Example Value
link / length	The reported integer length of the link measured in feet. Valid values include a number greater than zero and at most 32,767. ITSIQA handles all distances in miles, so this value is converted to a Double value in miles upon reading C2C Network Data.	6077
link / speedLimit	The reported integer speed limit for the link measured in miles per hour. Valid values include a number greater than zero and at most 32,767.	60
link / laneCount	The reported integer number of lanes for the link. Valid values include a number greater than zero and at most 32,767, if by chance there are 32,767 lanes within a single roadway link. If there are 32,767 lanes, ITSIQA assumes the link is located in some fifth dimension parallel universe where there are 32,767 lanes at any given point on a single roadway.	3
link / county	The county where the link upstream node is located. Note that although a link may transverse more than one county, this field will only report one county. Valid values of this field include county names listed in Table 4. No other county name is valid.	Orange

Table 14: Valid County Values

Alachua	Franklin	Lee	Pinellas
Baker	Gadsden	Leon	Polk
Bay	Gilchrist	Levy	Putnam
Bradford	Glades	Liberty	Santa Rosa
Brevard	Gulf	Madison	Sarasota
Broward	Hamilton	Manatee	Seminole

Calhoun	Hardee	Marion	St. Johns
Charlotte	Hendry	Martin	St. Lucie
Citrus	Hernando	Miami-Dade	Sumter
Clay	Highlands	Monroe	Suwannee
Collier	Hillsborough	Nassau	Taylor
Columbia	Holmes	Okaloosa	Union
DeSoto	Indian River	Okeechobee	Volusia
Dixie	Jackson	Orange	Wakulla
Duval	Jefferson	Osceola	Walton
Escambia	Lafayette	Palm Beach	Washington
Flagler	Lake	Pasco	

5.3.2 SunGuide Interface

ITSIQA subscribes to detectorData, roadwayGeometryData, mapDetectorData, and linkPollData from SunGuide R6.2's Databus. ITSIQA updates its master configuration and real-time status information as SunGuide reports data. Tables 4, 5, 6, and 7 describe which data fields ITSIQA reads interpretes, including the expected limits. Note that all other data fields not noted in Tables 5, 6, 7, and 8 are ignored by ITSIQA.

Table 15: SunGuide Detector Data (detectorData)

Data Field	Data Description	Example Value
detectorConfig / id / centerId	The alpha-numeric name of the network that the data was received from. This field is read, but not currently used since ITSIQA assumes all SunGuide data is reported from a single instance / center of SunGuide.	District 5
detectorConfig / id	The unique numeric identifier of the reported detector. Valid values include a number greater than zero and at most 32,767.	1856
detectorConfig / displayName	The alpha-numeric name of the detector. This name should be unique for the detector.	MVDS: I-95 at VOL MM262.5 NS
detectorConfig / roadway	The name of the roadway on which the detector is located.	I-10

Data Field	Data Description	Example Value
detectorConfig / direction	The detector's placement to read direction of travel. The only valid values of this field include: Northbound, Westbound, Southbound, or Eastbound. The reported data is manipulated to match the requirements for ITSIQA. For example, Northbound is replaced with North. If the data was reported incorrectly it would be set to the default value of North.	Northbound
detectorConfig / latitude	The latitude coordinate of the detector's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	29188200
detectorConfig / longitude	The longitude coordinate of the detector's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	-81088400
detectorConfig / locationDescription	The alpha-numeric name of the cross street that defines the precise location of the detector. If there is an "at" or "@" in the name, the interface only records everything past those indexes in the string. Example, "SR528 @ Friday Rd" is recorded as "Friday Rd"	North of US 92

Table 16: SunGuide Roadway Geometry Data (roadwayGeometryData)

Data Field	Data Description	Example Value
nodes / node / id / centerId	The alpha-numeric identifier of the network that the data was received from. This field is read, but not currently used since ITSIQA assumes all SunGuide data is reported from a single instance / center of SunGuide.	District 5

Data Field	Data Description	Example Value
nodes / node / id	The unique alpha-numeric identifier of either the start or end point, i.e. node, of a reported roadway link.	N851
nodes / node / latitude	The latitude coordinate of a node's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	28949140
nodes / node / longitude	The longitude coordinate of a node's location reported in micro-degrees. This should have a limited range of -180000000 to 180000000.	-80950240
links / linkGeometry / id	The unique numeric identifier of a roadway link.	6
links / linkGeometry / direction	The link's direction of travel. The only valid values of this field include: Northbound, Westbound, Southbound, or Eastbound.	Northbound
links / linkGeometry / numLanes	The reported integer number of lanes for the link. Valid values include a number greater than zero and at most 32,767.	2
links / linkGeometry / startNode / id	The alpha-numeric node identifier of the link's upstream point.	0N209
links / linkGeometry / endNode / id	The alpha-numeric node identifier of the link's downstream point for the link.	0N207

Table 17: SunGuide Detector Map Data (mapDetectorData)

Data Field	Data Description	Example Value
detectorMap / id	The reported integer id is the unique number associated with this detector. This should match the detector id from linkGeometry. Valid values include a number greater than zero and at most 32,767.	436

Data Field	Data Description	Example Value
detectorMap / link / lane	ITSIQA determines the number of lanes based on how many lane elements are reported.	\<lane\> … \</lane\>
detectorMap / link / id	The alpha-numeric name of the link. This name should be unique for the link.	3432
detectorMap / link / dsiplayName	The alpha-numeric name of the roadway link. This name should be unique for the link.	I95-S US 92-linkN
detectorMap / link / speedLimit	The reported integer speed limit for the link. Valid values include a number greater than zero and at most 32,767.	60
detectorMap / link / length	The reported double value representing the length of the link in miles. Valid values include a number greater than zero and at most 32,767.	1.5

Table 18: SunGuide Link Poll Data (linkPollData)

Data Field	Data Description	Example Value
linkPollData / id / centerId	The alpha-numeric name of the network that the data was received from. ITSIQA will only read if there was a valid mapDetectorData with the same centerId.	District 5
linkPollData / id	The unique integer identifier is associated with the reported roadway link. This ID should match the mapDetectorData ID exactly. Valid values include a number greater than zero and at most 32,767.	287

Data Field	Data Description	Example Value
linkData / timestamp	Date and time when the reported data was last updated. Format should be "YYYY-MM-DDTHH:MM:SS{Hour Offset}", where YYYY is the four-digit year, MM is the two-digit month, DD is the two-digit day, HH is the two-digit hour (24-hour based), MM is the two-digit minute, and SS is the two-digit seconds. The Hour Offset is the number of hours from GMT. For example, "2017-12-24T21:52:00-05:00" is negative five hours off of GMT.	2017-05-31T02:33:27-04:00
linkData / lanePollData / rawData / volume	The reported number of vehicles counted within the reporting period for the roadway link for each travel lane, reported one lane at a time. This should have a limited range of 0 to 32,767.	2
linkData / lanePollData / rawData / occupancy	The reported occupancy integer value of traffic traversing the reported roadway link for each travel lane, reported one lane at a time. This percentage should have a limited range of 0 to 100.	4
linkData / lanePollData / rawData / travelTime	The reported integer travel time in seconds of traffic traversing the reported roadway link for each travel lane, reported one lane at a time. This should have a limited range of 0 to 32,767.	55
linkData / lanePollData / rawData / speed	The reported average speed in MPH of traffic traversing the reported roadway link for each travel lane, reported one lane at a time. This should have a limited range of 0 to 32,767.	65

Data Field	Data Description	Example Value
linkData / lanePollData / rawData / class / binX (where X is an integer 1 to 8)	The reported volume of each vehicle classification reported in 8 different bins. The total all reported volumes of all classifications should equal the total volume reported in linkData / lanePollData / rawData / volume. The volume of each vehicle classification should have a limited range of 0 to 32,767.	5

5.3.3 WAZE Interface

Google's WAZE is a community-based traffic and navigation application. WAZE has a system called WAZE Reader which allows clients to pull information about traffic jams from their database. WAZE Reader reports interferences in the regular movement of traffic or other reports such as red light cameras. The relevant data received is extracted and manipulated into a format that is standard in the system. These reports are known as Jams.

FDOT CO operates an interface with Google's WAZE. ITSIQA acquires Jams configuration and traffic data condition information from this interface and integrates it into ITSIQA's consolidated data. Tables 9 and 10 below describe the data received from FDOT CO's WAZE interface.

Table 19: List of Data Fields Used from WAZE Reader as Jam Configuration Data

Data Field	Data Description	Example Value
jamID	The unique code for a particular jam report.	003c8dc8-e19c-3c41-8d43-ac01ef6c0396
lineList	The set of lineNodes that define a link.	\<lineNode\> … \</lineNode\>
lineNode	A single set of a latitude and a longitude point in the link reported in microdegrees.	\<latitude\>28494349\</latitude\> \<longitude\> -81432258\</longitude\>
midPoint	The list of coordinates reported in microdegrees that are geographically located in between the start coordinate and the end coordinates of a link to account for curves in the road. The startNodeId and EndNodeId are calculated using this since it is reported in the midpoints.	\<lat\>28569993\</lat\> \<lon\>-81556911\</lon\>
length	The length of the link in miles.	0.97

	This represents the average length of the stretch of roadway when traveled by a vehicle.	
county	The county to which the link belongs. Valid values are county names listed in Table 4.	Orange
roadway	The name of the road the link is located on.	I-4
direction	The direction of travel when on the road. Valid values include: Eastbound, Westbound, Northbound, or Southbound	Eastbound

Table 20: List of Data Fields Used from WAZE Reader as Traffic Condition Data

Data Field	Data Description	Example Value
jamID	The unique code for a particular jam report.	003c8dc8-e19c-3c41-8d43-ac01ef6c0396
datePublished	The date and time that the Jam was created.	2015-06-19T12:06:13-04:00
speed	The average speed of the cars traveling on the link in the Jam.	68.0

Once the WAZE interface data is accessed, ITSIQA accepts the incoming data as dynamically-changing link-based traffic data. Every read potentially changes the link configuration, as the start and end of the reported Jams data may change from one data pull to the next. The reported speed data and link length are used to calculate travel time data. Once received, WAZE link data is normalized with other data available within ITSIQA.

5.3.4 ATSPM Interface

FDOT D5 operates an ATSPM system which acquires and archives information at arterial intersections. ITSIQA interprets event codes from ATSPM to determine advanced vehicle counts. ITSIQA interfaces with the ATSPM system via a database connection, interprets intersection configuration information, and reports approach count information via the ITSIQA TMC data outputs.

Tables 11, 12, 13, 14, and 15 describe each of the ATSPM database tables that ITSIQA queries in order to determine the intersection configuration and calculate vehicle volumes data. Tables 11, 12, 13, and 14 provide configuration-related information, while Table 15 is only used to calculate vehicle volumes.

Table 21: ATSPM Detectors Table

Data Field	Data Description	Example Value
ID	The unique integer identifier for the detector, with a range 1 to	5

	2,147,483,647.	
ApproachID	The unique integer identifier for the approach, with a range 1 to 2,147,483,647.	8443
DetChannel	The unique integer identifier for the detector channel used to record the vehicle event, with a range 1 to 2,147,483,647. ITSIQA assumes that this value correlates with a single lane. Therefore, ***ITSIQA interprets this identifier as the lane ID.***	2

Table 22: ATSPM Approaches Table

Data Field	Data Description	Example Value
ApproachID	The unique integer identifier for the approach, with a range 1 to 2,147,483,647. This ID should match exactly with the ApproachID within the Detetors table.	8443
SignalID	The unique string identifier for the signal. This ID exactly matches the SignalID from the Signals table.	1015
Description	A string value that contains the direction of travel for the approach. This field should contain one of the following values: Northbound, Southbound, Eastbound, Westbound, NB, SB, EB, or WB. These values are care-sensitive. The ATSPM interface searches for one of these values in the following order: Northbound, Southbound, Eastbound, Westbound, NB, SB, EB, or WB. If the string contains more than one direction indicator, then only the first is used. For example, the string "SR-436 EB Westbound" would be interpreted as an eastbound approach. If a direction cannot be determined, the default direction used is northbound. For example, both	US-17/92 Northbound

	"SR-434 East" and "SR-434 eastbound" would be interpreted as northbound since "East" and "eastbound" are not acceptable descriptions.	

