# Detailed Software Design

## ***ITSIQA***

## ***Intelligent Transportation Systems Integration Quality and Analysis***

**Version:** ***1.18***

**Approval date:** ***DRAFT***

| DOCUMENT CONTROL PANEL | | |
|---|---|---|
| File Name: | ITSIQA - Detailed Design - V1.18 - 2023-02-16.docx | |
| File Location: | | |
| Version Number: | 1.18 | |
| | **Name** | **Date** |
| Created By: | John Hope, AECOM | 12/19/2016 |
| | | |
| Reviewed By: | Natesh Kirpalani, AECOM | 8/23/2018 |
| | Clay Packard, VHB | 8/30/2018 |
| | Natesh Kirpalani, AECOM | 9/6/2018 |
| | John Hope. AECOM | 9/7/2018 |
| | Natesh Kirpalani, AECOM | 12/29/2018 |
| | | |
| | | |
| Modified By: | Natesh Kirpalani, AECOM | 12/12/2017 |
| | John Hope, AECOM | 1/26/2018 |
| | John Hope, AECOM | 6/22/2018 |
| | John Hope, AECOM | 7/13/2018 |
| | John Hope, AECOM | 8/23/2018 |
| | John Hope. AECOM | 8/30/2018 |
| | John Hope. AECOM | 9/5/2018 |
| | Natesh Kirpalani, AECOM | 9/6/2018 |
| | John Hope. AECOM | 9/11/2018 |
| | John Hope. AECOM | 10/11/2018 |
| | John Hope. AECOM | 10/31/2018 |
| | John Hope. AECOM | 12/29/2018 |
| | John Hope. AECOM | 4/24/2019 |
| | John Hope. AECOM | 10/16/2019 |
| | John Hope. AECOM | 10/29/2019 |
| | John Hope. AECOM | 1/24/2020 |
| | John Hope. AECOM | 3/10/2020 |
| | John Hope. AECOM | 4/6/2020 |

| | | |
|---|---|---|
| | John Hope. AECOM | 7/1/2020 |
| | John Hope. AECOM | 4/6/2021 |
| | John Hope, VHB | 12/5/2022 |

# Table of Contents

# List of Tables

# List of Figures

# 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 link-based traffic information via seven interfaces:
    a. BlueTOAD Interface (Internet-Accessible)
    b. Center-to-Center Software (FDOT-Hosted)
    c. Currux Interface (FDOT-Hosted)
    d. ITSIQA-to-ITSIQA Interface (Local Agency-Hosted)
    e. SunGuide Interface (FDOT-Hosted)
    f. Velocity Interface (Local Agency-Hosted)
    g. WAZE Interface (Interface-Accessible)
2. Receive real-time turning movement count-based information via four interfaces, all of which are FDOT-hosted:
    a. ATSPM Interface (Direct Database Querying)
    b. SunStore Interface
    c. Signal Controller Logs Interface
    d. ITSIQA-Hosted Turning Movement Count Interface
3. Perform quality checks and analysis on the traffic information
4. Report the cleaned data to multiple systems including the SunGuide Software

Figure 1 depicts a high-level description of ITSIQA.

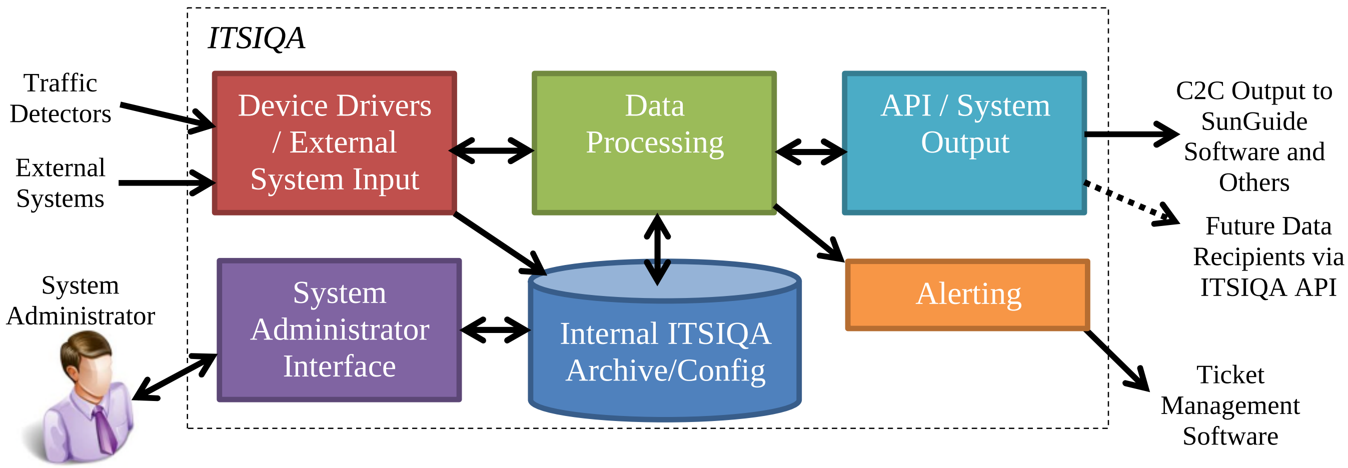



**Figure 1: High Level Description of ITSIQA**

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.

**Table 1: List of Documents Reviewed for ITSIQA Development**

| 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<br>Data Quality Calculations |
| **Travel Time Data Collection Handbook** | FHWA, Texas Transportation Institute | Mar-1998 | Error Checking<br>Data Reduction<br>Reporting |
| **Methods for Floating Car Sampling Period Optimization** | Journal of Transportation Systems Engineering and Information Technology<br>ITS Center, Wuhan University of Technology<br>School of Traffic and Transportation, Tongji University | Jun-2007 | Data Sample Period |
| **Guide to Establishing Monitoring Programs for Travel Time Reliability** | TRB<br>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<br>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<br>Incident Detection |
| **Measuring real-time traffic data quality based on floating car data** | ATEC ITS France Congress | Jan-2014 | Data Aggregation<br>Data Quality |

| Publication | Author / Publisher | Date | Useful Subject Matter |
|---|---|---|---|
| **Quality Management Methods for Real-Time Traffic Information** | 15th meeting of the EURO Working Group on Transportation<br>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<br>Data Quality<br>Arterial Travel Time |
| **Use of Multiple Data Sources for Monitoring Mobility Performance** | FDOT Transportation Statistics Office | Jan-2015 | Data Quality<br>segment mapping |
| **Data Fusion Based Hybrid Approach for the Estimation of Urban Arterial Travel Time** | Journal of Applied Mathematics | Jul-2012 | Arterial Travel Time |
| **Comparison of Methods for Measuring Travel Time at Florida Freeways and Arterials** | FDOT Systems Planning Office | Jul-2014 | Roadway Segment Correlation<br>Data Accuracy |
| **REGIONAL TRANSPORTATION DATA WAREHOUSE – Phase I, II, III** | Texas Transportation Institute | Aug-2008 | Data Aggregation<br>Data Quality<br>Data Filtering<br>Data Fusion<br>Data Warehousing |
| **Classifiers and Distance-Based Evidential Fusion for Road Travel Time Estimation** | Laboratoire d'Ingénierie Circulation Transports<br>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<br>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 7.2 Software.

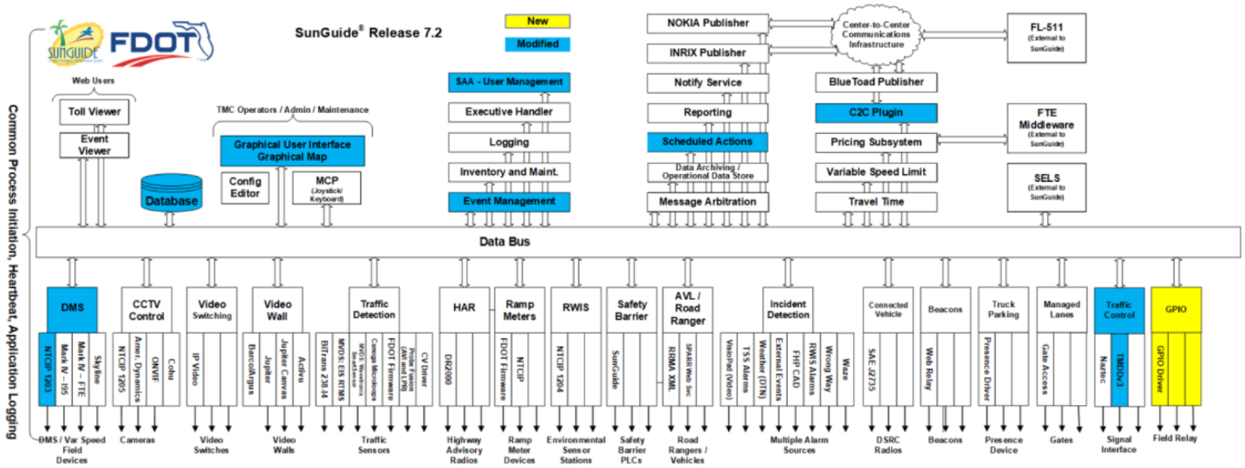



**Figure 2: SunGuide Release 7.2 Software Design Diagram**

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.

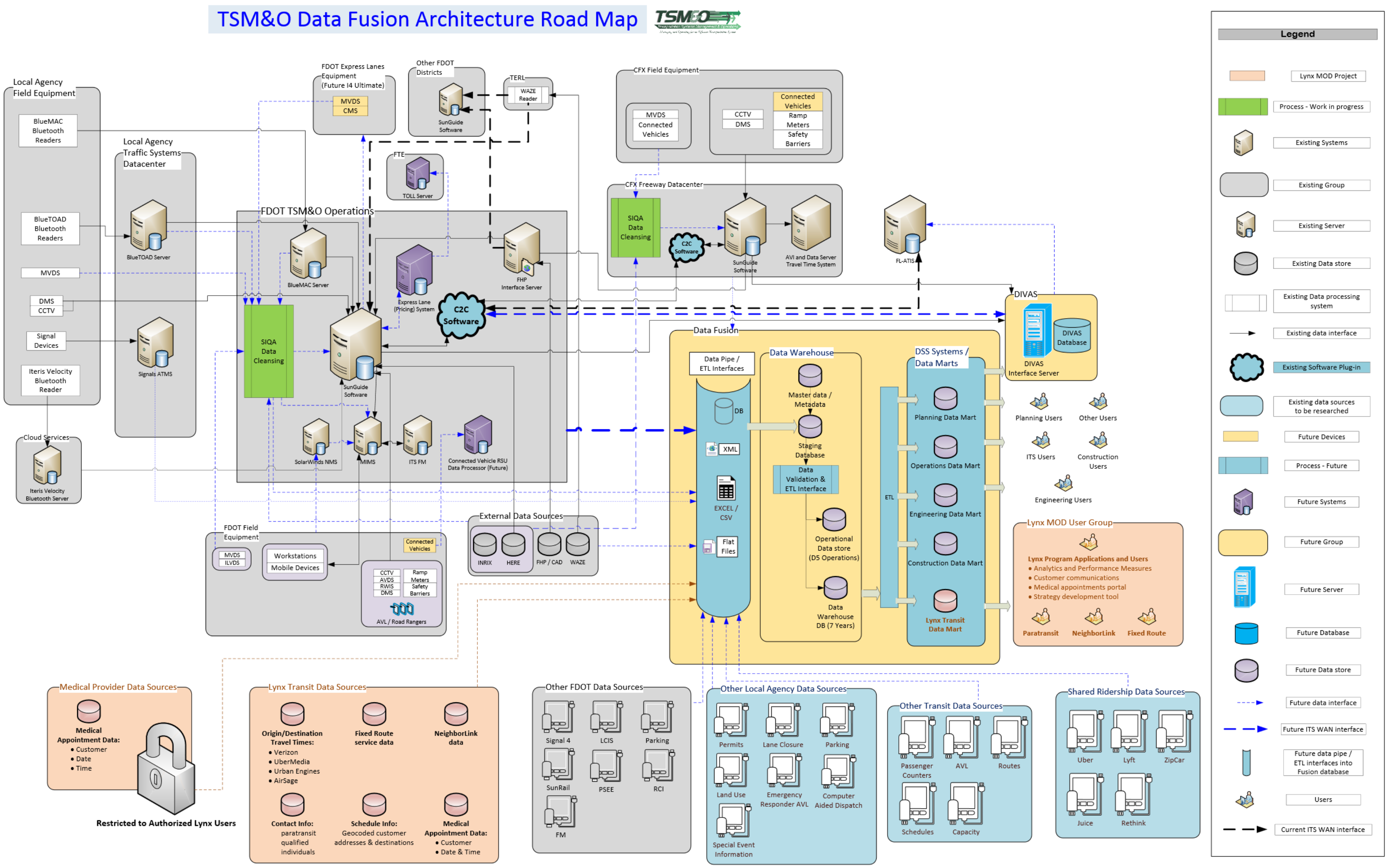



**Figure 3: TSM&O Data Fusion Architecture Road Map**

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 Functionality

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.

