


SIS BOTTLENECK STUDY

TECHNICAL MEMORANDUM NO. 1

Data Review

Table of Contents

List of Figures

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Data Review

This technical memorandum summarizes the various data available for analyzing bottlenecks and congestion on Florida's Strategic Intermodal System (SIS). The data includes information currently available within Florida Department of Transportation (FDOT) resources as well as the vehicle probe data from a private provider (INRIX). This technical memorandum also makes recommendations concerning the applicability of using existing FDOT data versus using the vehicle probe data from INRIX.

1.1 FDOT Data Sources and Measures

FDOT has continuously taken a strong position supporting performance based programs. It has an extensive performance measures program covering all aspects of transportation conditions in Florida and FDOT achievements. The cornerstone of FDOT's performance measures is its mobility performance measures program. FDOT's initial guidance for the development of its mobility performance measures program was adopted in 1998, with its publication of a Mobility Performance Measures Handbook. Since 2000, FDOT has been reporting key mobility performance measures annually in its Highway Data Sourcebook.

FDOT uses a combination of field data and calculation programs to develop the performance measures. The field data includes information from the Roadway Characteristics Inventory and Traffic Data. This section describes the data sources and the measures used by FDOT to quantify mobility performance.

1.1.1 Roadway Characteristics Inventory (RCI)

The RCI is a computerized database of information related to the roadway network maintained by or of special interest to FDOT. In addition to data required by FDOT, the RCI contains other data as required for special Federal and State reporting obligations. The RCI is maintained by District and Central Office personnel through the Transportation Statistics Office (TranStat). TranStat develops procedures and training for proper and uniform collection, reporting, and storage of the RCI data. However, most of the actual RCI data collection is the responsibility of the District Planning or Maintenance Offices. Quality Control (QC) and Quality Assurance (QA) activities are shared by Districts and TranStat.

The RCI represents Florida's road network indexed by data segments. RCI identifies the different roadway segments with a unique Roadway ID, with each segment containing information on roadway Features, Characteristics and other data elements.

- The Roadway IDs are eight-digit numbers assigned to any roadway for which the Department collects and reports roadway information. A Roadway ID contains three different components: County, Section, and Sub-section Numbers.

- A Feature is a general grouping of physical attributes of a roadway, identified by a unique three-digit number and name.
- A Characteristic is a more specific element of the roadway and is identified by a unique name up to eight characters long.

1.1.2 Traffic Monitoring Program

TranStat's Traffic Data Section maintains data on the usage of the State Highway System, such as annual average daily traffic, vehicle classification (auto, 3-axle 6-wheel truck, etc.), speed, and weight. Data for this program is collected using two types of sources:

- Telemetered Traffic Monitoring Sites (TTMSs) – Approximately 300 permanent counters that continuously monitor traffic are placed at specific locations throughout the state to record distribution and variation of traffic flow by hour of the day, day of the week, and month of the year. They cover a spectrum of facility types (freeways, signalized arterials, two-lane and multilane highways) and area types (urbanized, urban and rural areas). Data from these count stations used in performance measure calculations reflect seasonal fluctuations, weekday/weekend fluctuations, heavy vehicle counts, and peak hour/period traffic distributions under both congested and uncongested conditions.
- Portable Traffic Monitoring Sites (PTMSs) – Coverage counters are used at about 5,000 to 6,000 locations, collecting hourly data for 24 to 48 hours, and are deployed 1 to 4 times a year. They provide volume estimates for each segment of highway on Florida's State Highway System, and are adjusted for seasonal variations using factors from the permanent counters.