Table 23: ATSPM Signals Table

Data Field	Data Description	Example Value
SignalID	The unique string identifier for the signal. The intersection signal handles traffic for all directions of travel for the intersection. Note that although the database stores this ID as a string, it is typically an integer.	1015
PrimaryName	String that describes the name of the primary roadway on which vehicles travel through the intersection according to the configured approach direction, as specified in the Approaches – Description field. Note that each signal is assumed to handle only two opposite directions of travel, for example North and South, or East and West. These directions of travel should apply to the roadway specified in this field. For example, if PrimaryName is "SR-50" and SR-50 is an east/west roadway, then the only approaches configured for this signal should be an eastbound and a westbound approach.	SR-50
SecondaryName	String that describes the name of the cross street to the primary roadway on which vehicles travel through the intersection according to the configured approach direction, as specified in the Approaches – Description field.	SR-423
Latitude	Latitude value in degrees for the location of the center of the intersection.	28.604454
Longitude	Longitude value in degrees for the location of the center of the	-81.307422

	intersection.	
Enabled	Byte value with possible values of 0 or 1 that indicates if the signal is enabled. Only signals with an Enabled flag value of 1 are used.	1

Table 24: ATSPM DetectionTypeDetector Table

Data Field	Data Description	Example Value
ID	The unique integer identifier for the detector, with a range 1 to 2,147,483,647. This value matches with the Detectors – ID field value exactly.	5
DetectionTypeID	The unique integer identifier for the detection type, with a range 1 to 2,147,483,647. ITSIQA can be configured with a Detection Type filter. If this value is not null, only detector with the specified Detection Type will be used. Otherwise, all detectors will be used.	2

Table 25: ATSPM Controller_Event_Log Table

Data Field	Data Description	Example Value
SignalID	The unique string identifier for the signal. This value should exactly match with the Signals – SignalID field.	1015
EventParam	The unique integer parameter related to the logged event, with a range 1 to 2,147,483,647. Since ITSIQA only queries for event code 81, then this field provides the detector channel reporting the detection event. Channels are interpreted as the LaneID. Consequently, this field is interpreted as the reported LaneID and should match the Detectors – DetChannel field exactly.	2
Timestamp	DateTime indicating when the event recorded in this log has occurred. This value should be local time, which should be synchronized with the server	8/1/2018 12:42:17 PM

	clock on the ITSIQA server.	
EventCode	The unique integer identifier indicating the type of event that is being logged. ***The only event code that ITSIQA queries is code 81***, which indicates when a detector initially senses a vehicle entering a configured signal zone. All other event codes are ignored.	81

Vehicle volumes are calculated rather than directly reported. ITSIQA does this by querying the Controller_Event_Log table once per minute, acquiring all logged events with Event Code value of 81 within a 60-second time period. For each logged event, ITSIQA assumes one vehicle per lane. ITSIQA sums all vehicles per lane and provides these vehicle volumes to the rest of the ITSIQA for further processing.

The ATSPM system introduces latency to logging event data. Once an event is detected and timestamped, the event is not available within the Controller_Event_Log table for a period of time. ITSIQA has a configurable parameter Data Latency for the ATSPM interface that accounts for this period of time. By default, this latency is assumed to be 4 minutes, unless otherwise specified. This latency does not affect the reporting of the traffic volumes. Volumes are reported as they are received, regardless of their age. However, the quality value indicator will be degraded based on the age of the data.

5.3.5 TMC Interface

FDOT D5 operates systems that accumulate Turning Movement Counts (TMC). ITSIQA acquires processed TMC data from these external systems through a standardized Web Service Definition Language (WSDL)-based interface, called the Turning Movement Count API (TMC API). ITSIQA normalizes the data into its intersection configuration and reports it as a separate ITSIQA output. The TMC API is described in detail in the TMC API Interface Control Document.

5.4 ITSIQA Master Roadway Network

A major component to ITSIQA's configuration is its master roadway network. This configuration defines all roadways, roadway links, and intersections reported from ITSIQA. The system uses the master roadway network as a basis for all traffic condition reporting. Regardless of what data is reported to ITSIQA and how it is reported, ITSIQA will only ever report roadway links and intersections from its master roadway network. As such, ITSIQA normalizes all incoming roadway configuration onto the master roadway network.

5.4.1 ITSIQA Roadway Network Database Design

The master roadway network is configured completely within the ITSIQA database across multiple tables. Figure 6 depicts the database design for the master roadway network.
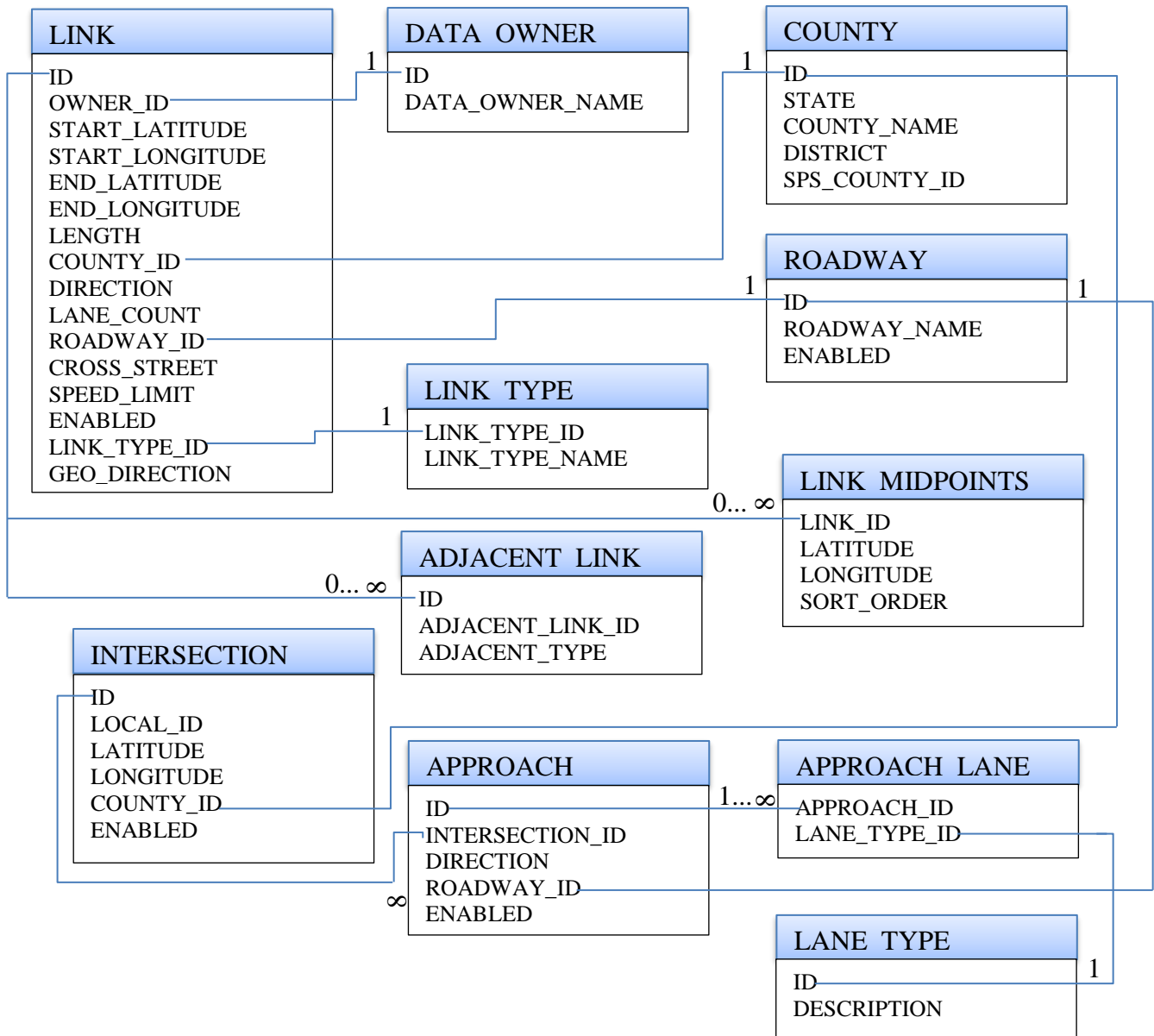

Figure 6: ITSIQA Master Roadway Network Database Design

The Link Table is the primary table defining ITSIQA's link roadway network. It contains a record for each roadway link. Each link has start and end points, in degrees, length in miles, direction of travel, the geographic direction, lane count, cross street, speed limit, and references to roadway, county, and link type (defined in other tables). The geographic direction is the predominate direction that a single link takes from its start point to the end point. For example,

through downtown Orlando, links on I-4 have a direction of travel of either eastbound or westbound, but geographic directions of either northbound or southbound since these links predominately span northbound or southbound even though the links are signed as eastbound or westbound.

The Intersection Table is the primary table defining ITSIQA's intersection roadway network. It contains one record per intersection. The Approach Table lists all approaches to each intersection. There is at least one approach per intersection, and in most cases there are four approaches per intersection for a common two-road intersection. For each approach, there are one or more approach lanes. TMCs are recorded and reported on a per lane per approach per intersection basis.

The Roadway Table contains one record for each roadway on which there exists at least one link. This is not a listing of cross streets. These roads referenced in the Link table.

The Midpoints Table contains all geographic points defining a roadway link. A link may contain zero to any number of midpoints, although there are typically less than twenty, and in most cases less than ten, for any given link. Each midpoint contains a latitude and longitude value, in degrees, and a sort order. The sort order starts at 1 and defines the order in which the points occur based on the direction of traffic.

Figure 7: Adjacent Link Table

The Adjacent Link Table, as shown in Figure 7, helps to describe how links are related to each other. If an adjacent link is upstream if a link, it has an adjacent type of U. Otherwise, if an adjacent link is downstream if a link, it has an adjacent type of D. In the example above, link 102P05014 has two adjacent links. Link 102+05014 is upstream of 102P05014 while link 102+05015 is downstream of 102P05014.

The Link Type, County, and Data Owner Tables provide additional attribution to each link that do not normally change when adding or modifying links. There three primary link types: freeway, arterial, and local. These types help to classify the links for display or organization of the links. The County Table contains FDOT district and SPS coding information about all 67 Florida counties. The Data Owner Table indicates the roadway network to which the links belong. Currently, the ITSIQA database only stores ITSIQA's master roadway network, consequently, this table only contains a single record for ITSIQA.

5.5 Data Processing

At this point the data has been gathered by the ITSIQA system from the individual sources as they are reported. The data would need to undergo checks to ensure the validity of the data. Once that has been completed the data can be matched to the ITSIQA standard. All the data from the various sources would then need to be consolidated and stored in the database.