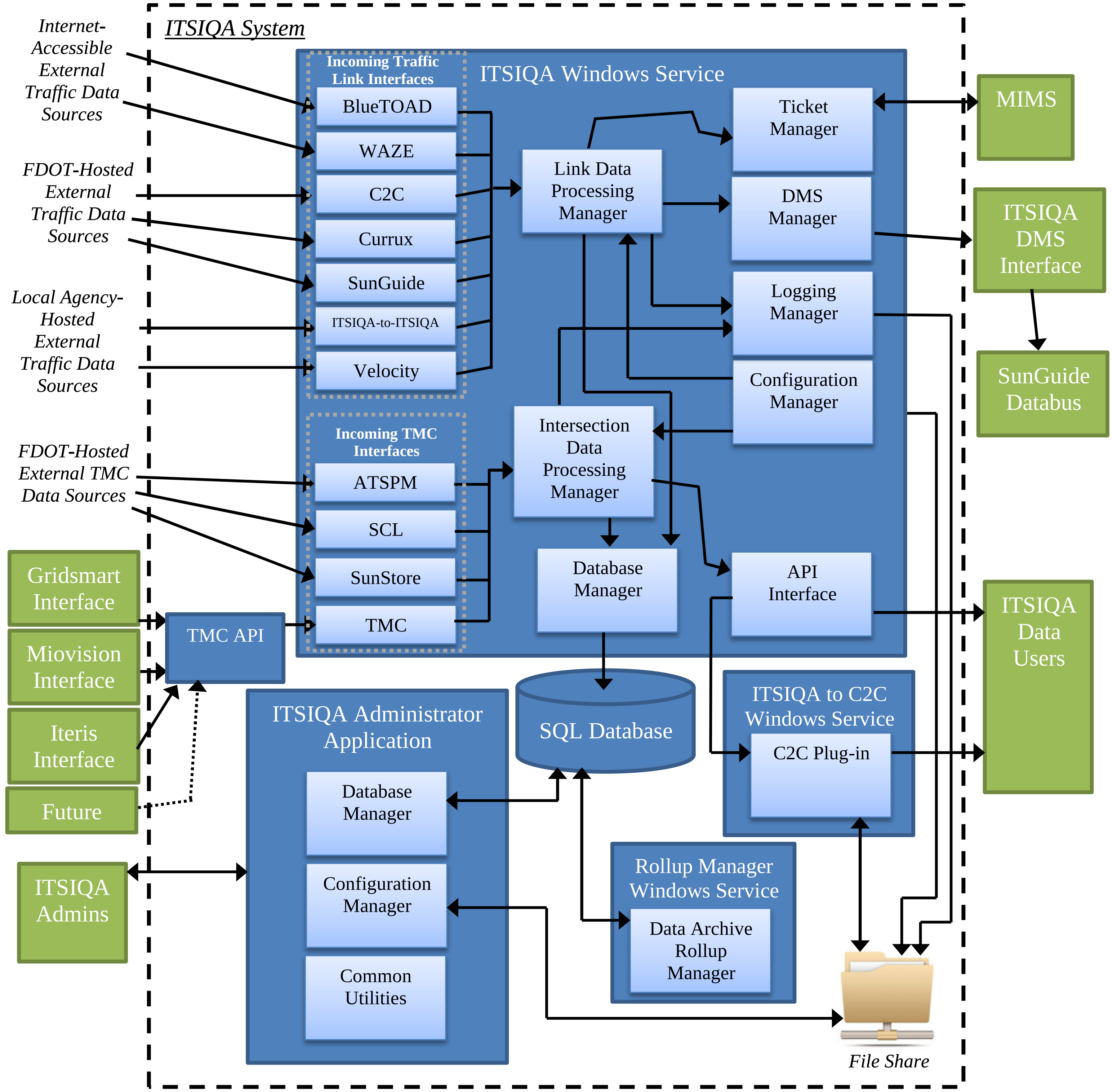



**Figure 4: ITSIQA Detailed Software Design**

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 |
| **Process Data From Now** | When the ITSIQA starts, this flag indicates if the first timestamp should be now, per the server system clock. If a different starting time/date is desired, this should be set to False and Process From Date should be set. This is typically always set to True unless ITSIQA is processing archived data. | True |
| **Process From Date** | Date from which data will be processed. This indicates the first date of the in-coming data. This parameter is only used when the Process Data From Now parameter is set to False. | 1/1/2020 |
| **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 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **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 |
| **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 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **Use Occupancy to Weight Speed** | When enabled, links reporting higher occupancy will be given preference over links reporting lower occupancy, and links reporting zero for occupancy will not be used at all. When disabled, links are weighed based on the length of the link. | True |
| **Persist Super Link Data (minutes)** | If a data for a Super Link cannot be calculated due to lack of valid data, ITSIQA will continue to report the previous-reported data for the Super Link for this number of minutes. Once this number of minutes has passed, the Super Link will report no data. Once data can be calculated again, the clock resets. | 10 |
| **Cap Speeds of Each Super Link Links** | When enabled, reported speeds for each ITSIQA link that comprise a super link will be capped at the super link's configured speed limit before overall super link calculations are made. For example, if a super link with a configured speed limit of 70 MPH is configured with link A and link B, and link A is reporting a speed of 80 MPH and link B is reporting 40 MPH, when this flag is disabled, the average speed limit for the super link would report (80 + 40) / 2 = 60 MPH. When this flag is enabled for the same reported values, the super link would first cap link A to 70 MPH and report (70 + 40) / 2 = 55 MPH. | True |
| **Enable Super Link Logging** | When enabled, ITSIQA will log additional Super Link information. | True |
| **Contiguous Congestion Link Count** | A Super Link is flagged for congestion when this number of links are flagged for congestion. The links must be contiguous. | 2 |
| **Distance Between Congestion (in miles)** | If groups of congested links are this number of miles apart, ITSIQA will consider the congestion to be the same group of congestion. | 5 |
| **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 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **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 |
| **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 |
| **Enable Traffic Data Output** | When enabled, Traffic Data is written to the ITSIQA output. If traffic data is not be processed by ITSIQA, this should be disabled. This value must be either True or False. | True |
| **Enable Classification Data Output** | When enabled, Classification Traffic Data is written to the ITSIQA output. If traffic data is not be processed by ITSIQA, this should be disabled. This value must be either True or False. | True |

| Configuration Field | Description | Example Value |
|---|---|---|
| **Enable Super Link Data Output** | When enabled, Super Link Data is written to the ITSIQA output. If traffic data is not be processed by ITSIQA, this should be disabled. This value must be either True or False. | True |
| **Enable TMC Data Output** | When enabled, TMC data is written to the ITSIQA output. If TMC data is not to be processed by ITSIQA, this should be disabled. This value must be either True or False. | True |
| **Enable Link Association Output** | When enabled, ITSIQA will write all link associations to a log file. Link associations may be a large data set. Writing of this file, consequently, could take minutes to complete, which would delay processing of data. This flag is typically only set to True if administrators are troubleshooting a link association issue. Otherwise, it is recommended that this flag is disabled. This value must be either True or False. | False |
| **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 |

| Configuration Field | Description | Example Value |
| --- | --- | --- |
| **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 |
| **Days of TRAFFIC INFO** | The number of days of data that ITSIQA will archive processed ITSIQA data in the ITSIQA database. | 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 |
| **Give Up Processing Time (seconds)** | The number of seconds ITSIQA will take to process incoming SunGuide data. If it takes longer than this time, ITSIQA will stop processing SunGuide data and continue processing all other data. The data not processed is discarded. | 30 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **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 |
| **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 |
| **TSS Archive Data Mode** | When enabled, ITSIQA will not only request detector configuration data from SunGuide and not detector status data. Detector speed, volume, and occupancy data will be retrieved from archive TSS text files, specified in the TSS Archive Data Path. Once all files specified within TSS Archive Data Path are read and processed, ITSIQA will no longer process data until the ITSIQA process is restarted. This value must be either True or False. | False |

| Configuration Field | Description | Example Value |
|---|---|---|
| **TSS Archive Data Path** | This is the file path of the TSS archive data files that ITSIQA will read when TSS Archive Data Mode is set to True. This path can contain any number of TSS archive data files. ***Files must be named using the following format in order to be read***: "TSS-MMDDYYYY—1.dat" – where MM is the two-digit numeric month value, DD is the two-digit day, and YYYY is the four-digit year. Files in this archive that are not named in this format will not be processed. | C:\Archive |

**Table 5: ITSIQA Input Interface Configuration Settings**

| Configuration Field | Description | Example Value |
|---|---|---|
| **Enabled** | When enabled, ITSIQA will connect to and ingest data from one or more externally-host ITSIQA systems. This value must be either True or False. | True |
| **ITSIQA Input List** | Comma-delimited list of external ITSIQA systems. Each item in this list comprises of the network name of the external ITSIQA system (which must be unique to all ITSIQA systems) and the file path where the external ITSIQA system writes its link configuration and traffic data. The network name and file path must be separated by a colon. See example. | Name1:\\1.1.1.1\, Name2:\\1.1.1.2\ |
| **Configuration Interval (in minutes)** | Interval in minutes of how often link configuration is read and processed by ITSIQA. This value must be a positive integer greater than 0. | 1440 |
| **Oldest Valid Data (in seconds)** | The number of seconds old traffic data will be accepted from an external ITSIQA system. If the external ITSIQA's data is more than this number of seconds, all traffic data from this source is ignored. This value must be a positive integer greater than 0. | 300 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **Use Batch Script** | When enabled, ITSIQA will copy link configuration and traffic data files from configured external ITSIQA systems to a local path using a batch script before processing. The copied files are stored temporarily and are overwritten every processing period. Otherwise, data is read directly from the configured path without first copying the file. | False |

**Table 6: Velocity Interface Configuration Settings**

| Configuration Field | Description | Example Value |
|---|---|---|
| **Enabled** | When enabled, ITSIQA will connect to and ingest data from a Velocity system. This value must be either True or False. | True |
| **Detector Config URL File Path** | Full URL file path of the Velocity-written file that specifies detector configuration. Path must be use HTTP and must specify the expected Velocity detector XML file. | http://1.1.1.1/ detetorfile.xml |
| **Read Detector Config Interval (in hours)** | Interval in hours of how often detector configuration is read and processed by ITSIQA. This value must be a positive integer greater than 0. | 24 |
| **Travel Time Data URL File Path** | Full URL file path of the Velocity-written file that specifies link configuration and travel time status data. Path must be use HTTP and must specify the expected Velocity travel time XML file. | http://1.1.1.1/ TTfile.xml |
| **Default Quality Values** | Comma-delimited list of Velocity networks and the default quality values used for each. Each item in the list must include the name of the network (which should be unique within ITSIQA), an equal sign (=), and the default quality value (which should be an integer between 1 and 10). See the example. A network with the value of DEFAULT will be used for all networks unless otherwise specified. | DEFAULT=5, OsceolaCo=10 |

**Table 7: ITSIQA DMS Handler Configuration Settings**

| Configuration Field | Description | Example Value |
|---|---|---|

| Configuration Field | Description | Example Value |
|---|---|---|
| **Enabled** | When enabled, ITSIQA will connect to and push DMS message data to SunGuide. When disabled, ITSIQA will not push DMS message data. 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 |
| **SunGuide Center ID** | Center ID of the SunGuide system to which ITSIQA is connecting. | District 5 |
| **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 |
| **Min Success Percentage (0 to 100)** | | |
| **Report TT Range** | When enabled, configured DMS travel time messages will be reported as a range of minutes. When disabled, travel times are reported as a single integer number. This value should be either True or False. | False |

| Configuration Field | Description | Example Value |
|---|---|---|
| **TT Range (minutes)** | When a Report TT Range is enabled, travel times will be reported as a range. This value defines the travel time range in minutes. The calculated travel time is used as the lower number. The upper number is the calculated travel time plus this configurable value. | 2 |
| **Message Priority** | DMS message sent to SunGuide will use this message priority. | 250 |
| **Message Duration (seconds)** | DMS messages sent to SunGuide will set to expire in this number of seconds. | 300 |
| **Message Header** | The DMS message header to be appended to all DMS configured to receive a message header. | [pb][cf] |
| **Default Message** | Message sent to enabled DMS signs when no valid travel time data can be calculated. If no message is desired to be sent when no valid travel time data can be calculated, this value should have no characters. | DIAL 511 |
| **Message Owner** | The name specified in the SunGuide MAS queue who owns the travel time messages provided by ITSIQA. This is used by SunGuide operation staff to keep track of messages posted to DMS. | ITSIQA |
| **Congestion Message Owner** | The name specified in the SunGuide MAS queue who owns the congestion messages provided by ITSIQA. This is used by SunGuide operation staff to keep track of messages posted to DMS. | ITSIQA Congestion |
| **Minimum From Distance (in miles)** | When composing a DMS congestion message, this is the minimum distance in miles from the DMS to the start of the congestion. If the start of the congestion is less than this distance from the DMS, then “From Distance Alternative Text” is reported rather than reporting the number of miles from the congestion. This value must be a positive integer greater than 0. | 1 |
| **Minimum Congestion Travel Time (minutes)** | A congestion message is not produced by a DMS unless the minimum congestion travel time is met for a list of links that have been flagged as having congestion. This value must be a positive integer greater than or equal to 0. When 0 is configured, this criterion is not used. | 4 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **From Distance Alternative Text** | This text is reported if the Minimum From Distance (in miles) is not met. This can be any text reportable from the DMS. | AHEAD |
| **From Distance Suffix** | When a distance from the DMS to the congestion is reported, this text is appended to the calculated number of miles ahead. | MI AHEAD |
| **Max Age of ITSIQA Data (seconds)** | This is the expiration age of all DMS messages posted to SunGuide. If ITSIQA does not update a DMS before this expiration is met, SunGuide will remove the ITSIQA-produced travel time message. | 600 |
| **Update Messages Interval (seconds)** | The frequency in seconds how often DMS messages are updated. | 60 |
| **Active DMS File Name and Path** | Full file path of the active DMS messages to be pushed to SunGuide. | \\1.1.1.1\ ActiveDMS.xml |
| **Read Active DMS File On Interval** | When enabled, the ITSIQA DMS Windows service will update DMS travel time messages on a timed interval. Otherwise, the message will only be updated when ITSIQA completes its processing and generates a new Active DMS file. | True |
| **Interval to Read Active DMS File (seconds)** | When the ITSIQA DMS Windows service is configured to push DMS messages on a timed interval, this is the interval in seconds. Value must be a positive integer greater than 0. | 60 |
| **Read Active DMS File Seconds Offset** | When the ITSIQA DMS Windows service is configured to push DMS messages on a timed interval, messages will be pushed this number of seconds past the minute on the system clock. For example, if this value is set to 50 and the Read Active DMS File On Interval is set to 60, then DMS messages will be updated at 1:00:50 AM, 1:01:50 AM, 1:02:50 AM, 1:03:50 AM, etc. This value must be an integer ranging from 0 to 59. | 50 |
| **Detail Logging** | When enabled, detailed information about the DMS messages being produced and pushed to SunGuide is logged. This value should be either True or False. | False |

**Table 8: ITSIQA C2C Input Interface Configuration Settings**

| Configuration Field | Description | Example Value |
|---|---|---|

| 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:<br><br>{Network ID}={Quality Value}<br><br>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.<br><br>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:<br><br>Net1=9,Net2=7, DEFAULT=10<br><br>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 9: 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 types of detection that ITSIQA should read within the ATSPM event codes. These detection types are defined within the ATSPM database. ITSIQA can process two types of ATSPM data, Advanced and Stopbar. Configuration must be in the format:<br><br>{DetectionType}={DetectionTypeValue}<br><br>The only value Detection Types are: Advanced and Stopbar. The Detection Type Values must be integers and match the ATSPM-reported Detection Type Values. One or more Detection Types can be listed in this configuration value. Each set of Detection Types must be separated by a comma. | Advanced=2, Stopbar=6 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **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 |
| **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 |
| **Through Only Pct (integer percent)** | The percent of vehicles that should be distributed to lanes based on the turn type of Through Only. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100. | 50 |
| **Through-Right or Through-Left Pct (integer percent)** | The percent of vehicles that should be distributed to lanes based on the turn type of Through-Right or Through-Left. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100. | 30 |
| **Right Only or Left Only Pct (integer percent)** | The percent of vehicles that should be distributed to lanes based on the turn type of Right Only or Left Only. The sum of all turn type weights should be 100. This field must have a value ranging 0 to 100. | 20 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **Generate Data for Right Turn Only** | When enabled, ITSIQA will generate data for right turn only lanes based on a data distribution configuration. See Data Inputs / ATSPM Interface for more information about this distribution. This value must be either True or False. | True |

**Table 10: 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 |
| **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 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **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 |
| **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 |

| Configuration Field | Description | Example Value |
|---|---|---|
| **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:<br><br>{ROAD}:{Tickets/NoTickets}<br><br>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:<br><br>I-95:Tickets,I-4:NoTickets<br><br>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 11: 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 12: 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 13: 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 14: 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 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.

The tables below describe each of the ATSPM database tables that ITSIQA queries in order to determine the intersection configuration and calculate vehicle volumes data.

**Table 15: ATSPM Detectors Table**

| Data Field | Data Description | Example Value |
|---|---|---|
| **ID** | The unique integer identifier for the detector, with a range 1 to 2,147,483,647. | 5 |
| **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 16: 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, | US-17/92 Northbound |

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

**Table 17: 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 | SR-423 |

| | | |
|---|---|---|
| | roadway on which vehicles travel through the intersection according to the configured approach direction, as specified in the Approaches – Description field. | |
| **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 intersection. | -81.307422 |
| **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 18: 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 19: 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 | 2 |

| | | |
|---|---|---|
| | interpreted as the LaneID. Consequently, this field is interpreted as the reported LaneID and should match the Detectors – DetChannel field exactly. | |
| **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 clock on the ITSIQA server. | 8/1/2018 12:42:17 PM |
| **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 |

#### 5.3.1.1 ATSPM Data Flow

ITSIQA reads ATSPM data directly from the ATSPM database, evaluated, distributed to configured lanes, and reported from ITSIQA. The following figure depicts the steps in which turning movement count data passes through ITSIQA. Note that ITSIQA give preference to data reported through the TMC Interface. If no per lane volumes are reported for a given intersection via the TMC Interface, then ATSPM per lane volumes and generated right turn only volumes are reported. Otherwise, ATSPM per lane volumes and generated right turn only volumes are ignored and TMC Interface per lane volumes are reported.