1.1.3 FDOT Mobility Performance Measures

FDOT developed a framework for performance measurement designed to characterize mobility in a manner understandable to the general public and decision makers. The recommended mobility performance measures reflect mobility from the users' perspectives, based on the following:

- Quantity of travel
  - Magnitude of use of a facility or service
  - More people and goods transported, the better
- Quality of travel
  - Traveler satisfaction with a facility or service
  - User experience is usually most important to the traveling public
- Accessibility
  - Ease with which travelers can engage in desired activities
  - It may not matter how good the service is if it is hard to get it

- Capacity utilization
  - Quantity of operations relative to capacity
  - Indicates how efficiently resources are being used; should be neither too high (no allowance for increased demand) nor too low (wasted resources)

FDOT developed multiple performance measures within each of the above mentioned dimensions that help frame the mobility picture and can lead to better decisions. The following are the measures FDOT uses for system-wide reporting:

- Quantity:
  - Vehicle miles traveled
  - Person miles traveled
  - Truck miles traveled
  - Transit ridership
- Quality
  - Average travel speed
  - Vehicle delay
  - Person delay
  - Level of Service
  - Travel time reliability
- Accessibility
  - Proximity to major transportation hubs
  - Percent urban miles with sidewalks
  - Percent urban miles with paved shoulders / bicycle lanes
- Capacity utilization
  - Vehicles per lane mile
  - Percent of miles heavily congested
  - Percent of travel heavily congested
  - Duration of congestion

1.2 Vehicle Probe Data from INRIX

INRIX is a private provider of vehicle probe data which combines real-time data from traditional sensors, a crowd-sourced network of over 4 million GPS-enabled vehicles, historical traffic speeds database and hundreds of other traffic impacting factors like accidents, construction and other local variables. FDOT purchased INRIX Historical Traffic Flow data, including data from July 2010 to June 2011.

INRIX Historical Traffic Flow data is a spatial and temporal database of average speeds for major roadways and arterials across all fifty (50) states. These speeds are determined by algorithms which

evaluate multiple years' worth of data collected using INRIX's patented 'Smart Dust Network' system which reports speed values on roads across the country. This speed data is then processed across several different temporal resolutions and reported on a customer-configurable basis for each temporal resolution.

1.2.1 INRIX Data Sources

INRIX derives historical flow data using the following:

- Traffic Sensors – Sensors put in places by local DOTs or private sector companies are utilized by INRIX from which traffic speed is either reported or can be inferred. The sensors utilize one of several types of technology includes:
  - Induction loop sensor imbedded in the roadway
  - Radar sensors
  - Toll tag readers along a stretch of roadway
- Probe Vehicles – INRIX network includes hundreds of thousands of probe vehicles – trucks, taxis, busses and passenger cars – with onboard GPS devices and a transmit capability to return speed and location back to a central location. INRIX has contracted with many different fleets to obtain that speed and location data anonymously.
- INRIX Smart Dust Network – It derives speed by combining data from one or more physical sensors as well as all available data from probe vehicles that fall within a specific segment of road for a particular time window. A patented component gathers all input points, weights them appropriately based on input quality and latency, and calculates the speed of that road segment to a measured degree of accuracy.

The data is updated twice a year, incorporating both changes to map databases as well as additional historical data from the INRIX Smart Dust Network.

1.2.2 INRIX Data Format

INRIX historical traffic flow data is delivered in CSV (comma separated value) format, compressed using WinRAR, on a DVD with all the data for the state of Florida. Data provided by INRIX contains the following information:

- TMC ID – Traffic Message Channel (TMC) is the basic spatial unit used by INRIX to report the traffic flow data. TMC is a specific application of the FM Radio Data System (RDS) used for broadcasting real-time traffic and weather information. INRIX uses a 9-digit TMC ID to define a unique segment and direction of roadway in North America.
- Year

TMC	YR	MM	DD	HH	MI	SPEED
102P04149	2010	07	01	07	55	63
102N05976	2010	07	01	07	55	40
102P05097	2010	07	01	07	55	64
102P04161	2010	07	01	07	55	65
102N11218	2010	07	01	07	55	60
102+04932	2010	07	01	07	55	55
102P05597	2010	07	01	06	55	70
102-06044	2010	07	01	07	55	23
102+09054	2010	07	01	07	55	28
102+09117	2010	07	01	07	55	35
102P07289	2010	07	01	07	55	60
102-04740	2010	07	01	07	55	64

- Month
- Day
- Hour
- Minute
- Speed

1.2.3 Summary of INRIX Data for Florida

FDOT purchased vehicle probe data from INRIX along Florida's roadways at five minute intervals from July 2010 to June 2011. This data for the state of Florida included 711,351,697 records (amounting to approximately 27 GB), with each record providing average speed on a roadway segment at five-minute interval. For the purpose of this study, the data pertaining to SIS network was extracted from the overall database. The INRIX data for the SIS network contained 293,372,069 records and amounted to approximately 9 GB. The INRIX data included 33,695 TMCs for all of Florida, of which 6,293 TMCs account for the SIS network.