5.5.1 ITSIQA Data Filtering

This section addresses one of the software design goals to provide an additional layer of quality controls and algorithms that determine a truer picture of actual traffic conditions. The defined data quality checks values can be edited through the ITSIQA Administrative Manager and are categorized as listed below:

- Max Volume - The Max Volume filter checks if the volume is greater than defined value for volume of vehicles per time check per lane.
- Max Occupancy - The Max Occupancy filter checks if the occupancy per lane is greater than the defined value.
- Lane Speed Differential - The Lane Speed Differential filter checks if the difference of speed between lanes is greater than value set. Will only be triggered if volume per lane is greater than or equal to a defined min volume.
- Max Speed - The Max Speed filter checks if all lanes report a speed greater than or equal to All Lanes Speed Threshold and the speed per lane are greater than the configured posted speed limit plus single lane speed threshold.
- Min Speed - The Min Speed filter checks if a speed per lane is less than defined min speed threshold when the volume is greater than value for the min volume threshold.
- Inconsistent Values – the Inconsistent Values filter checks if the volume, speed and occupancy reported values are not matching up with what they should be. For example a 70MPH Speed limit road with cars reportedly going under 35 MPH and the reported occupancy for the section is 3%.
- Sequential Volumes - The Sequential Volumes filter checks if the same volume is reported per lane for Sequential Volumes Range minutes when volume is greater than defined min volume.
- Duplicate Values -The Duplicate Values filter checks if the same volume, speed, or occupancy is reported for multiple lanes.
- Directional Checks - Directional Checks filter determines if the reported direction of travel is wrong for a detector. This is determined by comparing the reported volume for one direction against the opposite direction for the detector being checked to determine

the predominate direction. And then compare the pre-dominate direction with the upstream and downstream detectors.

- Reported Lanes Count - The Reported Lanes Count filter checks if the reported number of lanes doesn't match the configured number of lanes.
- AADT Check - The AADT Check determines if the reported volume for all lanes at a detector is greater than AADT Upper Check percentage or less than AADT Lower Check percentage.
- Communication Failed - The Communication Failed filter checks if no data is received from a detector for max no data minutes.

The current data gathered undergoes these validations. If the check fails for the reported data, it will decrease the data quality value by the data quality degradation value defined by the failed data quality type and it will flag the type for use during the consolidation phase. Excluding Min and Max Speed Filters, if the individual checks is flagged more than the Failure Threshold out of Failure Check Range times, a MIMS ticket shall be generated for the flagged detector. Though, if it has not failed past Failure Check Range times, the failure will only be available as an ITSIQA Failure and will be logged accordingly.

MIMS is the system that the field technicians use in order to know what detectors need to be repaired or maintained. A ticket is made due to an issue with a particular detector and has the relevant information for a device and description of the issue needs to be resolved. If there is a ticket that is active for the specific detector the description of the failed data quality check will be added to it. If in another execution of ITSIQA the ticket is resolved it will edit the ticket that was made for that detector site and place a comment indicating this.

5.5.2 ITSIQA Normalization and Consolidation

Each source reports their data according to their own location mapping scheme. Therefore in order to consolidate the information, it must first take their format scheme and have their data reference the appropriate ITSIQA link and intersection format for the roadway. This connects their data with ITSIQA's roadway reporting scheme.

The data from each source is consolidated after the data has been grabbed and filtered through data quality checks to ensure that the data is valid. The data is considered valid if it passes the defined minimum threshold in the system settings under ITSIQA Service. The valid data from the various sources are calculated together to generate an accurate average of the data that is reported.

5.6   ITSIQA Administrator Application

The ITSIQA Administrator application is the control panel of the system where the administrator or other representative with the appropriate privileges can monitor the system and manipulate set up and configuration data within the file share. There are many options you can do with the administrative manager. When the application is launched, it looks like Figure 8 below.
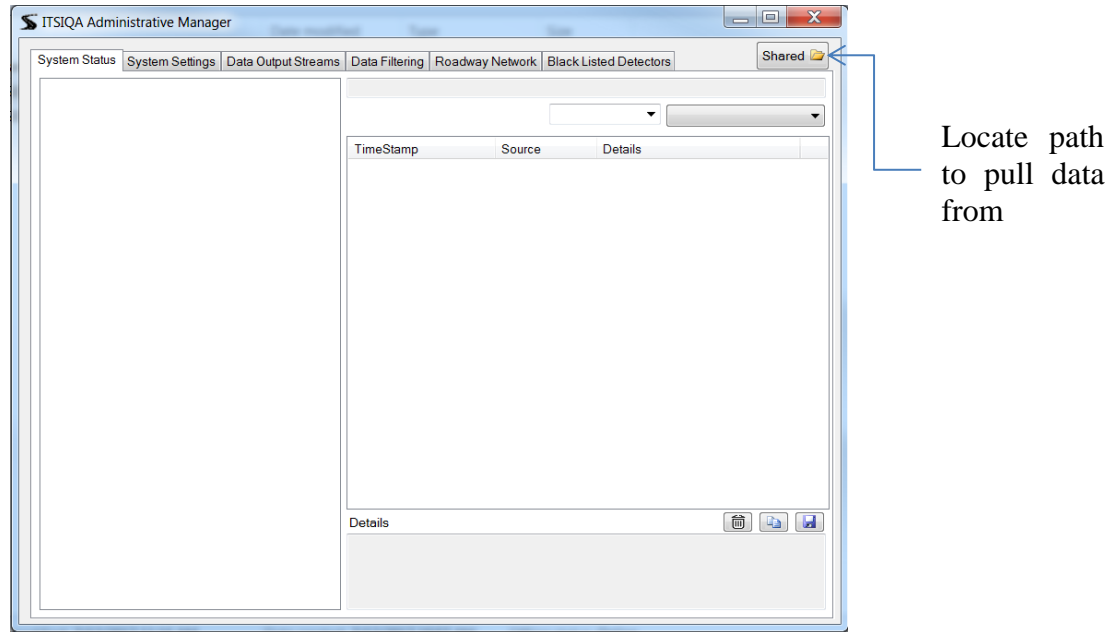
Figure 8: ITSIQA Administrator Application

Upon initial installation an empty window like the image above appears, locate and open the shared button to enter a shared network path for the application to connect to the system. Here is an example of the path, C:\Projects\ITSSIQA\Deliverables\Data\Shared. Once selected a valid path and executed the manager populates with the information with all the logs, settings and other system controllers. The Application does not automatically refresh itself, and will only display information up to the point to which the data was read into the application.

5.6.1 System Status

This tool keeps logs of all the processes performed in the system. It is categorized by the different sections such as the ITSIQA Service and other interfaces within the system. The information presented in each of these categories are TimeStamp, Source, and Details. The TimeStamp indicates the time at which the log was created. The Source provides information as to where the log instance was originated. The Details describes the status of the log entry. Each log entry has a color coded status indicator displayed just before the associated TimeStamp. The log statuses are defined as green for a successful operation, red for an error that ocured during the process, or blue for processes that are reporting information that ITSIQA functions are in progress. Each category has the option to display a previous day's data using the drop down menu. In addition, using the status indicator selection, the logs can be displayed for any one or all status types.
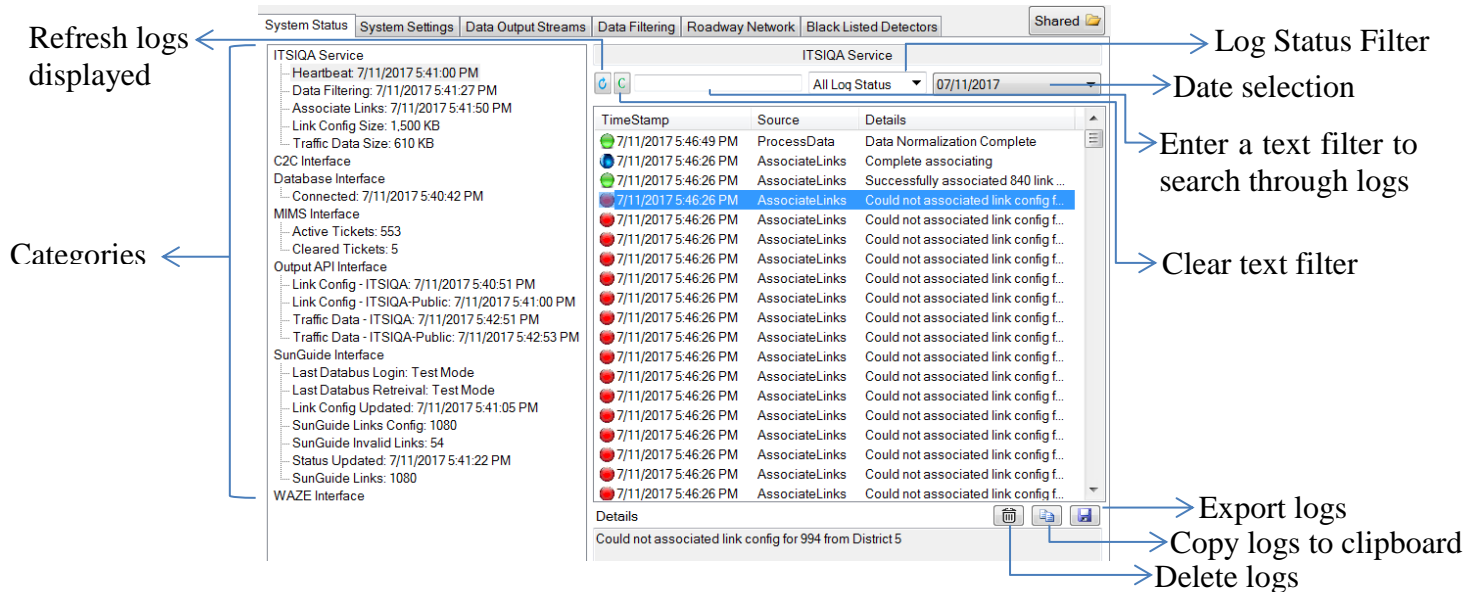
Figure 9: System Status Page Description

5.6.2   System Settings

In this section of the administrative manager the settings for the ITSIQA service and are where the default values, configuration values and paths for the interfaces in the system can be manipulated. Each set of settings is categorized by selecting the tabs located on the vertical column on the left. For example, in the database interface there is a parameter called Database ID, by double clicking the Value column this setting can be changed. ITSIQA will automatically update its configuration within ten seconds without restarting ITSIQA, with one exception.

Each of the interfaces, except for the Database and ITSIQA to C2C, has an "Enabled" flag. ITSIQA will not attempt to communicate with the interface when set to False. Changing this parameter requires restarting the ITSIQA Windows Service to enable or disable an interface. Enabled interfaces are designated with yellow smiley faces and disabled interfaces are designated with grayscale frowny faces.