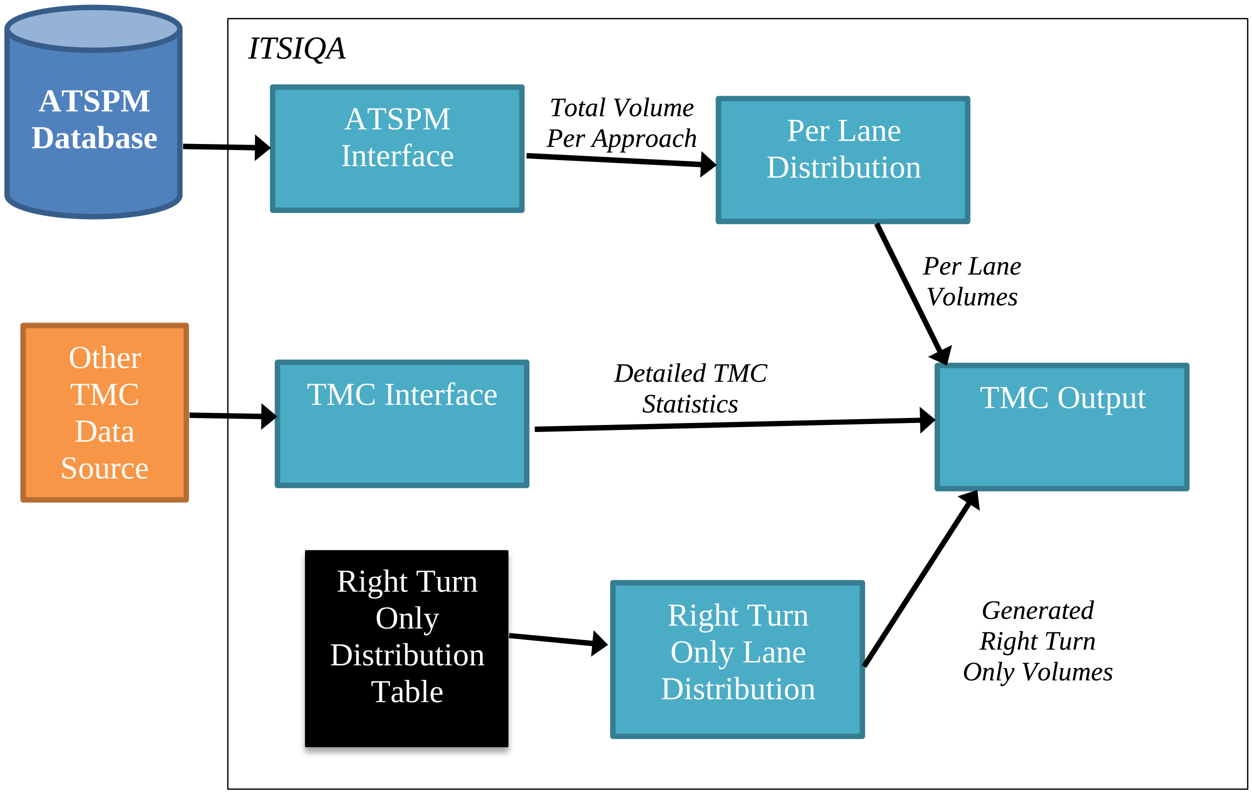



**Figure 5: Turning Movement Count Data Flow**

### 5.3.1.2 Reading and Distributing Volumes

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 has been captured.

Volumes are captured for both advanced and stopbar detectors. Once every 15 minutes, ITSIQA compares the total number of vehicles reported for advanced detectors for a given approach with total number of vehicles reported for stopbar detectors for the same approach. ITSIQA will use the greater of the two and continue to do so until the volumes are reevaluated 15 minutes later.

ITSIQA sums all vehicles for all lanes and redistributes the total vehicle volumes to the approach lanes depending on the configured lane distribution configuration. This lane distribution is based on the possible configured turning movement of each lane, which includes one of the following:

- Through Only
- Through-Right or Through-Left or Left-Through-Right
- Right Only or Left Only

A configured percentage is used for each of the three categories listed above. The sum of these percentages must equal 100. For example, consider the following percentages:

- Through Only: 50%
- Through-Right or Through-Left or Left-Through-Right: 30%
- Right Only or Left Only: 20%

If a total volume for all lanes is 10, then 5 of the 10 will be distributed to the Through Only lanes, 3 of the 10 will be distributed to the Through-Right and Through-Left lanes, and 2 of the 10 will be distributed to the Right Only and Left Only lanes. Consider the following example approach configuration below. For these lane configurations and the percentages previously given, for a total volume of 10 vehicles, the following volumes would be applied. Note that since there are two Through Only lanes, the total volume of 5 is distributed across Lane 2 and Lane 3.

| ***Lane*** | ***Possible Turning Movement*** | ***Reported Volume*** |
|---|---|---|
| Lane 1 | Left Only | 2 |
| Lane 2 | Through Only | 3 |
| Lane 3 | Through Only | 2 |
| Lane 4 | Through-Right | 3 |

### 5.3.1.3 Right Turn Only Data Generation

Traffic volume detection may not be available for right turn only lanes. As such, ITSIQA can generate volumes for lanes configured as right turn only. Data generation is based off a per-hour distribution table. This table is maintained in a comma-delimited file with one row per hour of the day. The table below describes each field in this file.

**Table 20: Right Turn Only Data Distribution Configuration Parameters**

| Data Field | Data Description | Example Value |
|---|---|---|
| **Hour** | Hour of the day, ranging from 12:00 AM to 11:00 PM, in which the row’s data distribution parameters are used to calculate the generated data. The span of time starts at this hour and ends 59 minutes and 59 seconds later. For example, an hour of 12:00 AM spans from 12:00:00 AM to 12:59:59 AM. | 12:00 AM |
| **Weekday Release Rate** | The average number of vehicles reported per minute on weekdays. Value must be a non-negative decimal value less than 100. | 0.04990002 |
| **Weekend Release Rate** | The average number of vehicles | 0.04990002 |

| | | |
|---|---|---|
| | reported per minute on weekends. Value must be a non-negative decimal value less than 100. | |
| **Minimum Volume Per Minute** | The minimum number of vehicles reported per minute. Value must be a non-negative integer less than 100. | 0 |
| **Maximum Volume Per Minute** | The maximum number of vehicles reported per minute. Value must be a non-negative integer greater than the minimum volume per minute and less than 100. | 9 |

#### 5.3.1.4 Reading Latency

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.

### *5.3.2 BlueTOAD Interface*

BlueTOAD uses vehicle probe-based technology to calculate and report travel time information. BlueTOAD devices are organized by BlueTOAD networks. ITSIQA requests detector and link configuration and travel time information from one or more BlueTOAD-hosted servers, each server potentially hosting a separate BlueTOAD network. The following diagram describes the data flow of BlueTOAD data into ITSIQA.

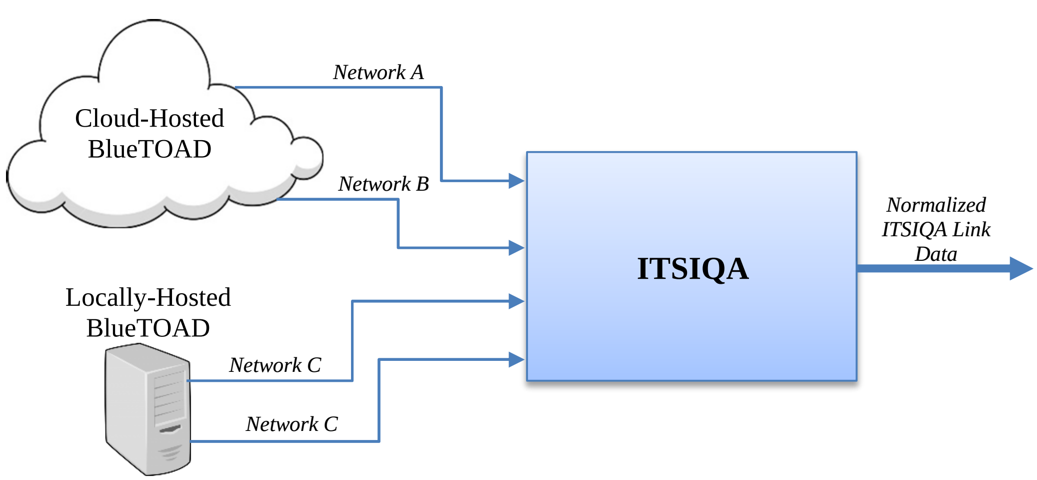



**Figure 6: BlueTOAD Data Flow**

Each BlueTOAD network is configured individually within ITSIQA configuration. Each specify a separate URL, with a BlueTOAD-defined username and password. Multiple BlueTOAD networks may be reported from the same URL endpoint as long as a different username and password are used. ITSIQA treats each BlueTOAD network as a separate source of data, leveraging the existing data normalization and consolidation functionality already built into ITSIQA. As such, each BlueTOAD network can be assigned a different data quality confidence value. If all BlueTOAD networks are set to the same data quality confidence value, then all data would be weighted equally while averaging overlapping links.

The following table provides details of the ITSIQA configuration of the BlueTOAD networks.

**Table 21: BlueTOAD Network Configuration**

| Data Field | Data Description | Example Value |
|---|---|---|
| **NetworkID** | The unique identifier for the BlueTOAD network. This is a ITSIQA-defined value that does not have to correspond with names or IDs defined in BlueTOAD. ITSIQA administrators should choose an identifier here that is different for each BlueTOAD network. | SemCoBT |
| **URL** | URL of the server hosting BlueTOAD for this network. | https://bluetoad.trafficcast.com |
| **Schema** | HTTP schema used for communication with BlueTOAD's hosting server. | https:// |
| **Domain** | Domain used for communication with BlueTOAD's hosting server. | bluetoad.trafficcast.com |
| **Username** | BlueTOAD-defined username for BlueTOAD network. | user |
| **Password** | Password for BlueTOAD-defined username. | password |

ITSIQA reads in three different XML feeds from each BlueTOAD network. They include the following:

- **Locations.xml**: This contains the configuration of latitude/longitude locations of each BlueTOAD detector.
- **Pairings.xml**: This contains the configuration of roadway links. Each link uses a start and end BlueTOAD detector, which are defined in the Locations configuration file.
- **TTData.xml**: This contains the reported travel time and speed information for each roadway link, as defined in the Pairings configuration file. This file is assumed to be updated once per minute.

The following tables describe the fields within each of the three BlueTOAD XML files that are read and utilized by ITSIQA.

**Table 22: BlueTOAD Locations XML File**

| Data Field | Data Description | Example Value |
|---|---|---|
| **DeviceID** | The unique numeric identifier for the BlueTOAD detector. Value should be a positive integer between 0 to 2,147,483,647. | 2415443 |
| **DeviceTitle** | Human-readable name of the BlueTOAD detector. Note that the name of the roadway must be included within this field. See Mapping BlueTOAD Roadways and Direction below for details to how the roadway name is interpreted and used within ITSIQA. | SR 46 & I-4 (u1591448) |
| **Coordinates** | Latitude/Longitude coordinate where the BlueTOAD detector is physically located. The format of this field should include a pair of decimal numbers separated by a single comma, the first number indicating the latitude value and the second number indicating the longitude value. Both values are assumed to be in degrees. ***Note that in order for the ITSIQA link association to function properly, it is assumed that detectors and their given*** | 28.811320, -81.339860 |

| | | |
|---|---|---|
| | ***locations are within 0.1 miles of the roadway in which they are detecting.*** | |

**Table 23: BlueTOAD Pairings XML File**

| Data Field | Data Description | Example Value |
|---|---|---|
| **PairID** | The unique numeric identifier for the roadway link on which BlueTOAD is calculating and reporting travel time data. Value should be a positive integer between 0 to 2,147,483,647. | 26748 |
| **Pairing** | Human-readable name of the roadway link. | SR 436 & SR 434 (u1034) to SR 434 & Sand Lake (u1419) - NB |
| **Distance** | The length of roadway link in miles. Value should be positive a decimal value larger than zero and no more than 2,147,483,647. | 1 |
| **Direction** | Indicator of direction of travel for traffic being detected. Value values include the following: NB, SB, EB, WB, NEB, NWB, SEB, SWB. See Mapping BlueTOAD Roadways and Direction below for details to how direction is used within ITSIQA. | NB |
| **OriginDeviceID** | Numeric ID of the device at the upstream end of the roadway link. This value must be reported as the DevceID in the Locations XML file, otherwise this link is ignored. | 12345 |
| **DestinationDeviceID** | Numeric ID of the device at the downstream end of the roadway link. This value must be reported as the DevceID in the Locations XML file, otherwise this link is ignored. | 12346 |

**Table 24: BlueTOAD TTData XML File**

| Data Field | Data Description | Example Value |
|---|---|---|

| | | |
|---|---|---|
| **PairID** | The unique numeric identifier for the roadway link on which BlueTOAD is calculating and reporting travel time data. Value must match the PairID reported in the Pairings XML file, otherwise this link is ignored. | 26748 |
| **Speed** | Reported speed for link in miles per hour. Value should be positive a decimal value between/including zero to 2,147,483,647. | 35 |
| **TravelTime** | Reported travel time for link in seconds. Value should be positive a decimal value between/including zero to 2,147,483,647. | 106 |

#### 5.3.2.1 Mapping BlueTOAD Roadways and Direction

A vital step in ingesting BlueTOAD data is properly mapping roadways and directions of reported links to ITSIQA links. This step is performed in two parts: 1) relating the reported roadway, and then 2) relating the reported direction.

In order to relate BlueTOAD-reported roadways, ITSIQA parses the roadway from the DeviceTitle field within the Locations XML file that BlueTOAD provides. The names of the roadways within this field are defined within BlueTOAD and do not necessarily match the names of the roadways within ITSIQA. Because they may not match, a mapping configuration file exists within ITSIQA, entitled the BlueTOAD Road Conversion configuration file. This file contains a list of BlueTOAD networks, and for each network there is a list of possible roadways. The following table explains the configurable parameters per possible roadway.

**Table 25: BlueTOAD Road Conversion Configuration**

| Data Field | Data Description | Example Value |
|---|---|---|
| **BTRoad** | The name of the roadway as reported from BlueTOAD. | SR 419 |
| **RoadName** | The name of the roadway as configured within ITSIQA. | SR-419 |
| **BiDirections** | The possible roadway link directions for this road. Valid values include: NS or EW. If the value is NS, then roadway will only accept links spanning north or south. If the value is EW, then roadway is | NS |

| | | |
|---|---|---|
| | will only accept links spanning east or west. | |

A BlueTOAD-reported link is assigned a roadway if the BTRoad (as defined in the Road Conversion configuration file) is matched for both the upstream and downstream BlueTOAD detectors. For example, if a reported link has an upstream detector DeviceTitle of “SR 434 & Wekiva Springs (u2166206)” and a downstream detector of “Sand Lake & SR 434 (u2163279)”, then the roadway that link would be located would be “SR 434” since this roadway is common between the two detectors. However, the link will only be processed if “SR 434” is included in the BlueTOAD Road Conversion configuration file.

After ITSIQA successfully maps a BlueTOAD-reported roadway, then it must determine the direction of travel. BlueTOAD links may be reported with one of eight possible directions, which include: NB, SB, EB, WB, NEB, NWB, SEB, SWB. The following table shows how ITSIQA maps the direction. Note that the first column “Direction Reported from BlueTOAD” is reported in the Pairings XML file from BlueTOAD. Note that the second column “Possible Directions for Roadway” is defined in the BlueTOAD Road Conversion configuration file.

**Table 26: Mapping of Direction from BlueTOAD to ITSIQA**

| Direction Reported from BlueTOAD | Possible Directions for Roadway | Mapped Direction |
|---|---|---|
| NB | NS | North |
| NB | EW | *Error, link not used* |
| SB | NS | South |
| SB | EW | *Error, link not used* |
| EB | NS | *Error, link not used* |
| EB | EW | East |
| WB | NS | *Error, link not used* |
| WB | EW | West |
| NEB | NS | North |
| NEB | EW | East |
| NWB | NS | North |
| NWB | EW | West |
| SEB | NS | South |
| SEB | EW | East |
| SWB | NS | South |
| SWB | EW | West |

### *5.3.3 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 27: 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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 28: 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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |
| **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:<br>AVI-0408E-ConwayRd<br><br>From BrevCoBT:<br>BrevCoBT - US-192 EB from Wickham Rd to Dayton Blvd<br><br>From Others:<br>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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 29: 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 | |

### *5.3.4 Currux Interface*

ITSIQA requests traffic data from Currux via HTTP requests on a configurable pulling interval more frequently than the ITSIQA processing interval. By default, ITSIQA requests traffic data from Currux sites once every 20 seconds. For every pull, incoming volumes are summed so that when ITSIQA processes data on a one-minute interval, it processes a full 60 seconds of traffic volumes. All traffic speeds reported are averaged, weighing each average by volume—speeds reported with higher volumes are weighed more than lesser volumes. If a speed is reported with a volume of zero, the speed is ignored.

Each Currux site is polled separately, each site having a different URL. The failure of one site not responding or responding with an error does not affect the polls of other sites. The polls are performed in threaded processes and timeout after 60 seconds.