Figure 1-1 illustrates the coverage of INRIX data on Florida's roadways. The length of TMC segment ranged from 0.002 mi (various locations) to 42.56 mi (US 1 in Monroe County) with an average length of 1.07 mi. The coverage of INRIX data is observed to be more extensive along the SIS and interstate facilities than the local street network.

Figure 1-2 illustrates the monthly variation of INRIX data points for the SIS network. This indicates a trend that higher vehicle probe data are available when traffic on the roadways is higher. The month of March is observed to have the highest vehicle probe points, which coincides with spring break and snowbirds heading to Florida.

Figure 1-3 illustrates the hourly variation of the vehicle probe data on the SIS network. This trend indicates that overnight hours account for lesser vehicle probe data than the daytime hours. It is observed that more than 70 percent of the vehicle probe data is accumulated between 6 AM and 6 PM.

Figure 1-1 Coverage of Florida's INRIX Vehicle Probe Data (2010-2011)

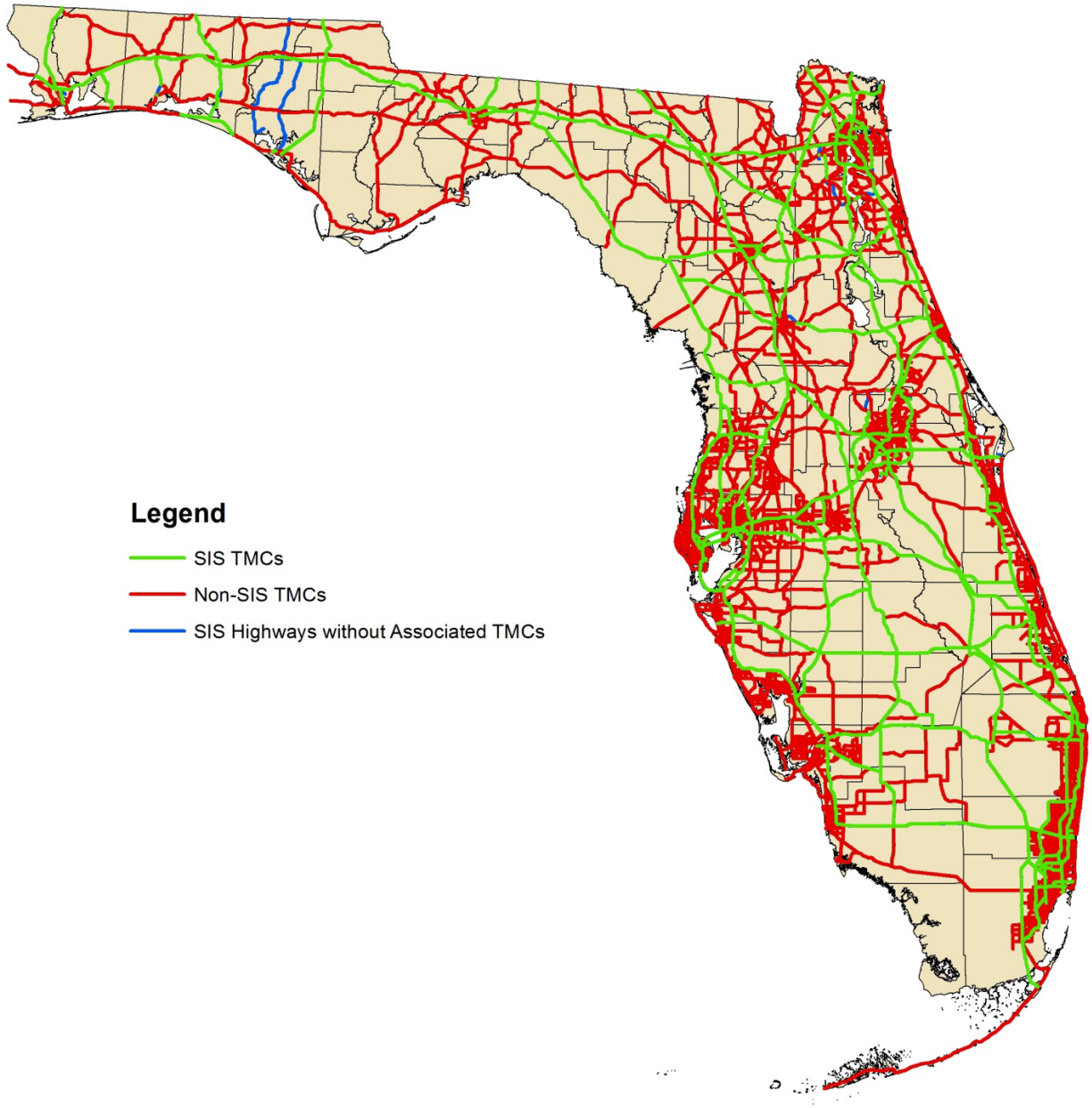


Figure 1-2 Monthly Variation of INRIX Data

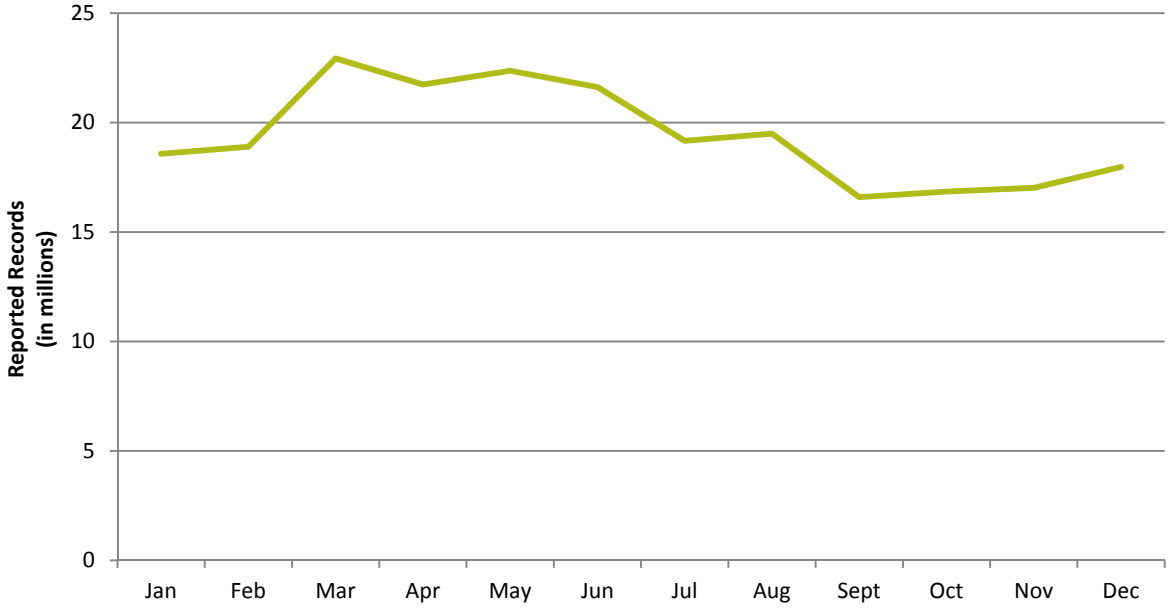
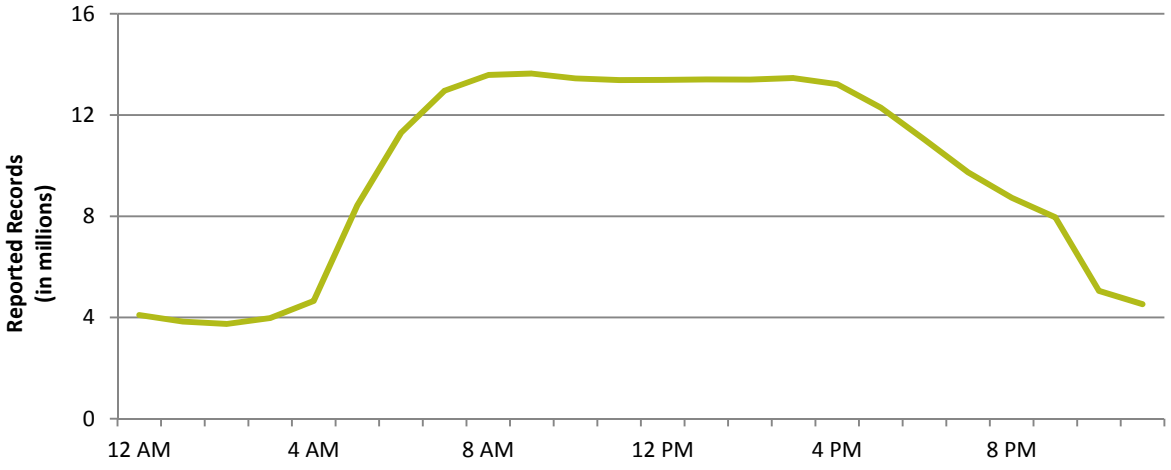