The options to access each interface's settings

Double click a value to have a dialog box appear to change the data.
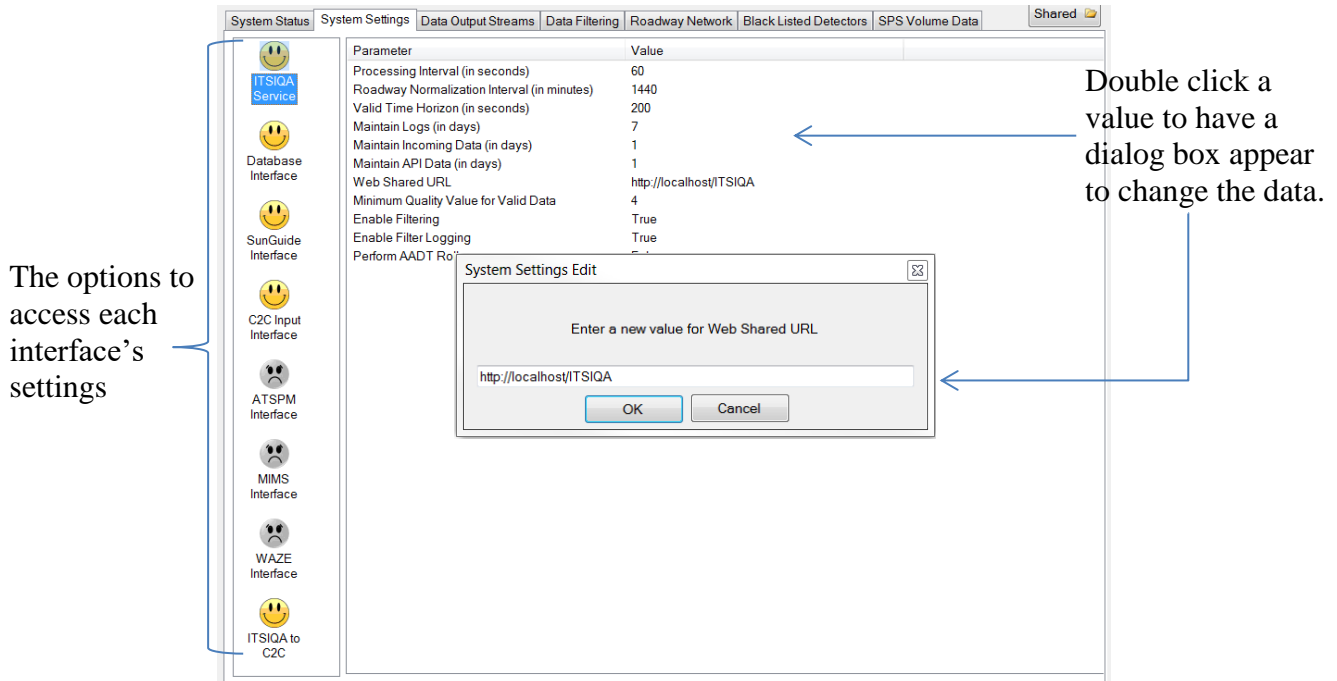
Figure 10: System Settings Page Description

5.6.3 Data Output Streams

In this option, data that is available through streams for output to external systems when there is a request for data from ITSIQA. For each Data Output Stream, one or more data inputs are selected, as well as desired counties. ITSIQA will separately merge the selected input data for each Data Output Stream. If no counties are selected, all enabled links are reported from all counties. The C2C Provider is the URL of the Center-to-Center Software Provider that will receive data. This provider is configurable per Data Output Stream. If it is desired to push multiple Data Output Streams into the same C2C Provider, the same C2C Provider URL should be configured.

Select a data input or county and use these options to add or remove selected to the stream

Options to manipulate the existence of streams

Save or undo changes that has been made to a stream
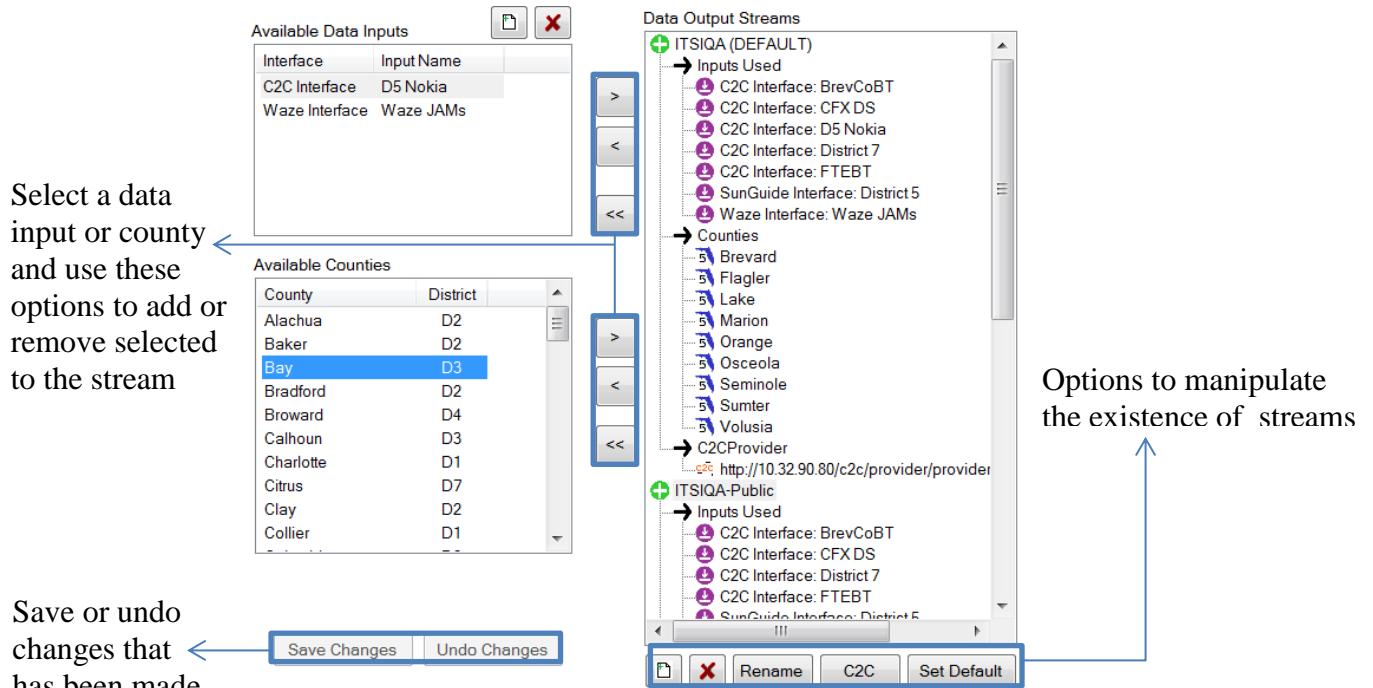
Figure 11: Data Output Streams Page Description

5.6.4 Data Filtering / Evaluation Handler

There is a listing of different rules and their settings which can be manipulated to evaluate the input data's accuracy. The input data for this is primarily received from SunGuide. One setting that is standard to all rules is Enabled, which can be set to true or false, which determines if the rule is enabled or disabled. A description of what each rule's settings entails is displayed to the right of the window. There is the option to change these values by selecting the Parameter and double clicking its value.

Select an option to view its parameters and manipulate it

The description associated with the selected parameter.
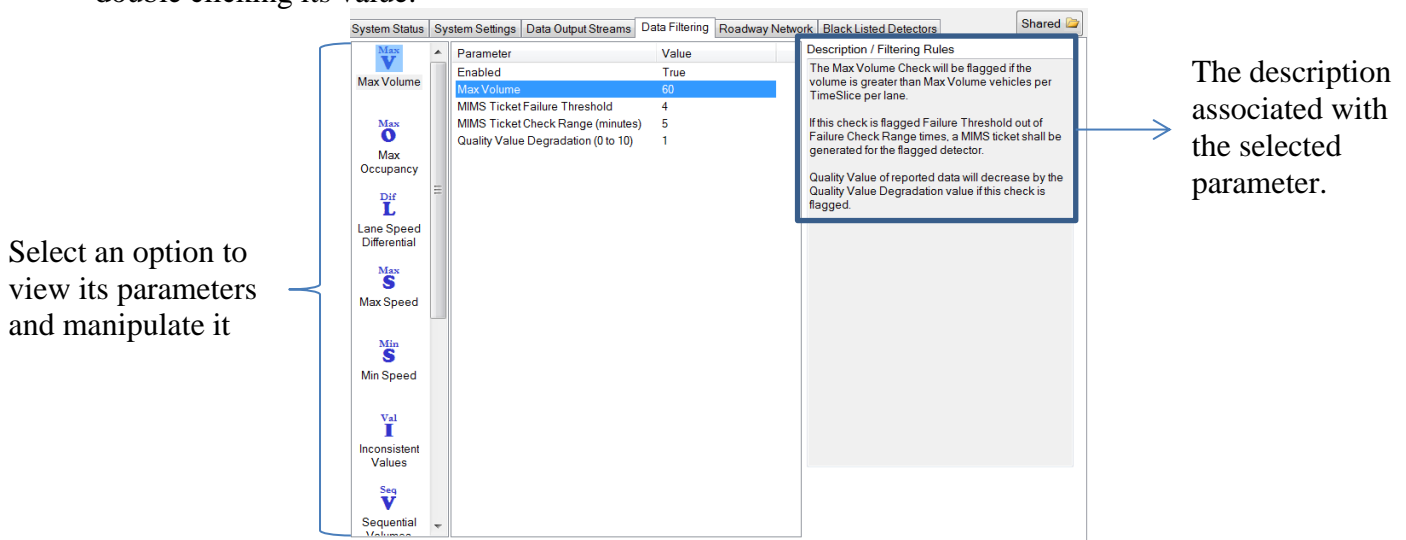
Figure 12: Data Filtering Page Description

5.6.5 Roadway Network

In this section of the administrative manager, the roadway network links in the database can be manipulated. The Roadway Network is the mapping scheme of using multiple links connected to each other to represent a stretch of road. An example is the I-4 Eastbound.

1. The Roadway network configuration from the database can be accessed using the Load ⬛ icon. The links will be loaded in. The check box labeled as "Show Disabled Links" is to be selected to have the disabled links displayed along with the enabled links when the Load button is used.
2. Selecting the check boxes on the left expands the category to show the links contained or to select all the links use the Sel All ✔ button.
3. The Show ⬛ button will display links on the selected roadways in the list.
4. The ✅ and ❌ buttons set the selected roadways to represent as active in the system or not. Select a disabled roadway in the list then use the ✅ button to enable it and vice versa.
5. The "Enable Link ✅" and "Disable Link ❌" buttons set the selected links to represent as active in the system or not.
6. The links can be sorted into the order at which they are represented using the upstream and downstream values by selecting the Order ⇅. The upstream value indicates the link of the next link connected to it, whereas the downstream represents the previous link it was connected to.
7. Though if the link is not correctly ordered, it can manually be changed with the Set Order ¹₂₃ option. Once selected clink each link in the order that is required then click the option Stop ¹₂₃ to complete the connection.
8. The number of lanes and Speed Limit of a link can be copied from another link and set as the values of another by using the two buttons of copy ⬛ or paste ⬛.
9. A new link can be created to the Roadway list using the add link ➕ button.
10. A selected link can be removed from the Roadway Network using the delete 🗑 button.
11. The edit ✎ option can edit any of the values displayed in the selected link.
12. The mapping option 🗺 opens a Google API map of the links and shows and shows where all are located. The enabled links will be displayed in close proximity with a 📍 icon whereas the disabled links would be indicated by a 📍 icon. The link has a fixed coordinates for both start at end points of the link with midpoint coordinates associated manipulating the line to show it accurately on curves of the road.
13. The Set Link Type 🛣 option opens a separate window with a menu option of different link types to set all the selected links as.
14. The Roadway Alias ⬦ option opens a separate window with a list of all the Roadway Aliases in the ITSIQA System. These aliases are used to correlate a roadway in the ITSIQA system to another naming convention used by one or more forms of data input.
15. The Import ⬇ and Export ⬆ utilities can load in a new file or output the data shown to another file.
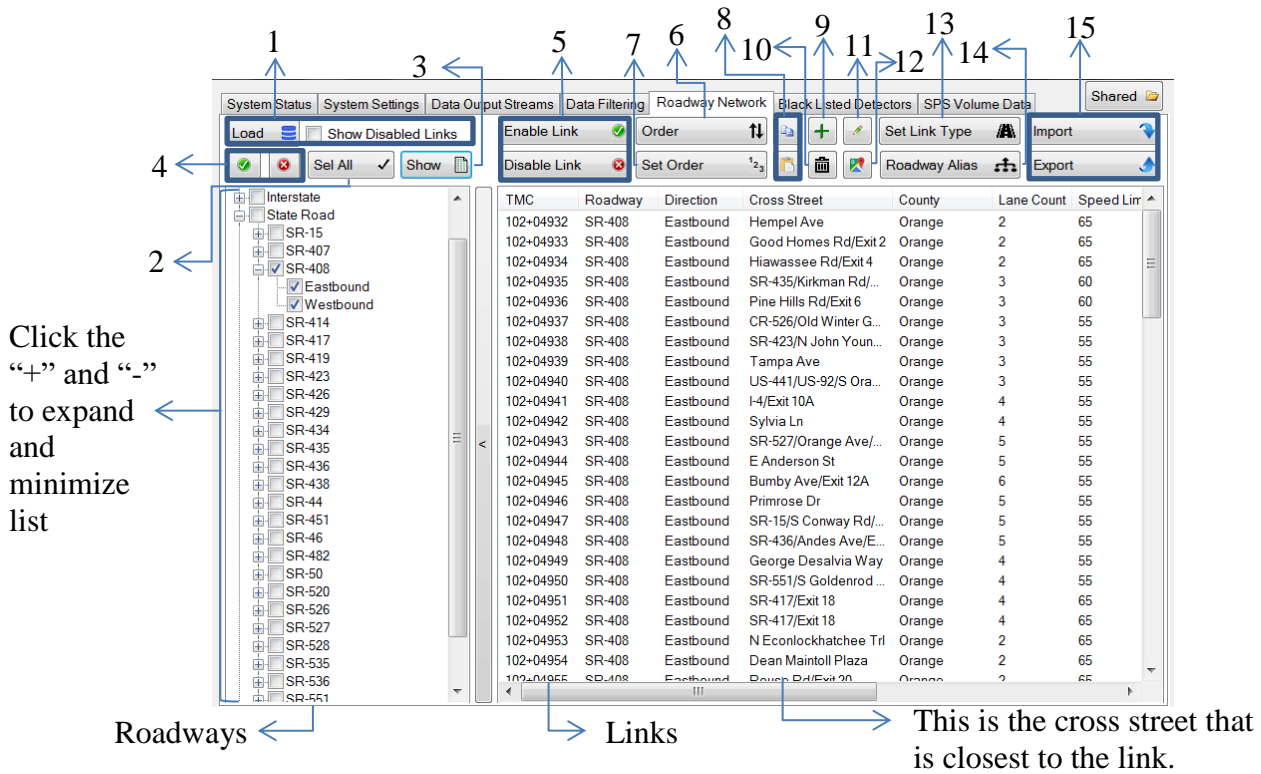
Figure 13: Roadway Network Page Description