Currux data is reported in a JSON format. The following table describes the key fields that ITSIQA reads.

**Table 30: List of Data Fields Used from the Currux Volume Data**

| Data Field | Data Description | Example Value |
|---|---|---|
| **title_line** | The unique name of the travel lane reported. Value is normally given as a numeric value but is read by ITSIQA as alpha-numeric. | 3 |
| **count_vehicle** | The number of vehicles reported in the given travel lane. Value is a whole integer. | 7 |
| **speed** | The average speed in miles per hour reported in the given travel lane. Value is a whole integer. | 72 |

In order to correctly locate the Currux sites and interpret the name of the lane reported by Currux sites (reported as title_line), ITSIQA maintains a configurable list of sites and lanes. This configuration provides latitude/longitude information, the definition of the lane, roadway, and direction. The following table describes each configurable field.

**Table 31: Currux Site Configuration**

| Data Field | Data Description | Example Value |
|---|---|---|
| **Name** | The unique name of a Currux site. This value is only used for logging purposes, allowing ITSIQA administrators to easily distinguish the sites. | MT001_I-4_EB_@_Lee_Rd |
| **URL** | The URL used to poll Currux data for a specific Currux site. | http://something |
| **LaneMapping** | Provides a list of lane definitions. | <LaneMapping>… </LaneMapping> |
| **Lane** | Provides the definition of a single lane. | <Lane>… </Lane> |
| **Road** | The name of the roadway on which the reported lane is associated. This name must match the name of the roadway as defined within ITSIQA. | I-4 |
| **Direction** | The direction of traffic for the reported lane. The possible values include: Eastbound, Westbound, Northbound, or Southbound. | Eastbound |
| **LaneNumber** | The lane number for the given lane. Note that lanes are numbered from the median, | 1 |

| | | |
|---|---|---|
| | counting outward. So the lane nearest to the median should have a LaneNumber of 1. This value is a whole integer. | |
| **LaneName** | This is the name of the lane as reported from Currux. Note that this name must match the title_line field exactly. The value can be alpha-numeric but is typically an integer. | 4 |
| **Location** | Contains the physical location of the Currux site. Note that the accuracy of this location is critically important for ITSIQA to accurately associate the data to the ITSIQA base map data. | <Location>… </Location> |
| **Lat** | The latitude location of the Currux site. Value is a decimal number. | 26.5878859 |
| **Lng** | The longitude location of the Currux site. Value is a decimal number. | -81.0959289 |

### *5.3.5 ITSIQA Input Interface*

ITSIQA can ingest link-based traffic information from one or more external ITSIQA systems. The ITSIQA Input Interface is a one-way delivery of ITSIQA output data, which means the external ITSIQA can provide data without receiving it from the local ITSIQA system. However, if both ITSIQA system enable and configure their respective ITSIQA Input Interfaces, two-way sharing of data is possible.

To enable the ITSIQA Input Interface, ITSIQA systems interfacing with each other should be operating the same version of ITSIQA to avoid compatibility issues. ITSIQA software upgrades/modifications should be coordinated. However, ITSIQA do not have to be using the same mapping link configuration.

The ITSIQA Input Interface treats each external ITSIQA as a separate link network. The receiving ITSIQA must specify which Data Output Stream it desires and uses this as the network name. See the section in this document regarding Data Output Streams for more information about how this can be configured within the external ITSIQA system. The name of network within the local ITSIQA must match the name of the Data Output Stream of the external ITSIQA system exactly. Also, these names need to be unique per ITSIQA system. If external ITSIQA systems are using the same name of their available Data Output Stream, then these names need to be changed or new Data Output Stream(s) need to be created to avoid duplication of names.

Incoming data can be transmitted via one of two methods:

- ***Direct Copying of ITSIQA XML Files***: Copies XML files from configured URL.
- ***ITSIQA's Output WSDL***: Pulls data via HTTP requests.

Each external ITSIQA's data should only use one of the two methods listed above. However, if interfacing with multiple external ITSIQA systems, both methods could be used.

The following figure depicts a sample of how data flow may be configured to/from ITSIQA systems.

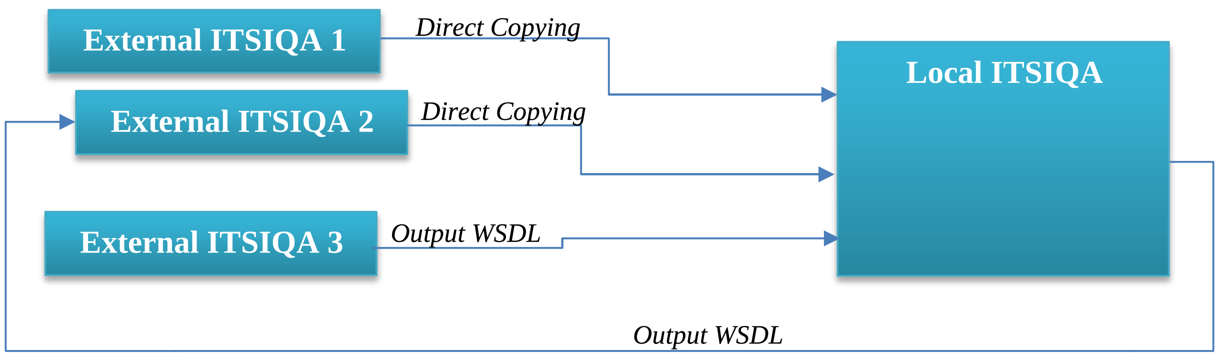



**Figure 7: Sample ITSIQA Input Interface Data Flow**

In the above sample ITSIQA Input Interface configuration, the local ITSIQA system is receiving link-based traffic data from three different external ITSIQA systems. The local ITSIQA system is directly copying the output XML files from two of these external ITSIQA systems, while requesting data from a ITSIQA output WSDL via HTTP requests from one external ITSIQA system. Additionally, one of the three external ITSIQA systems is also requesting ITSIQA output data from the local ITSIQA's output WSDL.

The ITSIQA Input Interface acquires two output XML files from external ITSIQA systems. These two files include:

- **LinkConfig.xml**: This file contains roadway link configuration information. The local ITSIQA system will request/copy and process this file on locally-configured interval, such as once per day.
- **TrafficData.xml**: This file contains the ITSIQA-generated traffic information, including speed, volume, and occupancy information as well as data quality values. The local ITSIQA system will request/copy and process this file once every processing period, which is typically set to once per minute. ***Note: External ITSIQA systems and the local ITSIQA system must be configured to use the same processing interval.***

### *5.3.6 Signal Controller Log Interface*

ITSIQA requests signal controller log information reported from an ATSPM system via its Signal Controller Log (SCL) Interface. ITSIQA interprets these signal controller logs to calculate and interpret turning movement counts. These counts are reported from ITSIQA via its TMC output. This output is reported in an XML format file, providing a list of logs for multiple signals, but not necessarily all signals. The XML requests are performed once per processing cycle (i.e. once per minute). Because not all signals are reported every reporting period, ITSIQA maintains a queue of incoming data and will report turning movement count data X minutes in the past—where the X is configurable within ITSIQA. By default, ITSIQA will report turning movement counts from 4 minutes ago.

Each signal controller log is reported as a ATSPM event. The event log includes an event code, signal ID, timestamp, and channel ID. ITSIQA filters out all codes except for the “Detector On” code (code 81) as defined in standard ATSPM documentation. Timestamps are used to queue incoming data, allowing ITSIQA to correctly select data 4 minutes ago. Therefore, the accuracy of timestamps reported are critically important. Signals should be time synched with the same (or equivalent) timing source as the server(s) hosting ITSIQA.

The signal ID issued to determine the ITSIQA-configured intersection. Signal ID and ITSIQA intersection IDs should match exactly, using the standard naming scheme: NNN-XXXX, where “NNN” is a three-character alpha-numeric value indicating the maintaining agency of the intersection and “XXXX” is a four-character numeric value indicating the signal controller ID.

The reported channel ID is used to determine the intersection’s approach. The mapping between channel IDs and approaches are maintained within ITSIQA’s database. If channel IDs change or signals are added/modified, ITSIQA’s approach configuration will need to be modified.

### *5.3.7 SunGuide Interface*

ITSIQA subscribes to detectorData, roadwayGeometryData, mapDetectorData, and linkPollData from SunGuide R7.2’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 32: 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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |
| **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 33: 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 |
| **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 34: SunGuide Detector Map Data (mapDetectorData)**

| Data Field | Data Description | Example Value |
|---|---|---|

| 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 |
| **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 35: 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 |

### *5.3.8 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.

### *5.3.9 SunStore Interface*

ITSIQA acquires HERE data from SunStore, an internally-hosted data warehousing and retrieval system. HTTPS requests with no credentials are sent to SunStore once per 5 minutes. SunStore replies with a JSON-formatted output containing the last 5 minutes of HERE data that has been archived within SunStore. ITSIQA maintains the speed data it receives, reusing it for multiple timeslices until the next SunStore request. Since ITSIQA processes data once per minute by default, the 5-minute SunStore data is reused for five timeslices. If ITSIQA fails to receive an update from one or more (or all) reporting HERE links after a request is made, then no HERE data will be used within ITSIQA until the next request.

The following table notes the key fields in the SunStore HERE output.

**Table 36: List of Data Fields Used from SunStore's HERE Output**

| Data Field | Data Description | Example Value |
|---|---|---|
| **key** | The unique identifier indicating the HERE TMC code which indicates the roadway link on which the speed data applies. Value is alpha-numeric with additional ASCII characters, typically in the format of | 102+10115 |

| | | |
|---|---|---|
| | "XXX+XXXXX" or "XXX-XXXXX" | |
| **AVGSpeed** | The current average speed in miles per hour of the given TMC roadway link. Value is provided as a decimal value ranging from 0 to 1000. | 47.6399965 |

The TMC Codes provided by SunStore's HERE output are defined in ITSIQA's database. ITSIQA maintains a version of the HERE base map and can be updated with an import of a different HERE base map, which includes TMC Codes, roadway, direction, start latitude, start longitude, end latitude, end longitude, and link length. As HERE data is reported from SunStore, ITSIQA matches the TMC Code with a code stored in ITSIQA's database in order to locate and associate the data within ITSIQA's base map data.

### *5.3.10 Velocity Interface*

Velocity uses vehicle probe-based technology to calculate and report travel time information. ITSIQA reads two specific files from Velocity, one includes detector configuration information and the other includes link configuration and travel time information. Each of these are read and processed on an ITSIQA-configurable interval. Both files are accessible to ITSIQA via an externally hosted website. ITSIQA downloads each file using Hyperlink Transfer Protocol (HTTP) with no user credentials. Both file names are statically defined in ITSIQA's system configuration. ITSIQA requests the same files each time, assuming that the Velocity software overwrites these files upon update. The detector configuration file is read on an interval configured within ITSIQA. The travel time file is read once per minute.

The following tables provide details of the data within these two files that are applicable to ITSIQA.

**Table 37: List of Data Fields Used from Velocity**

| Data Field | Data Description | Example Value |
|---|---|---|
| **id** | The unique identifier for the detector. This identifier must match the identifiers provided in the travel time link file provided by Velocity. | CypressPkwy_DMS |
| **latitude** | The latitude location of the detector given in degrees. | 26.5482844 |
| **longitude** | The longitude location of the detector given in degrees. | -81.5805637 |

**Table 38: List of Travel Time Link Data Fields Used from Velocity**

| Data Field | Data Description | Example Value |
|---|---|---|
| **system_id** | The unique identifier for the Velocity data. This identifier | OsceolaCounty |

| | | |
|---|---|---|
| | must be unique within ITSIQA compared to all other network identifiers processed within ITSIQA. | |
| **origin_id** | Identifier of the upstream detector for the given travel time link. This identifier must match the identifiers defined in the detector configuration file provided by Velocity. | CypressPkwy_DMS |
| **dest_id** | Identifier of the downstream detector for the given travel time link. This identifier must match the identifiers defined in the detector configuration file provided by Velocity. | PHill_Poinciana |
| **origin_roadway** | Name of the roadway for the given travel time link. | Cypress Pkwy |
| **origin_direction** | Direction of travel for the given travel time link. | Northbound |
| **segment_length_miles** | Length of reported travel time link reported in miles. | 1.1 |
| **timestamp** | Timestamp indicating when data was last updated, reported in local time. | 4/7/2021 9:03:25 AM |
| **travel_time** | Reported travel time in seconds. | 126 |
| **speed_mph** | Reported travel speed in miles per hour. | 60 |

### *5.3.11 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 below describe the data received from FDOT CO's WAZE interface.

**Table 39: 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. This represents the average length of the stretch of roadway when traveled by a vehicle. | 0.97 |
| **county** | The county to which the link belongs. Valid values are county names listed in Table 17. | 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 40: 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.

## *5.4 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. The figure below depicts the database design for the master roadway network.

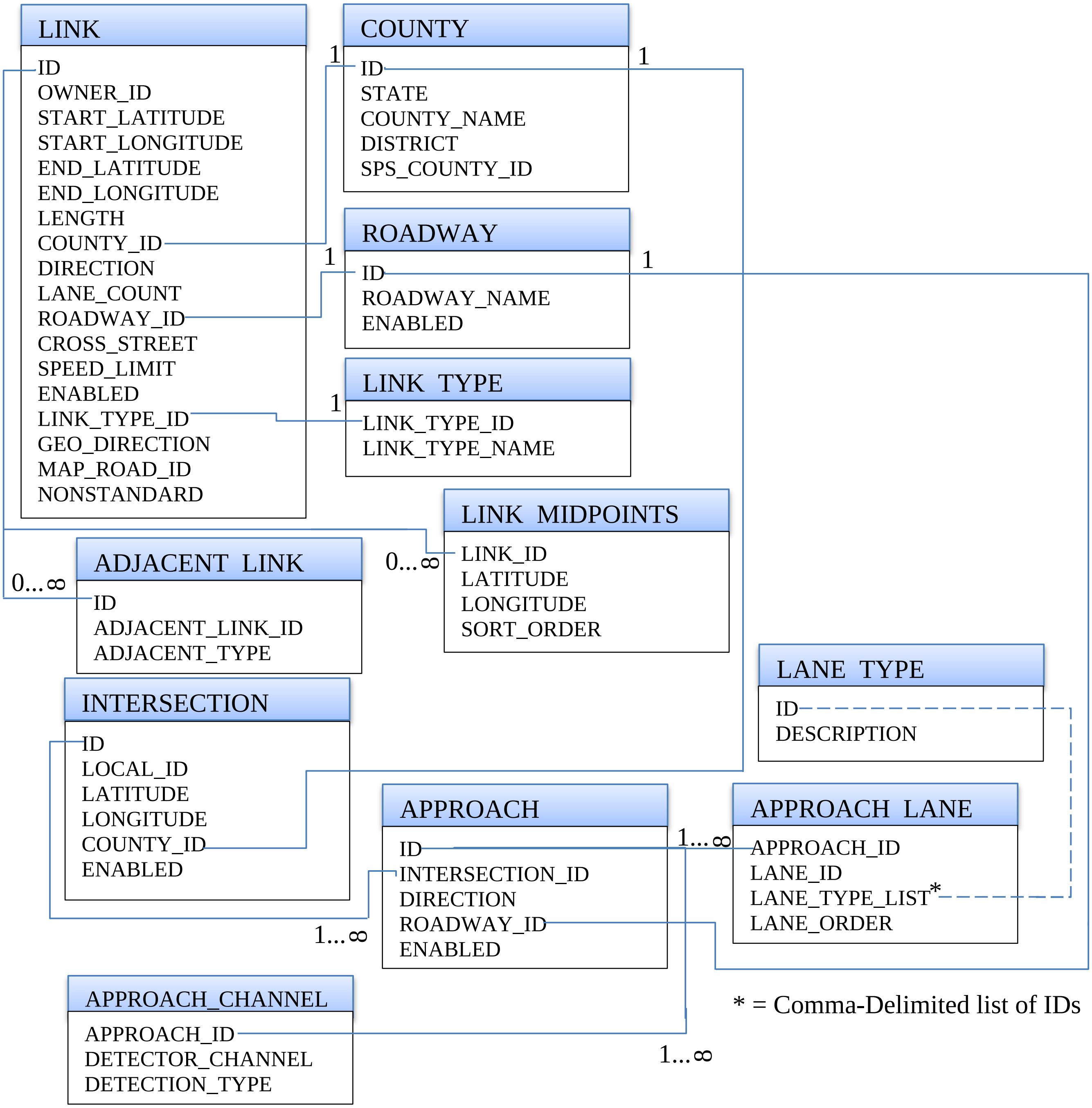


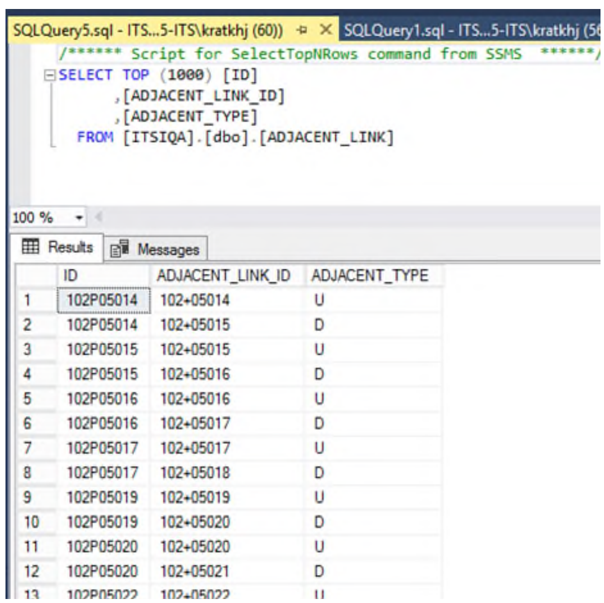

**Figure 8: ITSIQA Master Roadway Network Database Design**

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.




```
/****** Script for SelectTopNRows command from SSMS ******/
SELECT TOP (1000) [ID]
      ,[ADJACENT_LINK_ID]
      ,[ADJACENT_TYPE]
  FROM [ITSIQA].[dbo].[ADJACENT_LINK]
```