Figure 1-3 Hourly Variation of INRIX Data



1.3 Summary

As described in the previous sections, FDOT collects extensive roadway and traffic data for the State Highway System and updates them at periodic intervals. These data are used to produce several performance measures to monitor Florida's highway mobility. Most of these measures are calculated based on the speed/traffic flow relationships from the most recently available Transportation Research Board Highway Capacity Manual (HCM) and FDOT's Quality/Level of Service (Q/LOS) Handbook.

HCM and Q/LOS methodologies are easy to understand, commonly applied in practice, and have credibility among the professional community. The ability of HCM related measures to quantify congestion accurately depends upon the validity of the relationship between volume-to-capacity ratios and delay and, in the case of signalized intersections, the accuracy of the stop delay equations (especially under severely congested congestions). This relationship has changed in the numerous revisions of the HCM (1956, 1965, 1985, 1994, 2000 and 2010) causing a slightly different assessment of similar traffic conditions. Direct travel time measures are consistent in regard to their evaluation of traffic conditions.

The University of Florida and FDOT have developed a travel time reliability model to calculate the travel time reliability measures for the state's freeway system. This model is based on freeway speed/traffic flow relationships from the HCM and Q/LOS Handbook using information such as traffic volume, hourly traffic distributions, number of lanes, area type, probabilities of adverse weather, probabilities of blocking and non-blocking incidents, and probabilities of work zones. FDOT's system level mobility performance measures are excellent in analyzing various aspects of transportation performance in Florida. These measures are being used for reporting mobility trends of the highway system and to illustrate additional resource needs.

To quantify congestion accurately and to better identify bottlenecks on Florida's roadway system, direct observations of vehicle speed data is essential. INRIX vehicle probe data provides the direct observations of vehicle speeds on the roadway system which can be used to provide the direct measures of congestion. With travel time reliability being widely recognized as one of the most important qualities of service measures to travelers, analyzing field observed vehicle speeds is critical.

INRIX's historical traffic flow data can be used specifically for identifying bottlenecks and to supplement the current FDOT data collection and inventory. The combination of INRIX data, RCI and FDOT's traffic data can be effectively used to better understand Florida's roadway system. With the potential benefits of vehicle probe data, FDOT can consider purchasing the INRIX data for recurring future processes. It is, however, recommended that the latest available technologies for the vehicle probe data be monitored for obtaining the latest and greatest product.

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