5.6.6 Black Listed Detectors

This option allows the administrator to disable specific detectors that are malfunctioning or not in use in ITSIQA. The option to create new detectors that are not in the directory already is also available, in the event that detectors are installed in new locations. The changes made will be recorded in the database, however, a change will not be visible to the Application till the system process reads the data again.

Add or backlist
selected detector
to the list of
active detectors

List of
available
detectors in
specified
path

Reload
Detector
information
from database

Enter the name
of the network
the detector is
associated with.
Example,
District 5

Enter the
location
name for the
detector

Add new
detector or
remove selected
blacklisted
detector

List of the
detectors that
has been
blacklisted

Figure 14: Black Listed Detectors Page Description

5.6.7 SPS Data Conversion

This option was added to roll-up volume data reported from ITSIQA and format the rolled up data into the SPS Volume Data Output.

This section allows the user to select from a list of dates in a database that ITSIQA stored its traffic data and select a folder path to convert and store the generated SPS data. Once dates are selected and a valid output path is selected, the user can click "Generate". The Administrative manager finds the traffic data from the specified dates and filters them using the defined SPS ID's. For the SPS volume classification files, the total link volume is divided and rounded using the predefined fifteen classification spread percentages. While the data is being generated, the SPS Logger will provide feedback to the user about the system processes the converted data.

Figure 15: SPS Volume Data Conversion Page Description
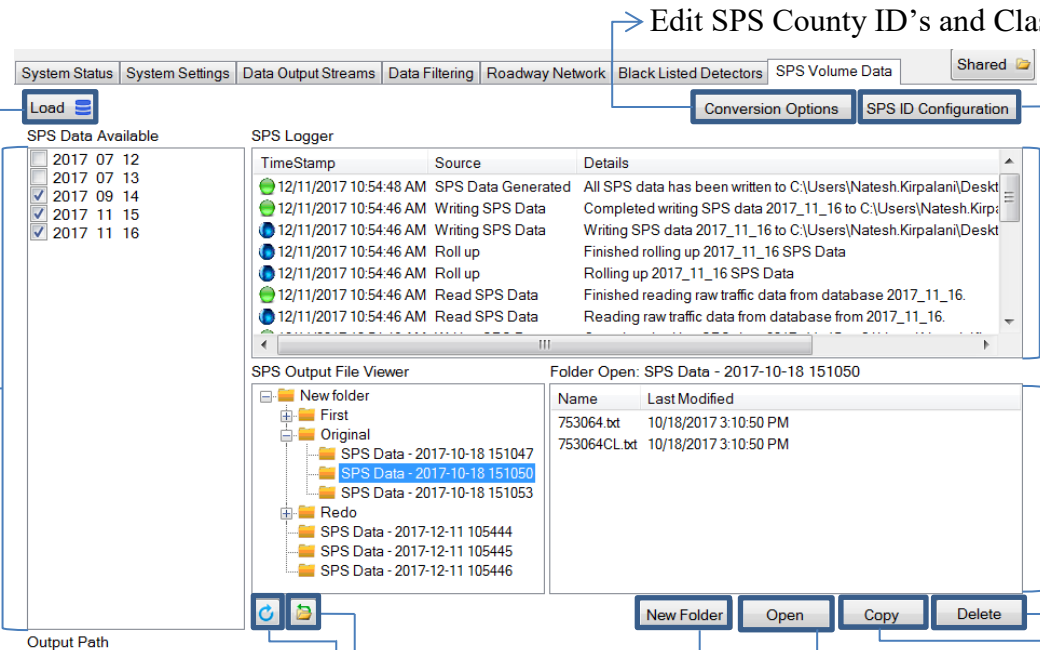
The user has the option to edit the SPS County ID's and Classification Spread percentage configurations using the "Conversion Options" button. The SPS County ID's are the ID's unique to each county defined by the SPS format. Since ITSIQA does not receive volume data separated by vehicle class from all sources, the user can set percentages of likelihood for each vehicle class using the Classification Spread editor. These percentages will be used to calculate the SPS class volume data.

1. Edit the SPS County ID's by using the three options of add, edit or delete which will cause a separate window to appear to select a county from a defined list and allow user entry for a SPS County ID. Select an entry in the table to be able to edit or delete a record.

2. To edit the Classification Spread percentages double click a class entry to be able to edit the percentages. The total percentages must equal 100% before saving them. In addition, to save the new Classification Spread percentages click "OK" on the SPS Conversion Options Window.
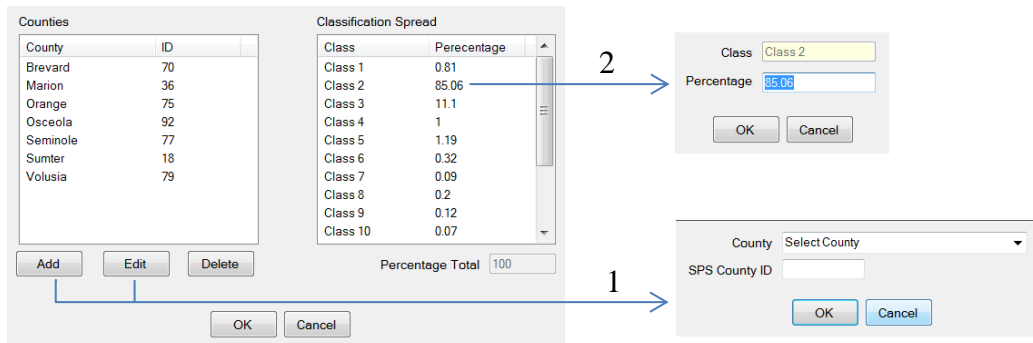
Figure 16: SPS Conversion Options Window Description

The user can edit the locations for each SPS ID using the "SPS ID Configuration". This creates an association between the SPS ID and ITSIQA's Link ID's to find and convert the traffic data. SPS ID's refer to one segment of roadway going both directions, whereas, ITSIQA has different ID's for both directions of travel on the same road. Therefore, there will be one SPS ID for the two ITSIQA links. The SPS ID Configuration Editor has search options to find a link by roadway and direction that would be displayed on a map. Optionally you can refine your search by entering a specified coordinates to find where the SPS ID location is to locate the nearest ITSIQA Link ID.
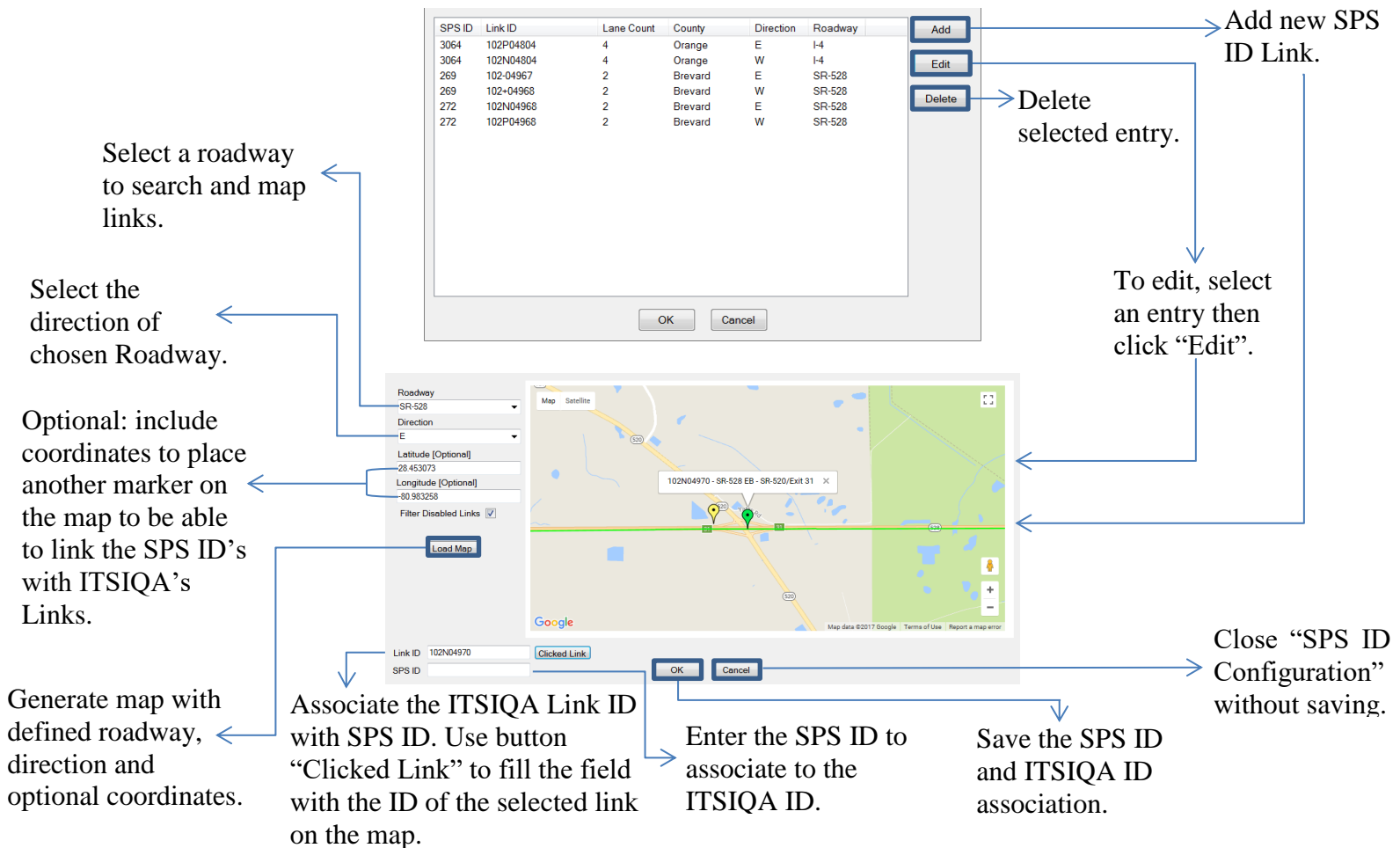
Figure 17: SPS ID Configuration Window Description

5.7   ITSIQA Output

The ITSIQA system provides an API that makes a series of Extensible Markup Language (XML) files. These files are written to a shared ITSIQA path, which could be made available to external systems via Hypertext Transfer Protocol (HTTP) requests, File Transfer Protocol (FTP), or direct URI path, depending on the interfacing system's requirements. Files are written to the ITSIQA server drive. External systems interested in receiving this data must develop a periodic pull of the data. If available, a direct file copy via a URI path will likely be the quickest mechanism for retrieving the files.