| | ID | ADJACENT_LINK_ID | ADJACENT_TYPE |
|---|---|---|---|
| 1 | 102P05014 | 102+05014 | U |
| 2 | 102P05014 | 102+05015 | D |
| 3 | 102P05015 | 102+05015 | U |
| 4 | 102P05015 | 102+05016 | D |
| 5 | 102P05016 | 102+05016 | U |
| 6 | 102P05016 | 102+05017 | D |
| 7 | 102P05017 | 102+05017 | U |
| 8 | 102P05017 | 102+05018 | D |
| 9 | 102P05019 | 102+05019 | U |
| 10 | 102P05019 | 102+05020 | D |
| 11 | 102P05020 | 102+05020 | U |
| 12 | 102P05020 | 102+05021 | D |
| 13 | 102P05022 | 102+05022 | U |

**Figure 9: Adjacent Link Table**

The Adjacent Link Table, as shown in the figure above, 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.

Once data is received from various inputs, Data Processing occurs in four phases:

1. Link Association Process
2. Data Filtering
3. Data Normalization
4. Summation and Calculation of Data

The following sections provides details of each of these four phases.

### 5.5.1 Link Association Process

The Link Association Processing is most the processing-intensive phase of Data Processing, and consequently takes the longest time to complete. This process logically associates roadway network links reported from external systems to ITSIQA's internal roadway network links. This process is performed automatically, but often requires configuration settings to be implemented to ensure the association process is successful.

The following diagram depicts the purpose of this process. Incoming data is reported using roadway links that likely are not aligned with the roadway links configured within ITSIQA. In the diagram below, links X, Y, and Z are reported from a data source, while links A, B, C, and D are configured within ITSIQA. Note that even though the two sets of links cover the same stretch of roadway, the starting/ending points of the corresponding links and the link lengths are not the same.

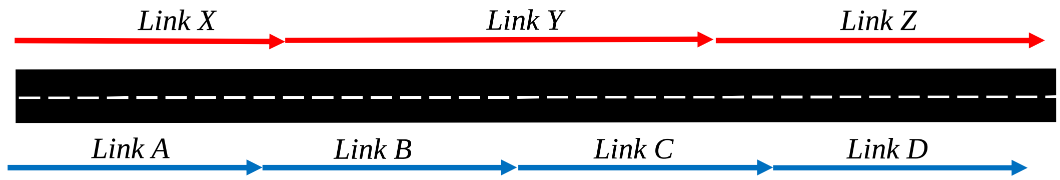



**Figure 10: Comparison of Incoming Links and ITSIQA Links**

In order for the link association process to successfully occur, the following criteria is required:

- The incoming links must report the correct direction of travel for all links, and this direction must be consistent with roadway's direction of travel.
- The incoming links must report a latitude/longitude value that is consist (compatible) with the latitude/longitude values for ITSIQA's mapping data.
- The incoming links must report a consistent name/identifier for the roadway that the links are on.
- ITSIQA must be configured to interpret the incoming links' roadway with ITSIQA's configured roadways.

For the last bullet above, there are Road Conversion configuration files for ITSIQA's incoming data interfaces. For example, for the C2C Interface, this configuration file provides the ability convert incoming roadways using one of two methods:

1. C2C Road Conversion Method 1: Numeric ID Definition. When SunGuide reports data via C2C, SunGuide provides a numeric identifier for their roadways. This method provides a mapping between these numeric identifiers and the roadway names defined within ITSIQA.
2. C2C Road Conversion Method 2: Parsing of Link Names. Several external systems use a standard naming convention when reporting links names. These names can be parsed using regular expressions defined in the ITSIQA configuration file to identify the roadway.

Once ITSIQA matches incoming links' roadway and direction of travel, latitude/longitude points are used to complete the link association process. The following steps are completed for each incoming link:

1. The incoming link's starting point is compared the starting point of all ITSIQA links that have the same roadway and direction as the incoming link. The closest starting point is determined.

2. The incoming link's ending point is compared the ending point of all ITSIQA links that have the same roadway and direction as the incoming link. The closest ending point is determined.

3. Take the link with the closest starting point and the link with the closest ending point and make a list of these two links and all links in between the two. For example, see the example below. Link X is an incoming link. Link X's starting point is closest to Link A's starting point. Link X's ending point is closest to Link C's ending point. The list created consists of Link A, B, and C.

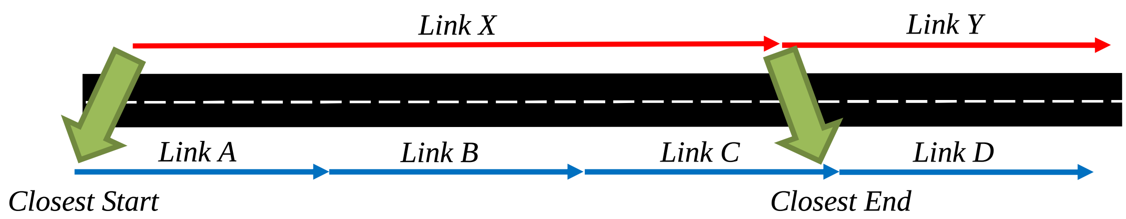



**Figure 11: Link Association of Incoming Links to ITSIQA Links**

4. Determine the percentage length of each of ITSIQA links in the list determined in the previous step (Step 3). These percentages are based on the geographic overlap of the ITSIQA link compared to the incoming link. In the example shown above, a high percentage (but not 100%) of Link A and Link C are used since a small fraction of each of these links do not overlap the incoming link. However, 100% of Link B is used since all of link is within the incoming link.

5. Determine the percentage length of the incoming link for each ITSIQA link. In other words, what percentage of the incoming link is overlapped by each ITSIQA link in the list of ITSIQA links determined in Step 3.

The link associations and their percentages determined in the steps above are used during the Summation and Calculation of Data phase of Data Processing.

Because the Link Association is so time-consuming, ITSIQA limits how many times this process occurs. This limit is configurable, but by default this occurs when the software is restarted and then once per day after that.

### *5.5.2 Data Filtering*

This phase of Data Processing 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.

Data Filtering is only performed for data reported from SunGuide. All other incoming data will skip this phase of Data Processing.

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 may 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.

If the checks result in the data quality to fall to zero, the associated links will not use the data reported from SunGuide for the offending detector. In this case, data reported from other data sources may be used instead, if reported.

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. ITSIQA will only create a new MIMS ticket if one doesn't already exist for the faulting detector. If one already exists, even if it was created for a different check, the ticket will be updated with a comment, noting the check that was flagged and the parameters that triggered the check.

### 5.5.3 Data Normalization

The Data Normalization phase of Data Processing ensures that the incoming data matches temporally with ITSIQA's reporting frequency. By default, ITSIQA processes data once every 60 seconds. Incoming data, however, may be available to ITSIQA a different interval. ITSIQA handles this temporal alignment in three different methods:

1. If incoming data is reported at the same interval as ITSIQA processing, no alignment is necessary. Data is process as it is reported.
2. If incoming data is reported LESS FREQUENTLY than the ITSIQA processing interval, travel time, speed, and occupancy data is maintained over the period when new incoming data is not available, while traffic volume data is divided over the incoming data's interval. In this case, travel time, speed, and occupancy are cached and the same values are processed within ITSIQA unless the data expires (configurable within ITSIQA). Volume data, however, is spread out over time so that the total volume reported is maintained. For example, if ITSIQA processes data every 60 seconds, a data source reports every 300 seconds, and that data source reports a speed of 60 MPH and a volume of 10, then for five minutes in a row, ITSIQA will process data from that data source for 5 sequential timeslices (300 seconds / 60 seconds = 5) with a speed of 60 MPH and a volume of 2 (10 vehicles / 5 timeslices = 2).
3. If the incoming data is reported MORE FREQUENTLY than the ITSIQA processing interval, travel time, speed, and occupancy are averaged prior processing, while volumes are summed prior to processing. For example, if ITSIQA processes data every 60 seconds and a data source reports every 30 seconds, then the data source will be reported twice for every ITSIQA processing interval. If that data source reports a speed of 60 MPH and a volume of 10 the first of these two times and a speed of 50 MPH and a volume of 5 the second time, then ITSIQA will use a speed of 55 MPH (60 MPH + 50 MPH / 2) and a volume of 15 (10 + 5 = 15) when processing data.

### 5.5.4 Summation and Calculation of Data

During the Link Association phase, each travel time link reported from each data source is associated with one or more ITSIQA master links, with percentages of each. During the Summation and Calculation of Data phase, the incoming data must be distributed to the ITSIQA master links and then summed or averaged together. Depending on the coverage of data from multiple data sources, any given ITSIQA master link may have any number of incoming links that feed it data. See the figure below.

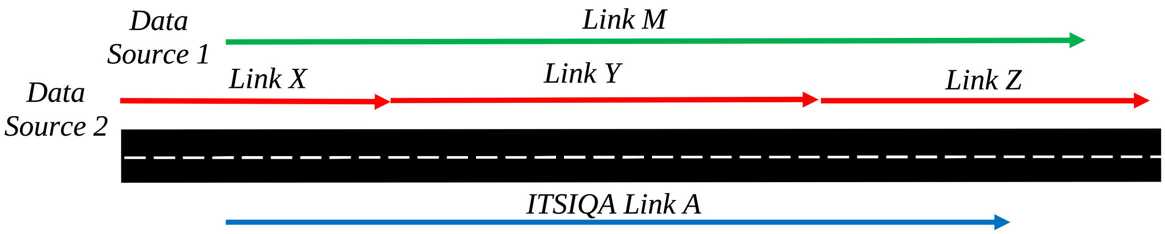



**Figure 12: Summation and Calculation Example**

In the example above, Link A is the ITSIQA master link. This link receives data from two data sources. Data Source 1 has one link, Link M, that provides data for the entire Link A. Data Source 2 has portions of three links—Link X, Link Y, and Link Z—that provide data for Link A. ITSIQA first averages data for all incoming links on a per data source basis based on percentages of the link lengths. So for the example above, Data Source 1 only has one link, so this one link is averaged against itself, i.e. its data does not change. Data Source 2, however, must average data from Link X, Link Y, and Link Z, weighing the data based on the percentages (determined during the Link Association phase) of each link's length.

Once the incoming links are consolidated to single average values, the data sources are combined. This combination is based on quality values of the incoming data. Quality values differ depending on the data source and data quality value alterations made during the Data Filtering phase. Formula used for this calculation includes the following:

$$\sum_{\substack{\text{Summation of All}\\ \text{Data Sources}\\ \text{within Data}\\ \text{Output Stream}}} \frac{\text{[(Reported Value) * (Quality Value of Reported Value)]}}{\text{[Sum of All Quality Values]}}$$

**Figure 13: Link Data Summation Formula**

For example, if Data Source 1 reports a speed of 60 MPH and has a data quality value for speed of 10, and Data Source 2 reports a speed of 50 MPH and has a data quality value for speed of 5, the resulting speed for the ITSIQA link is:

(60 MPH * 10 / 15) + (50 MPH * 5 / 15) = 56.667 MPH

Note that the resulting speed is closer to the reported speed from Data Source 1 (60 MPH) than the reported speed from Data Source 2 (50 MPH) because Data Source 1 has a higher data quality value for speed.

One final note: The summation of incoming data within phase is performed multiple times, once per data output stream. ITSIQA provides the ability to have multiple data output streams, each with a unique set of selected data sources. Consequently, at the end of this phase, there is a separate set of ITSIQA master links for each data output stream, each with resulting data sets that depend on how the data output stream is configured. This allows ITSIQA to output separate set of data per data output stream.

## *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 the figure below.

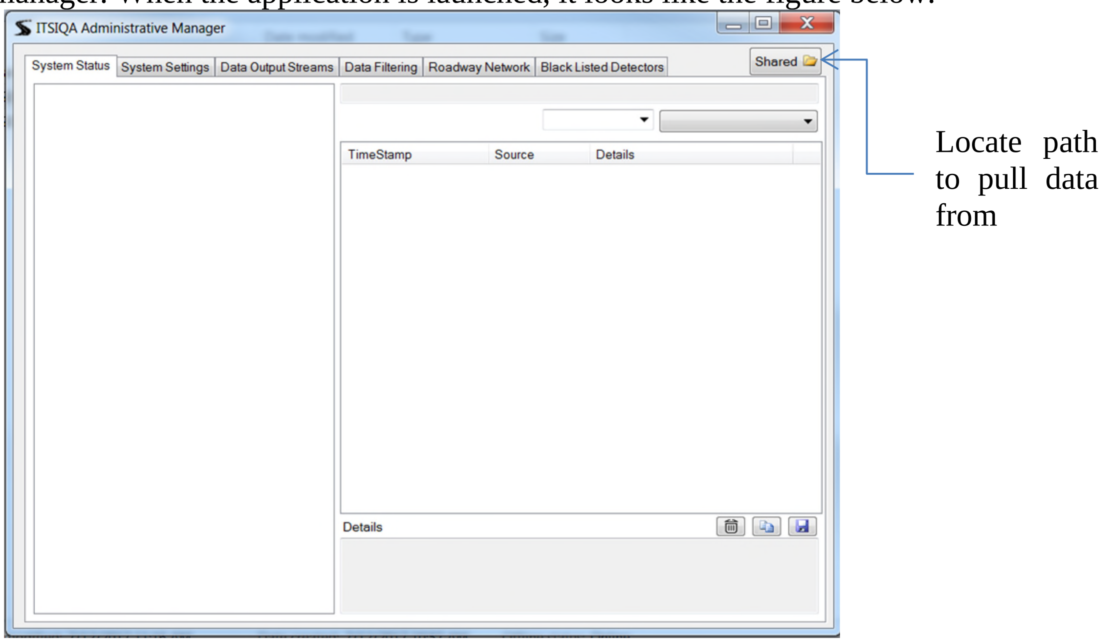



**Figure 14: ITSIQA Administrator Application**

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\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.

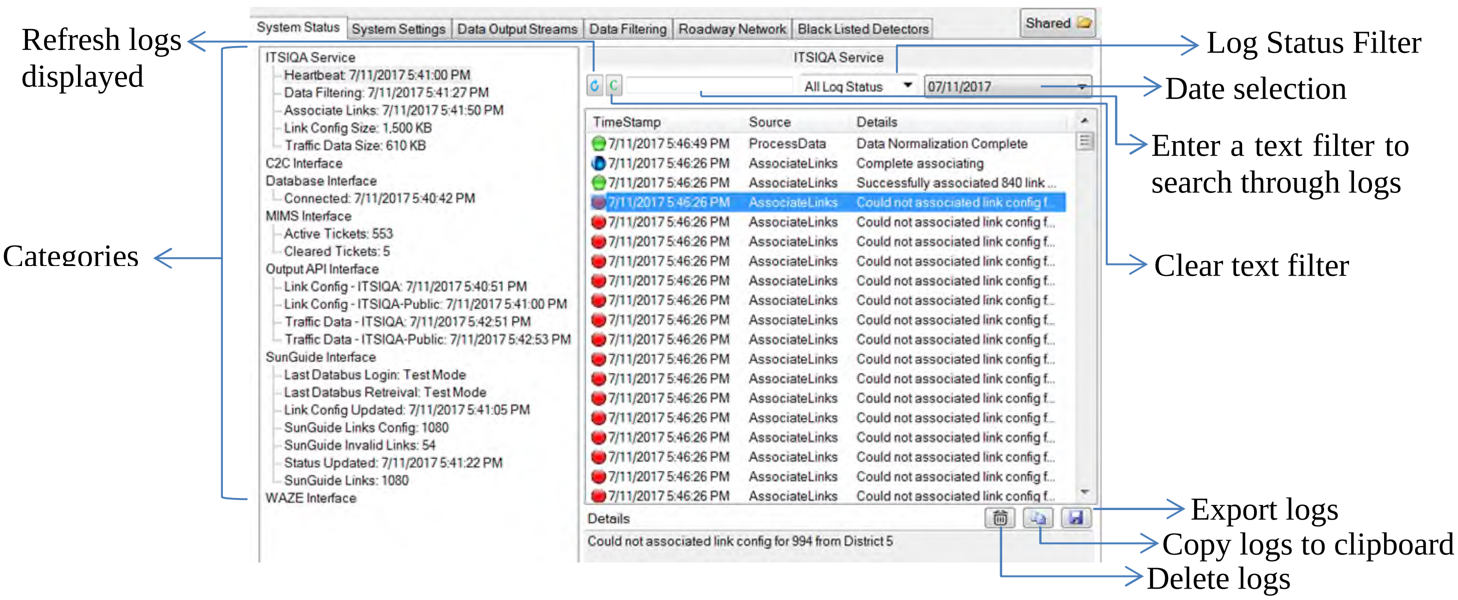



**Figure 15: System Status Page Description**

## 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.

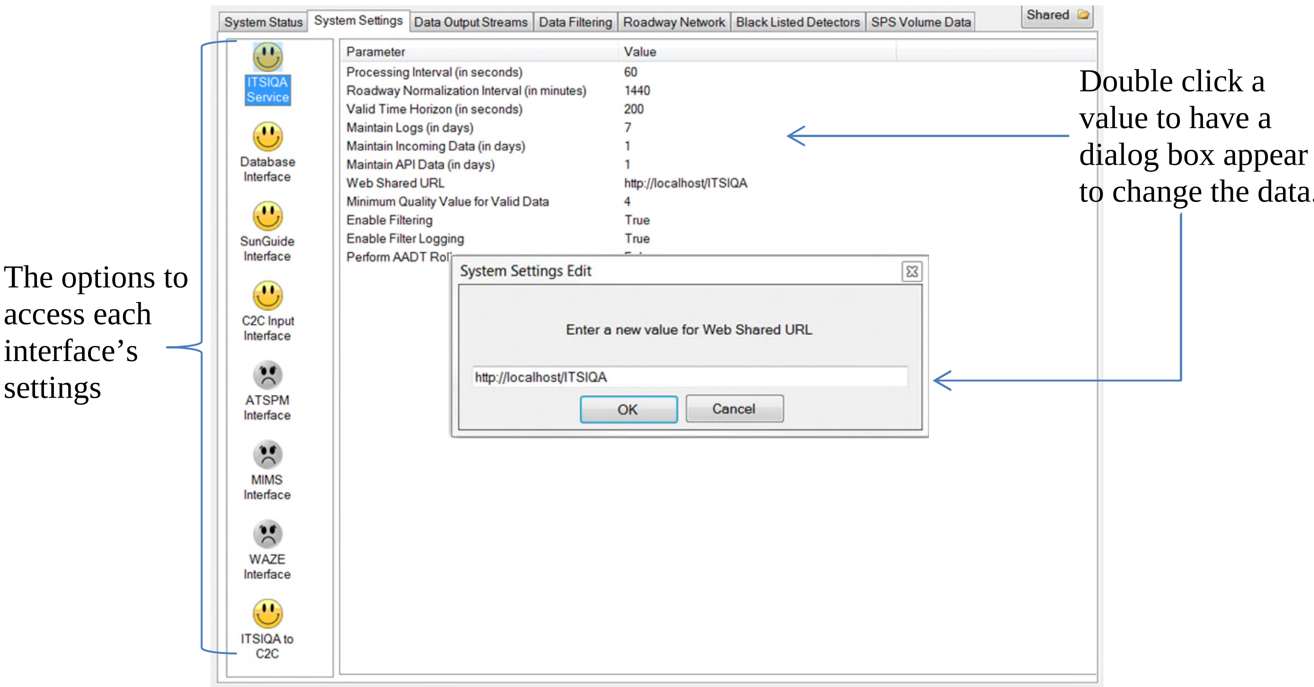



**Figure 16: System Settings Page Description**

## *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. Each Data Output Stream has a list of attributes that dictate how data should be fused and output.

For each Data Output Stream, one or more data inputs can be selected. Only the selected data inputs when consolidating and fusing the data together for each Data Output Stream.

Selected counties and roadways are used to filter which roadway links should be reported. If no counties are selected, all enabled links are reported from all counties. Likewise, if no roadways are selected, then all enabled links on all roads are reported. When one or more counties and one or more roads are selected, then reported links must be both located on the selected roadway and located within the selected county.

The Fusion Method may consist of one of two following methods:

6. **DQWeightedAverage**: With this fusion method, all selected data inputs will be averaged together, with preference given to each data inputs' data quality values. Initial data quality values are configured within system settings, C2C Input Interface settings, SunGuide Interface settings, and WAZE Interface settings. These values are modified depending on data filtering actions taken, if any.

7. **DQBasedSelection**: With this fusion method, only one selected data input will be used for a given link. ITSIQA will select the data input that is reporting valid data with the

highest data quality value. If the data input with highest data quality value is reporting no data or is not valid, then the data input with the next highest data quality value will be used.

The C2C Provider is the URL of the Center-to-Center Software Provider to where ITSIQA link data will be pushed. The C2C Super Provider is the URL of the Center-to-Center Software Provider to where ITSIQA super link data will be pushed. Note that super links are configured separately and consist of one or more ITSIQA-reported roadway links. These two Providers are 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.

Each C2C Provider can be configured with one or more Provide modes. These modes include:

1. **TrafficCondData**: When selected, ITSIQA links will be reported to the configured C2C Provider as trafficCondData type. This can be selected in combination with TrafficSpeedData and/or TrafficDetailData. See C2C documentation for more information about this data type.

2. **TrafficSpeedData**: When selected, ITSIQA links will be reported to the configured C2C Provider as trafficSpeedData type. This can be selected in combination with TrafficCondData and/or TrafficDetailData. See C2C documentation for more information about this data type.

3. **TrafficDetailData**: When selected, ITSIQA links will be reported to the configured C2C Provider as trafficDetailData type. This can be selected in combination with TrafficCondData and/or TrafficSpeedData. See C2C documentation for more information about this data type.

4. **TvTStatusData**: When selected, ITSIQA links will be reported to the configured C2C Provider as tvtStatusData type. When this is selected, TrafficCondData, TrafficSpeedData, nor TrafficDetailData cannot be selected. See C2C documentation for more information about this data type.

5. **Disabled**: When selected, ITSIQA will not push ITSIQA data to the selected C2C Provider.

The Restricted Use flag is a parameter reported via the Center-to-Center Software. When true, all reported data for the selected Data Output Stream will be flagged Restricted Use. Otherwise, no Restricted Use will be flagged.

Three parameters can be set per Data Output Stream indicating if certain intersection data should be reported. When Exclude Class is selected, then vehicle classification data will not be reported for the reported intersections. When Exclude Lanes is selected, then per lane vehicle counts will not be reported for the reported intersections. When Exclude No Data Int is selected, then intersection data that has no data for a given intersection will not be reported. Note that when this last parameter is selected, the data will be evaluated every minute that data is processed.

Consequently, for each minute, a different set of intersections may be reported depending on what data is currently available.

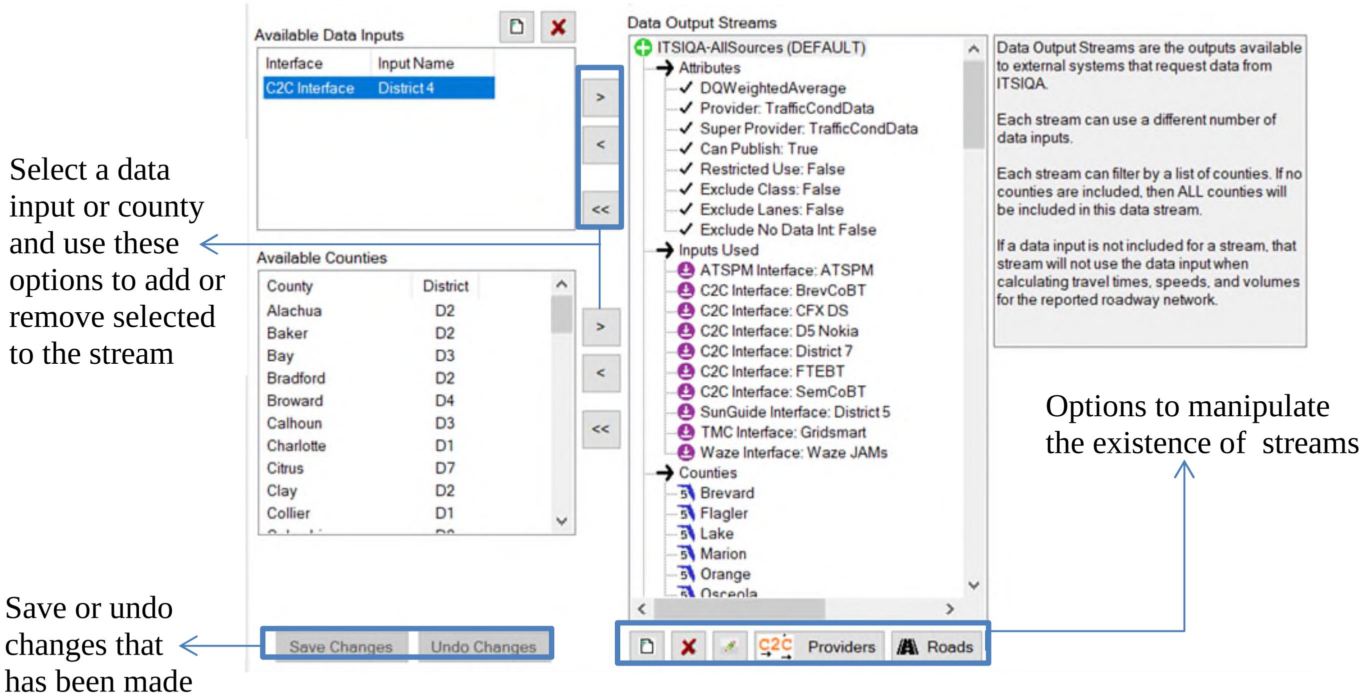



**Figure 17: Data Output Streams Page Description**

### *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.

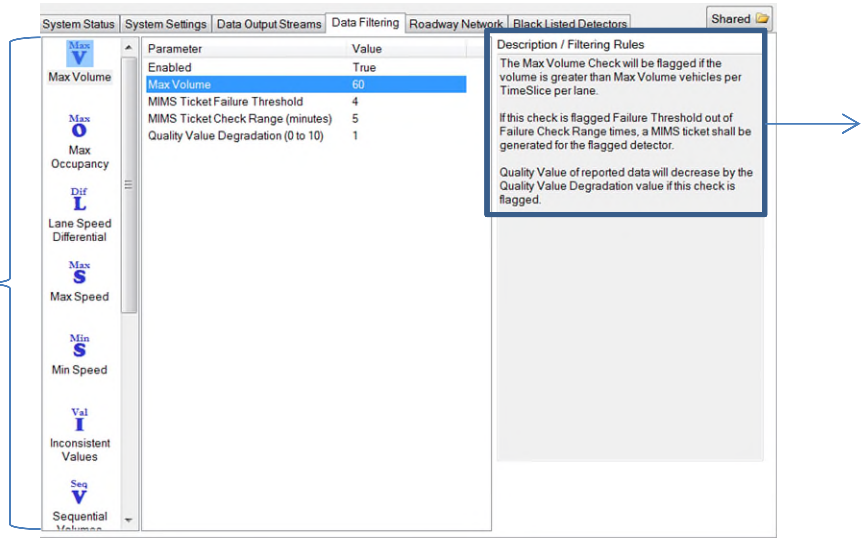



**Figure 18: Data Filtering Page Description**

### *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 option. Once selected clink each link in the order that is required then click the option Stop 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.

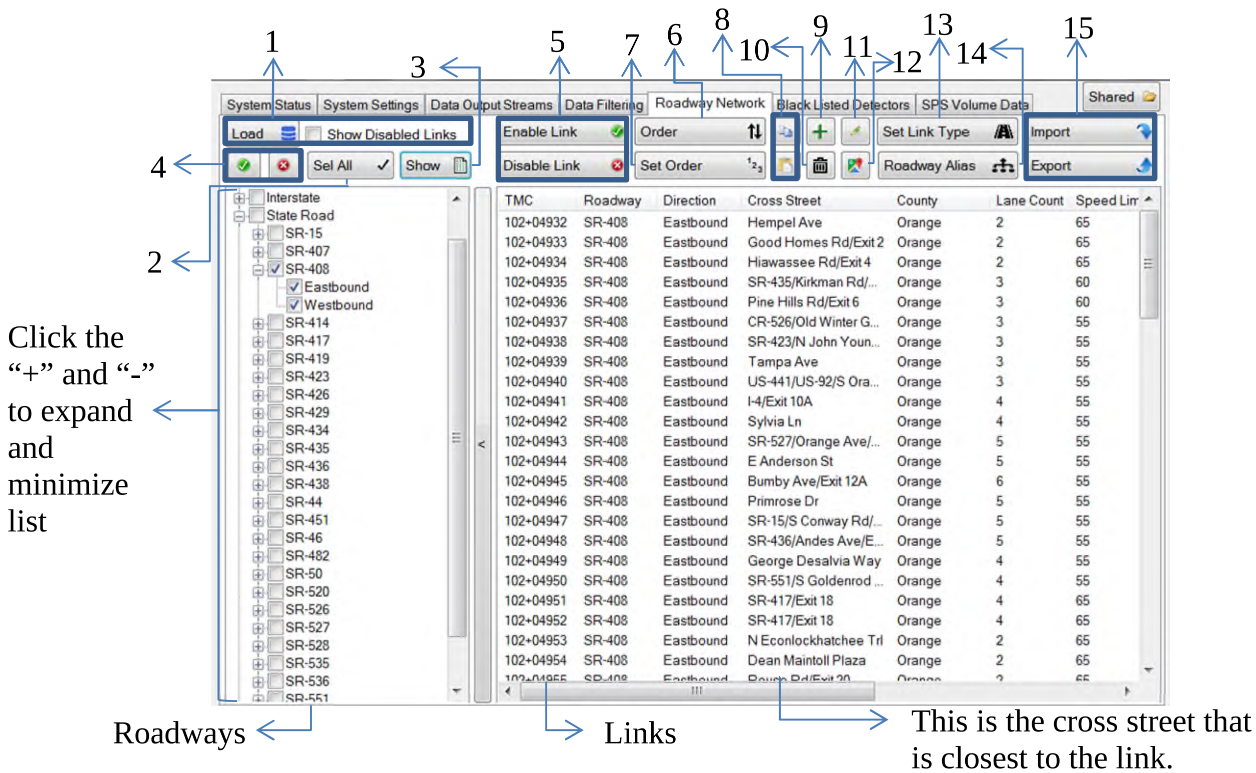



**Figure 19: Roadway Network Configuration**

## 5.6.6 Super Links

Super Links are administrator-created links that consist of one or more Roadway Network links. ITSIQA sums valid travel times of all associated Roadway Network links and averages out speeds and occupancy to report travel time, speed, and occupancy values for each Super Link. A separate set of Super Links are configurable per Data Output Stream. If a Data Output Stream is removed, all Super Links associated with the stream are also removed. These Super Links are reported separately from Roadway Network links and can be reported via C2C as roadway links or as TvT links. See section for Data Output Streams for more information.