5.7.1   ITSIQA Real-Time Output Files

ITSIQA generates four files per configured Data Output Stream, see Section 5.4.3. The file names are named based on the names of the Data Output Stream. Table 18 lists a description of each file and the names of each file. Note that {Data Output Stream} is the actual name of the Data Output Stream as configured within the ITSIQA Administrative Manager. The data contained in these files is the most current data available from ITSIQA. Each file contains a timestamp, indicating when the file was last updated.

Table 26: ITSIQA Output Files

Output File	Description	Update Frequency
LinkConfig-{Data Output Stream}.xml	Configuration information for ITSIQA's master link configuration, including a list of links and their mappable locations.	1 Day
TMCConfig-{Data Output Stream}.xml	Configuration information for ITSIQA's master TMC configuration, including a list of intersections, approaches, and lanes.	1 Day
TrafficData-{Data Output Stream}.xml	Primary link data output, providing speed, volume, occupancy, travel time, and quality values of each link.	60 Seconds
LaneTrafficData-{Data Output Stream}.xml	Detailed link data output, providing speed, volume, occupancy, travel time, and quality values of each link. Also includes speed, volume, occupancy, and travel time information for each lane for each link that contains lane-level data. The existence of lane data directly depends on lane data provided by the SunGuide software feeding ITSIQA.	60 Seconds

Output File	Description	Update Frequency
ClassData-{Data Output Stream}.xml	Vehicle classification data reported on a per link basis. The existence of classification data directly depends on classification data provided by the SunGuide software feeding ITSIQA.	60 Seconds
TMCData-{Data Output Stream}.xml	Turning movement count data reported on a per lane per approach per intersection basis.	60 Seconds

5.7.2 ITSIQA Archived Output Files

ITSIQA saves Real-Time Output Files to an Archive Output File repository. This repository maintains a number of files that is limited by ITSIQA's configured retention period, which by default is set to 24 hours.

Like the Real-Time data, Archive Output File repository is available to external systems via Hypertext Transfer Protocol (HTTP) requests, File Transfer Protocol (FTP), or direct URI path, depending on the interfacing system's requirements. Archive files are accessible via the base path plus "ITSIQA/Archive/". For example, via HTTP the archive can be reached here:

http://{ITSIQA Host}/ITSIQA/Archive/

Figure 18 depicts the directory structure within the Archive Output File repository.

- ITSIQA/Archive/
  - LinkConfig/
    - {List of Files in format: LinkConfig-{Data Output Stream}-YYYY-MM-DD.xml}
    - {List of Files in format: LinkConfig-{Data Output Stream}-YYYY-MM-DD.xml}
    - Etc.
  - TMCConfig/
    - {List of Files in format: TMCConfig-{Data Output Stream}-YYYY-MM-DD.xml}
    - {List of Files in format: TMCConfig-{Data Output Stream}-YYYY-MM-DD.xml}
    - Etc.
  - ClassificationData/
    - Data Output Stream 1/
      - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
        - {List of Files in format: ClassData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
    - Data Output Stream 2/
      - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
        - {List of Files in format: ClassData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
  - LaneTrafficData/
    - Data Output Stream 1/
      - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
        - {List of Files in format: LaneTrafficData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
    - Data Output Stream 2/
      - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}

- {List of Files in format: LaneTrafficData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
- TrafficData/
  - Data Output Stream 1/
    - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
      - {List of Files in format: TrafficData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
  - Data Output Stream 2/
    - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
      - {List of Files in format: TrafficData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
- TMCData/
  - Data Output Stream 1/
    - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
      - {List of Files in format: TMCData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}
  - Data Output Stream 2/
    - {Date in format: YYYY-MM-DD/, such as 2018-07-10/}
      - {List of Files in format: TMCData-{Data Output Stream}-YYYY-MM-DD-HHMM.xml}

Figure 18: Archive Output File Repository Directory Structure

Under each data type, there is one directory per Data Output Stream. For Classification Data, Lane Traffic Data, Traffic Data, and TMC Data, within each Data Output Stream directory, there is a list of directories, each named with the date of data contained within the directory. For example, a directory named "2018-07-10" contains files that were updated on July 10, 2018. For Link Config and TMC Config, there are no date directories or Data Output Stream directories. All available Link Config and TMC Config data for a Data Output Stream is contained directly within the LinkConfig and TMCConfig directories, respectively.

Status data files are named with the Data Output Stream name and the date and time that the file was updated. For example, a Traffic Data file with the name TrafficData-Stream1-2018-07-10-1305.xml is Traffic Data from Stream1 that was updated July 10, 2018 at 1:05 PM local time. Note that seconds are not included in the file name, since the files are not updated more than once per minute. Configuration data files are named with Data Output Stream name and the date that the file was updated. For example, a Link Configuration file with the name LinkConfig-Stream1-2018-07-10.xml is LinkConfig from Stream1 that was updated July 10, 2018. Note that a time is not included in the configuration files since they are not updated more than once per day. There should be one configuration file written per day.

5.7.3 Link Configuration Data

Link configuration data is reported in XML format. Table 19 describes each reported field.

Table 27: Link Configuration Data

Data Field	Data Description	Example Value
Links / DataOutputStream (attribute)	Unique alpha-numeric name of Data Output Stream. Should exactly match the name of the Data Output Stream name contained in the file name.	ITSIQA-AllSources
Links / TimeStamp (attribute)	Date and time when file was last updated, in local time.	6/18/2018 8:52:39 AM

Data Field	Data Description	Example Value
Links / Link	XML element containing all configuration information related to each link. The number of links vary depending on the list of counties configured for the Data Output Stream and the enabled links within each county.	\<Link\>…\</Link\>
Links / Link / ID	Unique alpha-numeric identifier for the reported link. External systems should not make any assumptions of the format of this identifier other than it is unique to the reported link.	102+04780
Links / Link / Road / RoadName	Name of the reported roadway on which the link is located. Roadway names are named using standard formatting for interstates, US roads, state roads, and county roads, using the format I-XXX, US-XXX, SR-XXX, and CR-XXX, respectively, where XXX is the integer associated with road. If a road has multiple names, only one is used. All roads are consistently reported. All links on I-4, for example, will have a Road value of I-4.	I-4 SR-408 US-441
Links / Link / Road / RoadID	Numeric ID of the given roadway. This ID is unique for the roadway and consistent along the entire stretch of a road.	25
Links / Link / Road / RCIRoadID	Alphanumeric ID of the given roadway at the link's location. Note that these IDs come from the All Roads Base Map and may not be consistent along the entire stretch of the roadway. Rather, this is the roadway identifier specific to the given link. Also note that this identifier may contain a combination of numeric digits and letters.	70050000
Links / Link / Direction	Direction of travel for the link. Each link has exactly one reported direction of travel. The only values for this field include one of the following: Northbound, Southbound, Eastbound, or Westbound	Northbound

Data Field	Data Description	Example Value
Links / Link / CrossStreet	Alpha-numeric name of the closest cross street, mile mark, exit, or point of interest that describes the location of the link. There is no standard naming for Cross Street values, nor are they unique. Links near exits typically provide the name of the cross street and the exit number.	World Dr/Exit 62
Links / Link / County	Name of the county where the link is located. A link has exactly one county associated with it. The value for this field is one of the county names listed in Table 4.	Osceola
Links / Link / LaneCount	Integer value for the number of lanes spanning the link. In some cases, the actual number of lanes changes within the length of a link, however, a link has only one lane count value. Ranges from 1 to 255.	3
Links / Link / SpeedLimit	Integer value for the speed limit spanning the link, in miles per hour. Ranges from 1 to 255.	65
Links / Link / Length	Double value for the length of the link in miles. Ranges from greater than zero to 32,767. Most links are less than 1.	0.985708178
Links / Link / LinkType	The type of the link based on the classification of the roadway. This field is one of the following values: unknown, freeway, arterial, collector, local, serviceRoad, tunnel, detour, dedicatedRoad, militaryRoad, railroadLink, airLink, or ferryLink. Note that most of the links configured within ITSIQA are one of the following: freeway, arterial, or local.	freeway
Links / Link / StartLocation	XML element containing Latitude and Longitude values, indicating the upstream start of the link.	\<Latitude\> 29.2859164 \</Latitude\> \<Longitude\> -81.0834688 \</Longitude\>

Data Field	Data Description	Example Value
Links / Link / EndLocation	XML element containing Latitude and Longitude values, indicating the downstream end of the link.	\<Latitude\> 29.2859164 \</Latitude\> \<Longitude\> -81.0834688 \</Longitude\>
Links / Link / MidPoints	XML element containing optional sub-elements called "MidPoint" which contains Latitude and Longitude values, indicating points lining the physical geometry of the roadway link. Not all links contain MidPoint values.	\<Latitude\> 29.2859164 \</Latitude\> \<Longitude\> -81.0834688 \</Longitude\>
Links / Link / UpStreamLink	Optional Link ID of the adjacent link upstream of the reported link.	102+10815
Links / Link / DownStreamLink	Optional Link ID of the adjacent link downstream of the reported link.	102+10817

5.7.4 Link Traffic Data

Link traffic data is reported in XML format. Table 20 describes each reported field.

Table 28: Link Traffic Data

Data Field	Data Description	Example Value
TrafficData / DataOutputStream (attribute)	Unique alpha-numeric name of Data Output Stream. Should exactly match the name of the Data Output Stream name contained in the file name.	ITSIQA-AllSources
TrafficData / TimeStamp (attribute)	Date and time when file was last updated, in local time.	6/18/2018 8:52:39 AM
TrafficData / Link	XML element containing all link traffic information related to each link. The number of links match exactly with the links reported from the LinkConfig file.	\<Link\>…\</Link\>
TrafficData / Link / ID	Unique alpha-numeric identifier for the reported link. Identifier matches with the link identifier reported in the LinkConfig file.	102+04780
TrafficData / Link / Speed	Integer value of the reported speed calculated over the reporting period for the link in miles per hour.	64

Data Field	Data Description	Example Value
TrafficData / Link / Speed / DataQuality (attribute)	Data Quality integer value for the reported speed. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	9
TrafficData / Link / Volume	Integer value of the reported volume calculated over the reporting period for the link in the total number of vehicles for all lanes.	21
TrafficData / Link / Volume / DataQuality (attribute)	Data Quality integer value for the reported volume. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	7
TrafficData / Link / Occupancy	Integer value of the reported occupancy calculated over the reporting period for the link.	8
TrafficData / Link / Occupancy/ DataQuality (attribute)	Data Quality integer value for the reported occupancy. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	5
TrafficData / Link / TravelTime	Integer value of the reported travel time calculated over the reporting period for the link in seconds.	21
TrafficData / Link / TravelTime / DataQuality (attribute)	Data Quality integer value for the reported travel time. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	10

5.7.5 Lane Link Traffic Data

Lane link traffic data is reported in XML format. Table 21 describes each reported field.