The figure below depicts the tab where Super Links are configured. Each Super Link is defined with a name (which must be unique within the selected Data Output Stream), an overall length, a roadway, direction, number of lanes, speed limit, county, roadway type, and list of Roadway Network links. A percentage of each configured Roadway Network link can be defined. A percentage of less than 100% would result in only using a fraction of the configured link. Note that regardless of how may links are configured and their defined individual links, the final calculation of travel time and speed depends on the configured Super Link length.

When adding Roadway Network links to a Super Link, if one or more than two links are selected from the "Master Links" list and the add button is pressed, all selected links will be added to the Super Link. If exactly two links are selected from the "Master Links" list, the user will be prompted with a question if all links that lie in between the two links should also be added. This allows administrators to select the start link and end link only, then all intermediate links will automatically be added. Note that this function only works if the Roadway Network links are configured correctly with no gaps between any links. If no links are added when attempting to add, it is likely that the Roadway Network links are misconfigured.

There are copy and paste options for the list of Super Links. When one or more Super Links are selected and the copy button is pressed, the selected Super Links are copied to the internal clipboard. Pasting will add a copy of all copied Super Links and all Roadway Network links associated with the copied Super Links.

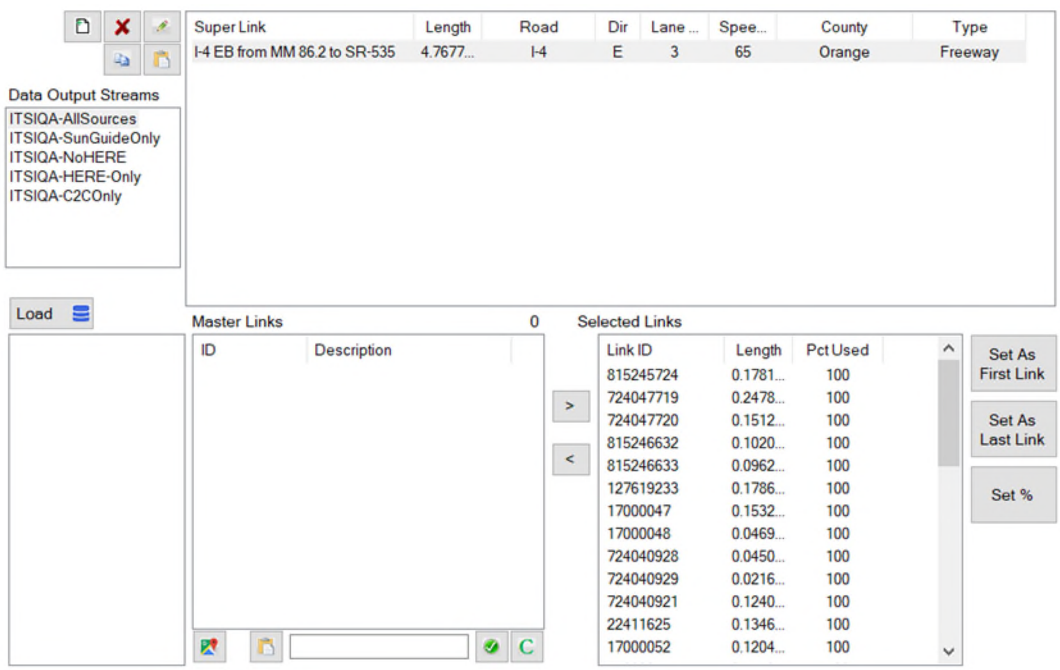



**Figure 20: Super Link Configuration**

### 5.6.7 Intersection Configuration

ITSIQA's intersection configuration is designed for piping and reporting turning movement count information through ITSIQA using a standard reporting mechanism. When an intersection is initially added, it is not associated with any roadway until at least one approach has been added. An intersection must have a unique identifier, starting with a three-letter agency code (the agency who operates the intersection), followed by a four-digit controller identifier. Each approach has a roadway and direction. There are typically four approaches per intersection, one pre cardinal direction (North, South, East, and West). However, this is not necessary. In fact, there can be more than one roadway with the same direction. Each approach should have at least one lane. Each lane can have any combination of four different types of turning types, which include: Through, Right, Left, or UTurn. The figure below depicts the intersection configuration tab.

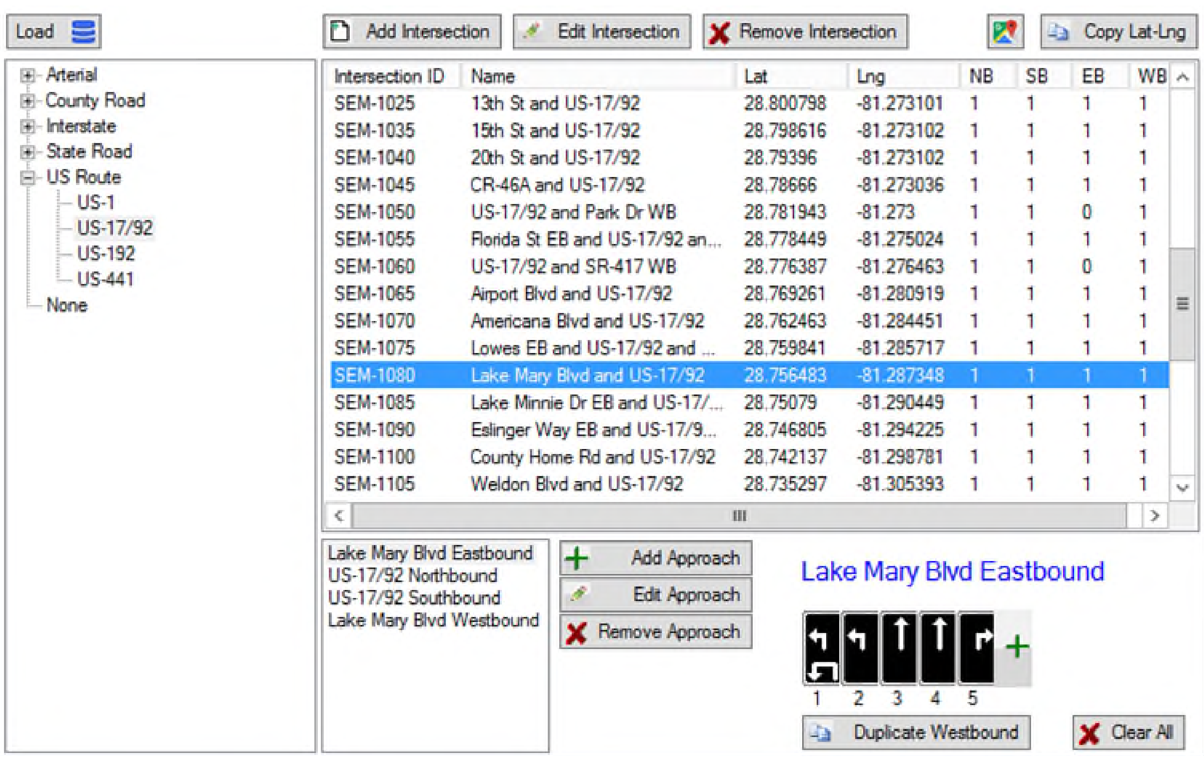



**Figure 21: Intersection Configuration**

Adding and editing intersections requires a detailed understanding of the number of lanes available and each lane's possible turning types. As such, once an intersection has been added with accurate latitude/longitude values, the intersection can be mapped using Google Maps. The figure below shows an example of the mapping of an intersection location. Using standard Google Maps tools facilitates administrators to configuring the lane configuration accurately.