Table 29: Lane Link Traffic Data

Data Field	Data Description	Example Value
LaneTrafficData / DataOutputStream (attribute)	Unique alpha-numeric name of Data Output Stream. Should exactly match the name of the Data Output Stream name contained in the file name.	ITSIQA-AllSources
LaneTrafficData / TimeStamp (attribute)	Date and time when file was last updated, in local time.	6/18/2018 8:52:39 AM
LaneTrafficData / Link	XML element containing all link traffic information related to each link. The number of links match exactly with the links reported from the LinkConfig file.	<Link>…</Link>
LaneTrafficData / Link / ID	Unique alpha-numeric identifier for the reported link. Identifier matches with the link identifier reported in the LinkConfig file.	102+04780
LaneTrafficData / Link / Speed	Integer value of the reported speed calculated over the reporting period for the link in miles per hour.	64
LaneTrafficData / Link / Speed / DataQuality (attribute)	Data Quality integer value for the reported speed. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	9
LaneTrafficData / Link / Volume	Integer value of the reported volume calculated over the reporting period for the link in the total number of vehicles for all lanes.	21
LaneTrafficData / Link / Volume / DataQuality (attribute)	Data Quality integer value for the reported volume. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	7
LaneTrafficData / Link / Occupancy	Integer value of the reported occupancy calculated over the reporting period for the link.	8
LaneTrafficData / Link / Occupancy/ DataQuality (attribute)	Data Quality integer value for the reported occupancy. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	5

Data Field	Data Description	Example Value
LaneTrafficData / Link / TravelTime	Integer value of the reported travel time calculated over the reporting period for the link in seconds.	21
LaneTrafficData / Link / TravelTime / DataQuality (attribute)	Data Quality integer value for the reported travel time. Value ranges from 0 to 10, where 0 is the lowest quality and 10 is the highest value. Values are calculated based on ITSIQA's configuration and other ITSIQA-specific algorithms.	10
LaneTrafficData / Link / Lanes	XML element containing the list of lanes reported. If no lane-level data is available for the reported link, this XML element is empty.	\<Lanes\>…\</Lanes\>
LaneTrafficData / Link / Lanes / Lane	XML element containing the lane-level status information.	\<Lane\>…\</Lane\>
LaneTrafficData / Link / Lanes / Lane / LaneNumber (attribute)	Integer value of the reported lane number, ordered based on the order reported from SunGuide. Values range from 1 to 255.	1
LaneTrafficData / Link / Lanes / Lane / Speed	Integer value of the reported speed calculated over the reporting period for the lane in miles per hour.	64
LaneTrafficData / Link / Lanes / Lane / Volume	Integer value of the reported volume calculated over the reporting period for the lane.	12
LaneTrafficData / Link / Lanes / Lane / Occupancy	Integer value of the reported occupancy calculated over the reporting period for the lane.	8
LaneTrafficData / Link / Lanes / Lane / TravelTime	Integer value of the reported travel time calculated over the reporting period for the lane in seconds.	50

5.7.6 Vehicle Classification Data

Vehicle Classification data is reported in XML format. Table 22 describes each reported field.

Table 30: Vehicle Classification Data

Data Field	Data Description	Example Value
ClassData / DataOutputStream (attribute)	Unique alpha-numeric name of Data Output Stream. Should exactly match the name of the Data Output Stream name contained in the file name.	ITSIQA-AllSources

Data Field	Data Description	Example Value
ClassData / TimeStamp (attribute)	Date and time when file was last updated, in local time.	6/18/2018 8:52:39 AM
ClassData / Link	XML element containing all link traffic information related to each link. The number of links match exactly with the links reported from the LinkConfig file.	\<Link\>…\</Link\>
ClassData / Link / ID (attribute)	Unique alpha-numeric identifier for the reported link. Identifier matches with the link identifier reported in the LinkConfig file.	102+04780
ClassData / Link / ClassX (where X varies from 1 to 8)	Integer value for the number of vehicles reported within each vehicle classification for the selected link. ITSIQA reports classification values as they are reported from SunGuide. Classifications are divided amongst eight different classifications, one per field. For example, Class1 represents the number of vehicles reported in classification bin 1. These values range from 0 to 32,767.	5
ClassData / Link / Lanes	XML element containing all lanes contained within link.	\<Lanes\>…\</Lanes\>
ClassData / Link / Lanes / Lane	XML element containing classification data contained within each lane.	\<Lane\>…\</Lane\>
ClassData / Link / Lanes / Lane / LaneNumber	Integer indicating the index (starting at 1) of the reported lane. Values range from 1 to 255.	2
ClassData / Link / Lanes / Lane / ClassX (where X varies from 1 to 8)	Integer value for the number of vehicles reported within each vehicle classification for the selected lane. ITSIQA reports classification values as they are reported from SunGuide. Classifications are divided amongst eight different classifications, one per field. For example, Class1 represents the number of vehicles reported in classification bin 1. These values range from 0 to 32,767.	5

5.7.7 TMC Configuration Data

TMC configuration data is reported in XML format. Table 23 describes each reported field.

Table 31: TMC Configuration Data

Data Field	Data Description	Example Value
Intersections / DataOutputStream (attribute)	Unique alpha-numeric name of Data Output Stream. Should exactly match the name of the Data Output Stream name contained in the file name.	ITSIQA-AllSources
Intersections / TimeStamp (attribute)	Date and time when file was last updated, in local time.	6/18/2018 8:52:39 AM
Intersections / Intersection	XML element containing all configuration information related to each intersection. The number of intersections vary depending on the list of counties configured for the Data Output Stream and the enabled intersections within each county.	<Intersection>… </Intersection >
Intersections / Intersection / IntersectionID	Unique alpha-numeric identifier for the reported intersection. External systems should not make any assumptions of the format of this identifier other than it is unique to the reported intersection.	12345
Intersections / Intersection / Name	Common name for intersection, consisting of roadway names separated by " and ". The roadway names refer to the roadways included in the configured approaches. This name may only include one roadway if the approach or approaches only include one roadway.	SR-434 and US-17/92
Intersections / Intersection / Location	XML element containing Latitude and Longitude values, indicating the geographic center of the intersection.	<Latitude> 29.285916 </Latitude> <Longitude> -81.083468 </Longitude>
Intersections / Intersection / County	Name of the county where the intersection is located. An intersection has exactly one county associated with it. The value for this field is one of the county names listed in Table 4.	Osceola

Data Field	Data Description	Example Value
Intersections / Intersection / Approaches / Approach	XML element containing all configuration information related to each approach within an intersection. The number of approaches vary with each intersection, although a common two-road intersection typically has four approaches. Each approach is associated with exactly one direction of travel. The direction of travel may be repeated at an intersection. For example, there may be more than one Northbound approach.	<Approach>… </Approach >
Intersections / Intersection / Approaches / Approach / ApproachID	Unique alpha-numeric identifier for the reported approach. External systems should not make any assumptions of the format of this identifier other than it is unique to the reported approach.	12345-1
Intersections / Intersection / Approaches / Approach / Road	The XML element containing information related to the approach's roadway. Each approach has exactly one roadway.	<Road>… </Road>
Intersections / Intersection / Approaches / Approach / Road / RoadName	Name of the reported roadway on which the approach is located. Roadway names are named using standard formatting for interstates, US roads, state roads, and county roads, using the format I-XXX, US-XXX, SR-XXX, and CR-XXX, respectively, where XXX is the integer associated with road. If a road has multiple names, only one is used. All roads are consistently reported. All approaches on I-4, for example, will have a Road value of I-4.	I-4 SR-408 US-441
Intersections / Intersection / Approaches / Approach / Road / RoadID	Numeric ID of the given roadway. This ID is unique for the roadway and consistent along the entire stretch of a road.	25

Data Field	Data Description	Example Value
Intersections / Intersection / Approaches / Approach / Road / RCIRoadID	Alphanumeric ID of the given roadway at the location of the intersection. Note that these IDs come from the All Roads Base Map and may not be consistent along the entire stretch of the roadway. Rather, this is the roadway identifier specific to the link that spans this intersection. Note that this identifier may contain a combination of numeric digits and letters. If there are no links configured within ITSIQA that span this approach, this field will be blank.	70050000
Intersections / Intersection / Approaches / Approach / Direction	Direction of travel for the approach. Each approach has exactly one reported direction of travel. The only values for this field include one of the following: Northbound, Southbound, Eastbound, or Westbound. Combinations of these directions is not allowed. For example, a northwest direction must either be Northbound or Westbound, not both.	Northbound
Intersections / Intersection / Approaches / Approach / AssociatedLink	This is an optional XML element containing information about the link associated with this approach. The associated link is calculated by ITSIQA based on the configured latitude/longitude points configured for the intersection and the links, the roadway of the link, and the link direction. If there are no links spanning the approach, this XML element will be blank.	<AssociatedLink>… </AssociatedLink>
Intersections / Intersection / Approaches / Approach / AssociatedLink / LinkID	The LinkID of the link that spans the given approach. This LinkID will match the LinkID from the Link Configuration Data.	22396203-N

Data Field	Data Description	Example Value
Intersections / Intersection / Approaches / Approach / AssociatedLink / LinkDirection	The direction of travel of vehicles traversing the associate link. This direction of travel should be consistent for all links on a given roadway. For example, since SR-434 is an East/West roadway, all links have either an eastbound or westbound direction. This value may only contain one of the following four values: Eastbound, Westbound, Northbound, Southbound.	Northbound
Intersections / Intersection / Approaches / Approach / Lanes / Lane	XML element containing all configuration information related to each lane within an approach. The number of lanes vary with each approach, although there must be at least one.	<Lane>… </Lane>
Intersections / Intersection / Approaches / Approach / Lanes / Lane / LaneID	Unique alpha-numeric identifier for the reported lane. External systems should not make any assumptions of the format of this identifier other than it is unique to the reported lane.	12345-1-1
Intersections / Intersection / Approaches / Approach / Lanes / Lane / LaneOrder	Positive integer, starting with 1, that identifies the ordering of the lane. Lane 1 is always the lane closest to the median. The largest Lane Order value is the lane closest to the shoulder.	1
Intersections / Intersection / Approaches / Approach / Lanes / Lane / LaneTypeIDs	Comma-delimited list of identifiers that describe the allowable movement through the lane. There may be between one and four identifiers reported in this field. There are four valid identifiers which include the following: Left, Through, Right, UTurn	Through,Right

5.7.8 Turning Movement Count Data

Turning Movement Count (TMC) data is reported in XML format. Table 24 describes each reported field.

Table 32: Turning Movement Count Data

Data Field	Data Description	Example Value
Intersections / DataOutputStream (attribute)	Unique alpha-numeric name of Data Output Stream. Should exactly match the name of the Data Output Stream name contained in the file name.	ITSIQA-AllSources

Data Field	Data Description	Example Value
Intersections / TimeStamp (attribute)	Date and time when file was last updated, in local time.	6/18/2018 8:52:39 AM
Intersections / Intersection	XML element containing all configuration information related to each intersection. The number of intersections vary depending on the list of counties configured for the Data Output Stream and the enabled intersections within each county.	<Intersection>… </Intersection >
Intersections / Intersection / IntersectionID	Unique alpha-numeric identifier for the reported intersection. This identifier should match the Intersection identifier reported from Intersection Configuration Data exactly.	12345
Intersections / Intersection / Approaches / Approach	XML element containing all configuration information related to each approach within an intersection. The number of approaches vary with each intersection, although a common two-road intersection typically has four approaches.	<Approach>… </Approach >
Intersections / Intersection / Approaches / Approach / ApproachID	Unique alpha-numeric identifier for the reported approach. This identifier should match the Approach identifier reported from Intersection Configuration Data exactly.	12345-1
Intersections / Intersection / Approaches / Approach / ApproachTMCData	Comma-delimited list of numbers representing a specific list of data values. These values are summed and are associated with the specified approach. The reported values are updated every processing period. However, the data field indexes do not change. Table 25 describes each value in this number array by data field index.	2,9,0,40,1058, 1500,100,0,17,8,35,2, 2,0,0.8123,2

Data Field	Data Description	Example Value
Intersections / Intersection / Approaches / Approach / BikeCount	Reported Bike Volume for the given approach. Value is reported as two integers separated by a comma. The first integer is the forward direction, compared to the approach's vehicle direction of travel, and the second integer is the reverse direction. For example, for a northbound approach, a BikeCount value of "2,1" means 2 bicycles were reported traveling northbound in the northbound approach and 1 bicycle was reported traveling southbound in the northbound approach.	2,1
Intersections / Intersection / Approaches / Approach / PedestrianCount	Reported Pedestrian Volume for the given approach. Value is reported as two integers separated by a comma. The first integer is the forward direction, compared to the approach's vehicle direction of travel, and the second integer is the reverse direction. For example, for a northbound approach, a PedestrianCount value of "2,1" means 2 pedestrians were reported traveling northbound in the northbound approach and 1 pedestrian was reported traveling southbound in the northbound approach.	2,1
Intersections / Intersection / Approaches / Approach / Lanes *POTENTIALLY OPTIONAL*	XML element containing list of lanes. Note that this may not be reported depending on output data stream configuration settings.	\<Lanes\>… \</Lanes\>
Intersections / Intersection / Approaches / Approach / Lanes / Lane	XML element containing all information related to each lane within an approach. The number of lanes vary with each approach, although there must be at least one.	\<Lane\>… \</Lane\>
Intersections / Intersection / Approaches / Approach / Lanes / Lane / LaneID	Unique alpha-numeric identifier for the reported lane. This identifier should match the Lane identifier reported from Intersection Configuration Data exactly.	12345-1-1

Data Field	Data Description	Example Value
Intersections / Intersection / Approaches / Approach / Lanes / Lane / LaneTMCData	Comma-delimited list of numbers representing a specific list of data values. These values are summed and are associated with the specified lane. The reported values are updated every processing period. However, the data field indexes do not change. Table 25 describes each value in this number array by data field index.	2,9,0,40,1058, 1500,100,0,17,8,35,2, 2,0,0.8123,2
Intersections / Intersection / Approaches / Approach / Lanes / Lane / TMCClass	XML element containing turn movement count (TMC) data. Note that this may not be reported depending on output data stream configuration settings.	<TMCClass>… </TMCClass>
POTENTIALLY OPTIONAL		
Intersections / Intersection / Approaches / Approach / Lanes / Lane / TMCClass / Through	Comma-delimited list of numbers representing a specific list turn movement count values for traffic traveling straight through an intersection. The reported values are updated every processing period. However, the data field indexes do not change. Table 26 describes each value in this number array by data field index.	2,0,1,1,0,0,0,0,0
Intersections / Intersection / Approaches / Approach / Lanes / Lane / TMCClass / Right	Comma-delimited list of numbers representing a specific list turn movement count values for traffic turning right in an intersection. The reported values are updated every processing period. However, the data field indexes do not change. Table 26 describes each value in this number array by data field index.	2,0,1,1,0,0,0,0,0
Intersections / Intersection / Approaches / Approach / Lanes / Lane / TMCClass / Left	Comma-delimited list of numbers representing a specific list turn movement count values for traffic turning left in an intersection. The reported values are updated every processing period. However, the data field indexes do not change. Table 26 describes each value in this number array by data field index.	2,0,1,1,0,0,0,0,0

Data Field	Data Description	Example Value
Intersections / Intersection / Approaches / Approach / Lanes / Lane / TMCClass / UTurn	Comma-delimited list of numbers representing a specific list turn movement count values for traffic making U-turns at an intersection. The reported values are updated every processing period. However, the data field indexes do not change. Table 26 describes each value in this number array by data field index.	2,0,1,1,0,0,0,0,0

Table 25 describes the integer data array reported within the TMCData XML file. ***Note that if the reported value is less than zero, that field should be interpreted as having no data.*** At any reported time period, there may be any number of fields reporting no data. All fields in Table 25 are reported as integers, with a range of 0 to 32,767 for valid values or less than zero for invalid values, except for Peak Hour Factor. Peak Hour Factor is reported as a decimal with a range of 0 to 1 and up to four decimal places for valid values and less than zero for invalid values.

ITSIQA outputs different TMCData per output data stream and the exact contents of the TMCData may differ per output data stream. The following options are available, configurable per output data stream:

> ➤ *Exclude No Data Intersections*: When selected, ITSIQA-configured intersections that have not received any data for a reporting period will not be reported.
> ➤ *Exclude TMC Lanes*: When selected, Lane-level data will not be reported. This includes Lane TMC data and Lane-level Classification data.
> ➤ *Exclude TMC Classification*: When selected, Lane-level Classification data will not be reported.

Table 33: Turning Movement Count Data Indexes

Data Field Index	Data Field Name	Data Description	Example Value
0	**Total Volume**	Total number of vehicles to travel the intersection as reported. *Note: Total Volume may not equal the sum of Through, Right, Left, and UTurn Volumes if turning volumes are not available from the intersection data source.*	2
1	**Green Occupancy**	Seconds of time in which vehicles occupied the lanes during the green light.	9

Data Field Index	Data Field Name	Data Description	Example Value
2	Red Occupancy	Seconds of time in which vehicles occupied the lanes during the red light.	0
3	Speed	Reported speed of traffic in miles per hour.	40
4	Flow Rate	The calculated flow rate of traffic.	1058
5	Saturation Flow Rate	The calculated saturation flow rate of traffic.	1500
6	Percent Arrival on Green	Percentage of vehicles arriving in the specified zone during the green light of that minute's increment.	100
7	Percent Arrival on Red	Percentage of vehicles arriving in the specified zone during the red light of that minute's increment.	0
8	Green Time	Time in seconds when the green light was active.	17
9	Yellow Time	Time in seconds when the yellow light was active.	8
10	Red Time	Time in seconds when the red light was active.	35
11	Underutilized Green	Reported calculation for underutilized green time in seconds.	2
12	Count Arrival on Green	Equal to the Total Volume (index 4) times Percent Arrival on Green (index 10) divided by 100.	2
13	Count Arrival on Red	Equal to the Total Volume (index 4) times Percent Arrival on Red (index 11) divided by 100.	0
14	Peak Hour Factor	The result of the following formula: Total Volume at the Peak Hour over past 24 hours divided by 4 times the volume at the largest 15-minute period within the peak hour.	0.8548
15	Right Turn on Red	Volume of vehicles in allowable Right turn lane when light is red.	2

Table 26 describes the integer data array reported within the TMCData XML file containing turn movement counts. All four turning types – through, right, left, and U-turn – use the same format. See Table 26 for details of this format. Note that if classification data is not available per turning movement, the total volumes of all bins will not match the Total Volume value. ***Note that if the reported value is less than zero, that field should be interpreted as having no data.*** All fields in Table 26 are reported as integers, with a range of 0 to 32,767 for valid values or less than zero for invalid values.

Table 34: Classification Turning Movement Count Data Indexes

Data Field Index	Data Field Name	Data Description	Example Value
0	**Total Volume**	The total number of vehicles reported for a specific turning type. The turning type is dictated by the parent XML element.	2
1	**Classification Volume – Bin1**	The number of vehicles reported within classification Bin1 per turning movement.	0
2	**Classification Volume – Bin2**	The number of vehicles reported within classification Bin2 per turning movement.	1
3	**Classification Volume – Bin3**	The number of vehicles reported within classification Bin3 per turning movement.	1
4	**Classification Volume – Bin4**	The number of vehicles reported within classification Bin4 per turning movement.	0
5	**Classification Volume – Bin5**	The number of vehicles reported within classification Bin5 per turning movement.	0
6	**Classification Volume – Bin6**	The number of vehicles reported within classification Bin6 per turning movement.	0
7	**Classification Volume – Bin7**	The number of vehicles reported within classification Bin7 per turning movement.	0
8	**Classification Volume – Bin8**	The number of vehicles reported within classification Bin8 per turning movement.	0

FDOT District 5 has standardized the reporting of vehicle classification bins. This configuration is performed within the vehicle detector controller. Classifying a vehicle is based on vehicle length. The FDOT District 5 standard for reporting vehicle classifications is outlined in Table 35.

Table 35: Classification Bins Per Vehicle Length

Classification Bin	Minimum Vehicle Length	Maximum Vehicle Length
Bin1	0 Feet	10 Feet
Bin2	Greater Than 10 Feet	24 Feet
Bin3	Greater Than 24 Feet	54 Feet
Bin4	Greater Than 54 Feet	*No Maximum*
Bin5		*Not Used*
Bin6		*Not Used*

Classification Bin	Minimum Vehicle Length	Maximum Vehicle Length
Bin7	*Not Used*	
Bin8	*Not Used*	

5.8   ITSIQA to C2C Output

The ITSIQA to C2C plug-in operates as a separate service, transforming the ITSIQA output into standard C2C formats and pushing them into one or more C2C Providers. The ITSIQA to C2C plug-in is configured via the ITSIQA Administrative Editor. Primary application settings are configurable within the System Settings tab. The configuration of C2C Provider(s) is/are within the Data Output Streams tab. Each Data Output Stream can be configured with a separate C2C Provider. The ITSIQA to C2C plug-in reads each Data Output Stream ITSIQA and pushes this data to the C2C Provider associated with the Data Output Stream. See Figure 19 depicting how the plug-in fits into the overall functionality.
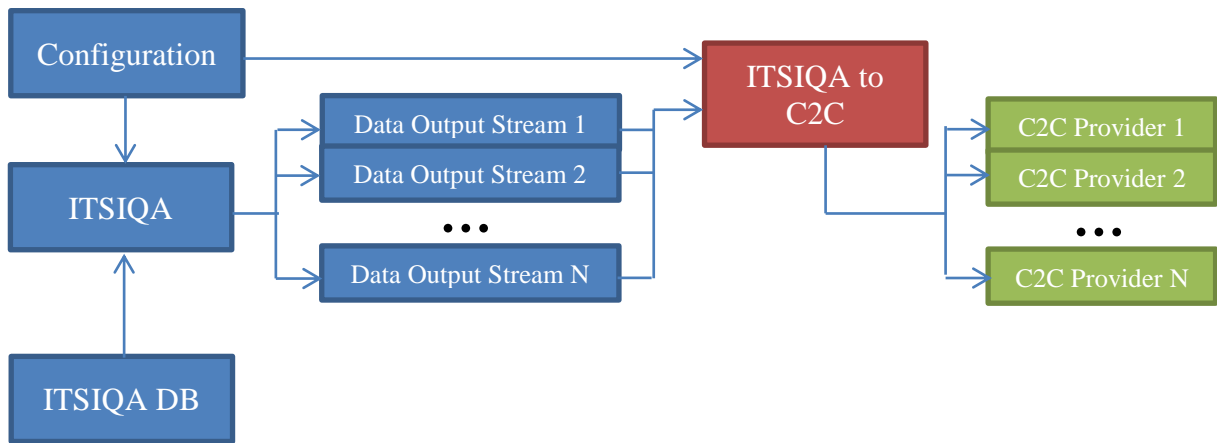

Figure 19: ITSIQA to C2C Plug-in Data Flow

The ITSIQA to C2C plug-in generates four C2C data types. Table 27 lists each of these data types and descriptions of each.

Table 36: ITSIQA to C2C Plug-in Data Types

C2C Data Type	Description
networkData	Contains nodes and links that define the roadway network for the Data Output Stream.
trafficCondData	Contains traffic status data including speeds and volumes. Data is reported by link, whose configuration is defined in networkData.
trafficDetail	Contains traffic status data, including speeds, volumes, occupancies, travel times, and quality values. Data is reported by link, whose configuration is defined in networkData, and by lane.

This document does not detail the individual fields within the types of data listed in Table 16. The ITSIQA to C2C plug-in conforms to C2C R7.0 data schemas. Details of these schemas are documented in C2C R7.0's documentation.