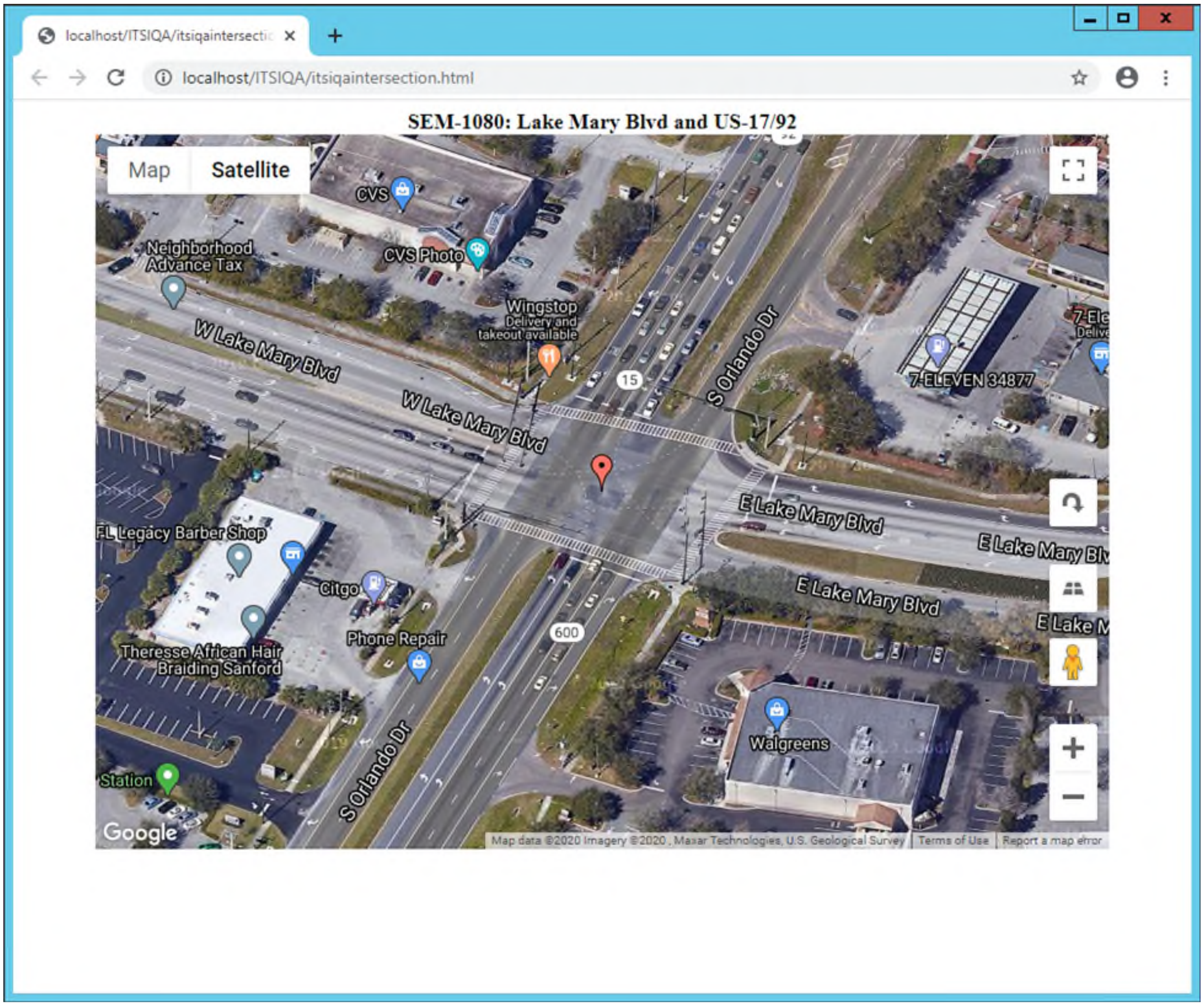



**Figure 22: Intersection Location Using Google Maps**

## *5.6.8 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.

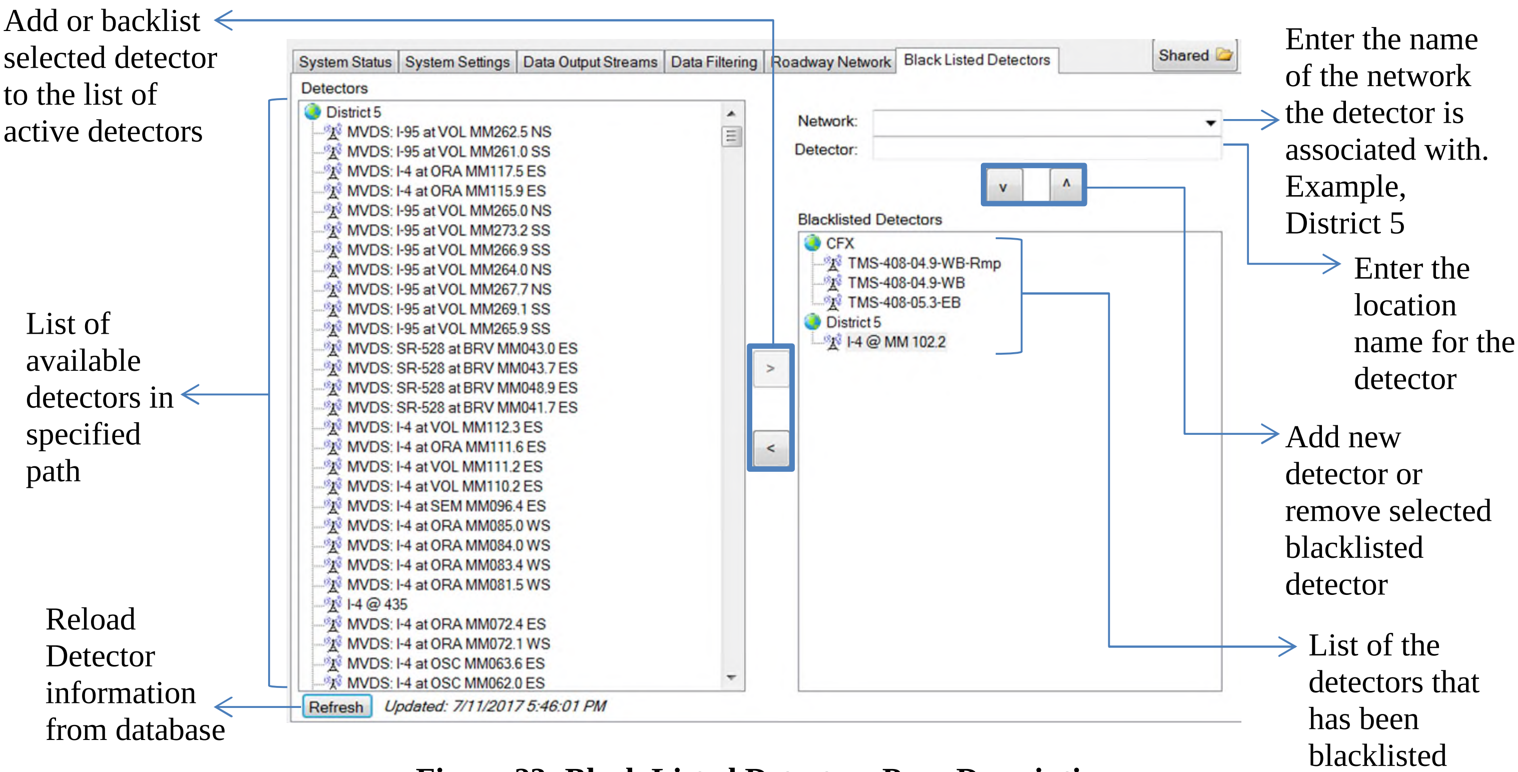



**Figure 23: Black Listed Detectors Page Description**

### *5.6.9 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.

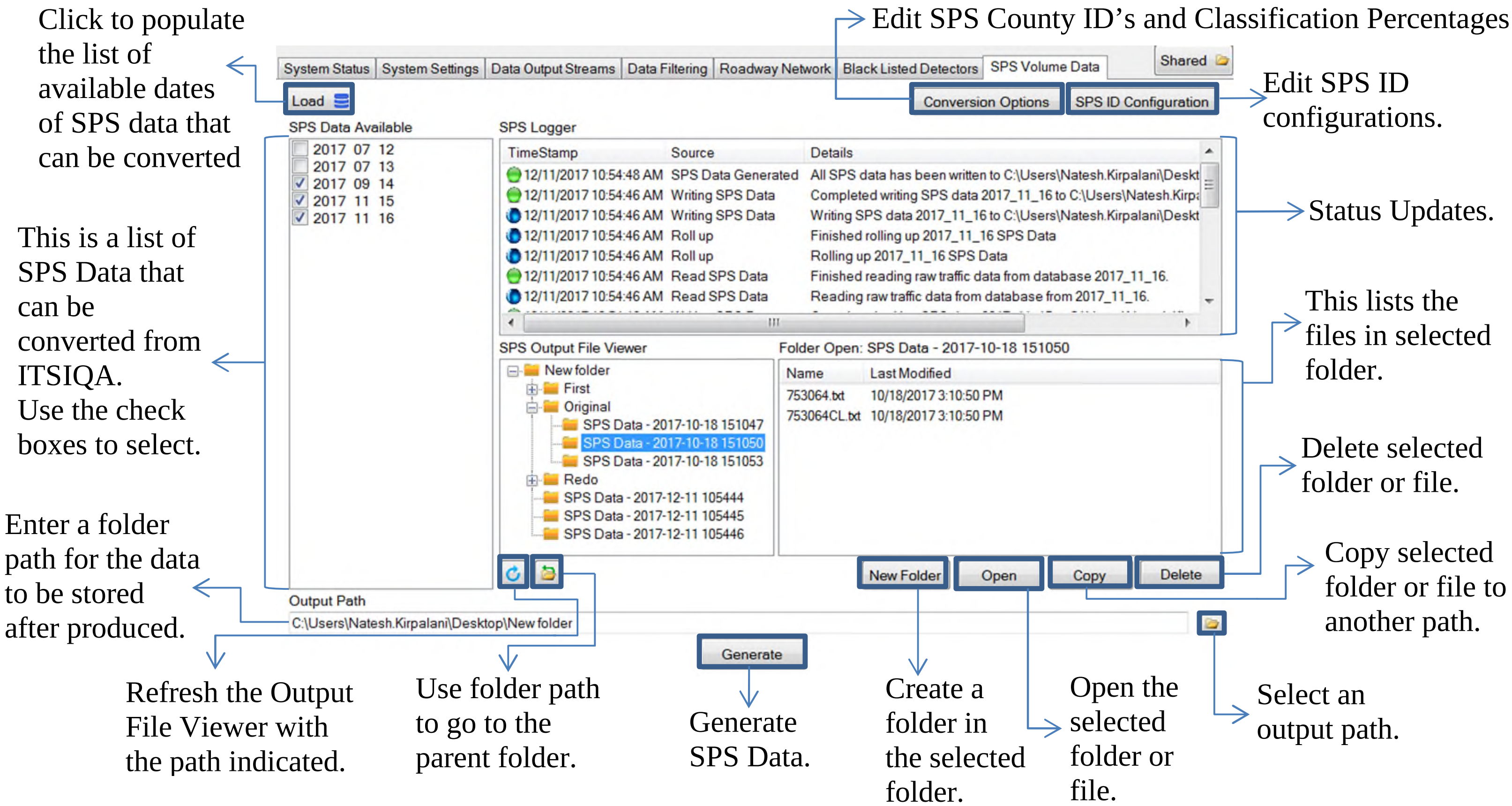



**Figure 24: SPS Volume Data Conversion Page Description**

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.

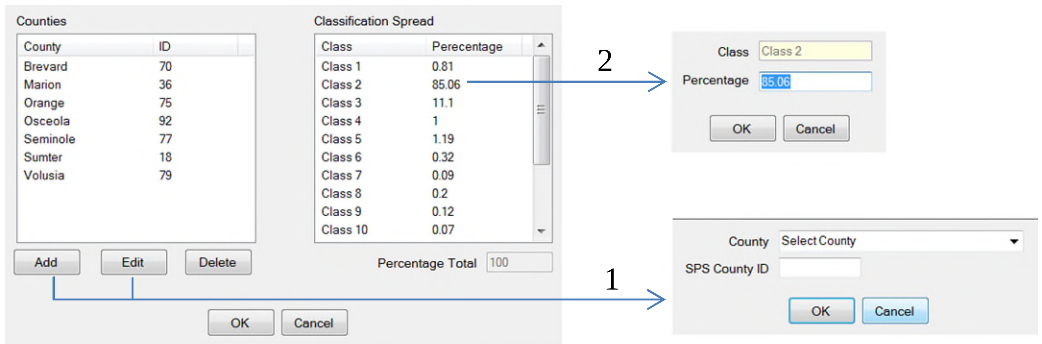



**Figure 25: SPS Conversion Options Window Description**

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.

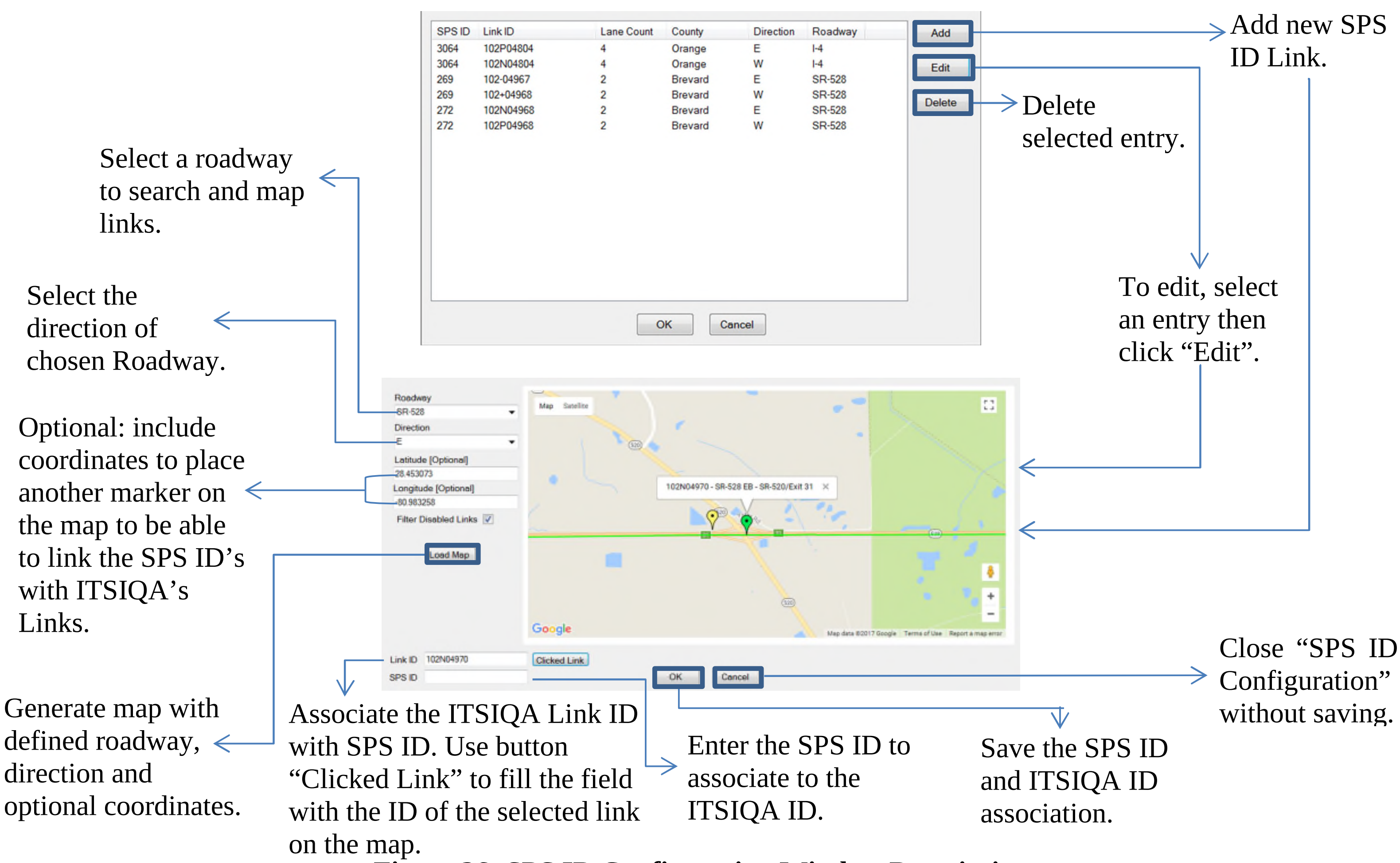



**Figure 26: SPS ID Configuration Window Description**

## 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 Output Methods

ITSIQA can provide XML output files via three different methods:

1. **Files Written to Disk**: In this method, output files are written to disk to a common configurable path. All files are written to the same URI-specified folder. Although files are written at the completion of a processing period (typically configured once per minute), the write process is completed via separate threaded processes. Consequently, writes are completed at a different time depending on the size of the output file and the speed at which the disk allows data to be written. Previously written files are overwritten by new data once it is available. All writes are written to a temporary location first, then a File Move method is called to minimize the time when the overwritten file is unavailable. External systems accessing these files outside of ITSIQA must have read access to the folder where the files are written.
2. **Response from HTTP Requests**: In this method, external systems must submit a HTTP request using a standard WDSL web service. This method uses Windows-provided IIS to host the webservice and is consequently dependent on IIS to be functional and responsive in a timely manner. Since this method uses IIS as an intermediary, this method is typically slower than retrieving files directly from disk, i.e. Method 1.
3. **FTP Data Push**: In this method, selected ITSIQA XML output files are pushed to a specific FTP site, hosted independently of ITSIQA. The FTP site could be locally or externally hosted. ITSIQA allows the configuration of only one FTP site. The push method could use standard FTP or sFTP, with or without configurable credentials. This method pushes data at a configurable push interval that does not have to match ITSIQA's processing interval.

All three methods could be enabled, allowing multiple systems to retrieve ITSIQA output data at the same time.

### 5.7.2 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 32 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 41: 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 |
| **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 |

### *5.7.3 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/

The figure below 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 27: 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.

### *5.7.4 Link Configuration Data*

Link configuration data is reported in XML format. The table below describes each reported field.

**Table 42: 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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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<br><br>SR-408<br><br>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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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> |
| **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 |

### 5.7.5 Link Traffic Data

Link traffic data is reported in XML format. The table below describes each reported field.

**Table 43: 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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |

### *5.7.6 Lane Link Traffic Data*

Lane link traffic data is reported in XML format. The table below describes each reported field.

**Table 44: 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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |
| **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> |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |

### *5.7.7 Vehicle Classification Data*

Vehicle Classification data is reported in XML format. The table below describes each reported field.

**Table 45: 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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |

### *5.7.8 TMC Configuration Data*

TMC configuration data is reported in XML format. The table below describes each reported field.

**Table 46: 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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |
| **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 > |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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<br><br>SR-408<br><br>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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |
| **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> |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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 |

### *5.7.9 Turning Movement Count Data*

Turning Movement Count (TMC) data is reported in XML format. The table below describes each reported field.

**Table 47: 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 |
| **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 |

| 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. | <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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **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**<br><br>***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 |
| **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 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **Intersections / Intersection / Approaches / Approach / Lanes / Lane / TMCClass**<br><br>***POTENTIALLY OPTIONAL*** | XML element containing turn movement count (TMC) data. Note that this may not be reported depending on output data stream configuration settings. | <TMCClass>…</TMCClass> |
| **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 |
| **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 |

The table below 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 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 48: 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 |
| **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 |

| Data Field Index | Data Field Name | Data Description | Example Value |
|---|---|---|---|
| **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 |

the following table 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 the following table 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 the following table are reported as integers, with a range of 0 to 32,767 for valid values or less than zero for invalid values.

**Table 49: Classification Turning Movement Count Data Indexes**

| Data Field Index | Data Field Name | Data Description | Example Value |
|---|---|---|---|

| 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 the following table.

**Table 50: 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* | |

### *5.7.10 Turning Movement Count Volume Data*

Turning Movement Count (TMC) volume data is reported in XML format. The table below describes each reported field.

**Table 51: Turning Movement Count Volume 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 / ConfigTimeStamp (attribute)** | Date and time when the cooresponding configuration data file was last updated, in local time. | 6/18/2018 12:00:00 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 (attribute)** | Unique alpha-numeric identifier for the reported intersection. This identifier should match the Intersection identifier reported from Intersection Configuration Data exactly. | BRE-0002 |
| **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 (attribute)** | Unique alpha-numeric identifier for the reported approach. This identifier should match the Approach identifier reported from Intersection Configuration Data exactly. | BRE-0002-E1 |

| Data Field | Data Description | Example Value |
|---|---|---|
| **Intersections / Intersection / Approaches / Approach / ApproachVol** | The total number of vehicles reported for the given approach for all lanes. | 5 |
| **Intersections / Intersection / Approaches / Approach / Lane** | The total number of vehicles reported for the given lane. | 5 |
| **Intersections / Intersection / Approaches / Approach / Lane / LaneID (attribute)** | Unique alpha-numeric identifier for the reported lane. This identifier should match the Lane identifier reported from Intersection Configuration Data exactly. | BRE-0002-E1-1 |
| **Intersections / Intersection / Approaches / Approach / Lane / TurnType (attribute)** | Identifier that indicates the possible turns from the given lane. Table 38 describes the possible values for this field. | TR |

***Note that if the reported values are 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 are reported as integers, with a range of 0 to 32,767 for valid values or less than zero for invalid values.

**Table 52: Turn Type Values**

| Turn Type Identifier | Possible Turns |
|---|---|
| **L** | Left Turn Only |
| **LR** | Left or Right Turn |
| **LRU** | Left or Right Turn, or UTurn |
| **LU** | Left Turn or UTurn |
| **R** | Right Turn Only |
| **RU** | Right Turn or UTurn |
| **T** | Through Only |
| **TL** | Through or Left Turn |
| **TLR** | Through, or Left or Right Turn |
| **TLRU** | Through, Left or Right Turn, or UTurn |
| **TLU** | Through, Left Turn, or UTurn |
| **TR** | Through or Right Turn |
| **TRU** | Through, Right Turn, or UTurn |
| **TU** | Through or UTurn |
| **U** | UTurn Only |

## 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. The figure below depicting how the plug-in fits into the overall functionality.

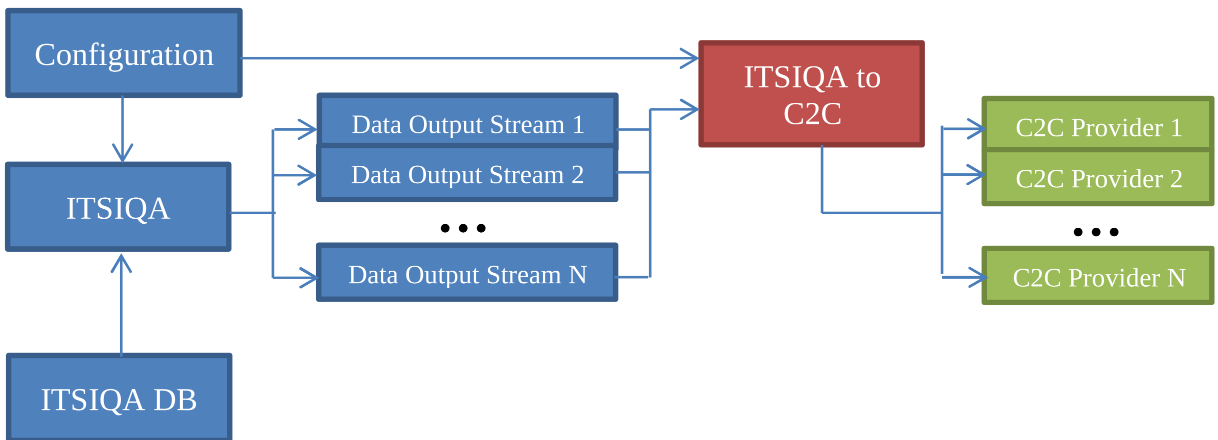



**Figure 28: ITSIQA to C2C Plug-in Data Flow**

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

**Table 53: 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.