Smart Signal Treatment Overview

So what are we doing here?

Check out the TSM&O Methodology to understand the overarching objectives of the program and on the variety of current and planned projects.

So that was fluffy; what does it have to do with me as a signal designer?

We have two goals we are trying to satisfy: safety and mobility. Mobility is the easier to explain, so we will start there.

First, mobility on arterial facilities is mostly affected by proper maintenance, so we are seeking to minimize maintenance work and maximize uptime. As a designer, consider not just cost but also what the most robust solution is. This may mean a Microwave Vehicle Detection System (MVDS) versus a loop for detection, adding UPS, including an RPM, or other items. Second, knowing the demand on a corridor could lead to a different investment in configuration.

Right now, our investments are driven by reoccurring congestion modelled out 20 years in the future. This is because we can measure reoccurring congestion, but non-reoccurring congestion is harder to quantify. Third, signal timing is done based on the frequency and not need, because need is harder to quantify. Also, we time for peak period even when these periods are overcapacity and retiming does really benefit them.

We are seeking to turn these issues on their head. Collecting ubiquitous data will allow us to quantify how well the current geometry fits the demand, and whether that demand is reoccurring or non-reoccurring. We are also generating software to see what timing plans are most needed in a corridor and getting the information to an engineer to produce the timing plan. We are then measuring conditions in real-time to understand if today conditions make it right to use a stored plan. To see how this is done look at the Explain Mobility slide show.

We have projects that will clean, normalize and process the data ITSIQA ConOps and ITSIQA Design. Frequency of the data collection had been taken into consideration. Data collection frequencies include one (1) minute for arterials and 30 seconds for interstate. These collection frequencies are imperative for incident detection, which will be discussed further in the safety discussion. UCF is researching a turning movement and volume approach data combination. UF is research turning movement count accuracy in over capacity scenarios. This will take into account data from the IMC and the Advanced Traffic Signal Performance Metrics (ATSPM). Kittelson is researching converting Bluetooth data with turning movement counts to generate unmet demand.

The goal for safety is more long term, and includes the placement of fixed-detection CCTV that provide high-definition video, allowing for future object definition, trajectory information, and location information via a hardened server or industrialized computer. MVDS may provide this information directly without processing, but many are locked, limiting access to this data.

First, this data can be processed in the back office to generate near-miss calculations that allow for heat maps to be generated, helping to identify safety hot spots on our roadways. Generally, a few weeks of near-miss data is considered more statistically significant than collision data over a period of five (5) years. Perhaps the greatest benefit is that no injuries need to occur to measure results and identify safety these hot spots.

Second, obtaining this data allows unequipped vehicles to be identified and Basic Safety Messages (BSM) to be generated and broadcast. These BSMs can then be used by properly equipped vehicles and infrastructure to: 1) generate TIM if a collision seems eminent, 2) extend all red times as needed, and 3) allow other Connected Vehicle applications to use the information to make for a safer roadway.

Intersection Treatments

1. **All Intersections**
    a. **Controllers –** current Spec 671 required ATC Controllers; ensure controller meets this specification. It is important to note that most controllers within the District communicate to a Central Software determined by the maintaining agency. These require Synchronization with Existing to function properly with the Central Software and will require a Proprietary Product Certification. If you would like examples or have any questions about the proprietary product certification process you can contact Katie King (Katie.King@dot.state.fl.us or 386-943-5333) in the Traffic Operations Department.

    b. **ATSPM (Advanced Traffic Signal Performance Metrics)** will be needed for counting vehicles, detecting crashes, grouping signals, and adjusting timings. To achieve these functions there is a need for stop bar and advanced detection on all lanes all approaches assigned to standard channels. See ATSPM Guidance.

        i. **Stop Bar Detection –** There are multiple considerations here. Stop Bar Detection can either function as presence or pulse. Traditional Stop Bar detection typically functions in presence meaning that it goes on and stays on until it no longer detects a vehicle. Pulse stop bar detection functions in an on-off manner similar to an advance loop and is more common in some adaptive signals.

            1. **IMC (Intersection Movement Counts)** – IMC detection provides real-time turning movement counts (left, thru, right, and u-turn by lane split by turn type) at an intersection. They use strategically placed emulated loops/zones or vehicle trajectory tracking to generate these tuning movement counts. The device can serve as

both IMC as well as the traditional presence/pulse detection at the Stop Bar. MSP 660 provides a spec for the hardware. The IMC Data typically can come through two different paths. The first is through an API call for an XML or JSON file to the device server. The Second is by using un-used detector channels with pulse loops/zones near the stop bar to and recording the detector data to into the controller using high resolution logging from the ATSPM system. **Consideration for data accessibility must be made by the engineer**. These do NOT substitute the need to add Advanced "loops." Note all isolated intersections turning movement counts should be gathered using IMC devices.

2. IMC Examples of Wiring Diagrams (PedSafe Wiring Diagram), sample plans (PedSafe), and MSP (PedSafe MSP TSP) are provided.

ii. **Advanced Loops/Zones –** These will need to be in major and minor arterials. The cost will vary based on the technology used to provide this detection. It is important to consider the speed limit and the maximum detection capability from the device in this decision. With advance detection provided on both the major and minor roadway, typical FDOT detection specifications can be used and the IMC could be approximated for select intersections (~1/3 of intersections) on coordinated corridors using ITSIQA approximation.

2. **Intersections on Principle Arterials, Hurricane Evacuation Routes, and Detour Routes (KMZs are available for some of these at Diversion Route Resources)**
   a. **CCTV for confirmation –** PTZ for operations observation, locate for visibility of approaches, generally on a mast arm over the major street. Use judgement for spans on all signalized intersections.

   b. **BlueTooth (BT; speed and OD) –** BT devices should be placed to gather speed and origin-destination information. Devices should be located outside of queues between intersections. One Bluetooth device for every third signal is an approximate density for large roadways. Smaller facilities will likely require more devices, possibly every signal. Device should attempt to bookend controlling intersections. These are intersections where major turning movements occur or delays occur. Block Diagrams (AAM phase 3), sample plans (AAM phase 3 plans), and MSPs (AAM phase 3 msp tsp) are provided.

3. **Contextual Data –**These devices supply a good deal of data to the Traffic Management Center, but in order to make sense of it all, engineers need to understand what devices are configured on each intersection to understand which SOPs can be applied. This contextual data needs to be gathered in part by the engineer at the TMC and in part by

the contractor. MSP 611 (Signal Inventory Tool) should be used in all jobs to have the contractor collect the field data to operationalize the data. The Department is currently in development of a Signal Inventory Tool web application to be used to make collecting the data easier and to have a seemless tie-in with the existing maintenance inventory database program. (See Signal Inventory Tool Application Design – Draft) While this tool web application is in development an interim local software application version is available for download and use. Instruction for getting access to this interim software program can be found on the cflsmartroads website. (See Signal Inventory Tool Interim Application Procedure).

4. **Network Connectivity –** Fiber is preferred. It allows for CV architecture that accommodates 5G and DSRC communications . If not possible, design should accommodate cell backhaul. It is important to ask who maintains and who operates the equipment in developing the network connectivity plan. How is the network connected outside the project limits? Does it communicate back to the local agency traffic management center or does it communicate back to the D5 ITS network? Is there logical connectivity between the local agency and the department?

   If you do not know, please contact FDOT ITS (Jim Miller / Shane Owens). DO NOT ASSUME.

   a. **Logical Connectivity** – How does the data get back to the network it needs to outside the limits of your project? Work with FDOT Network personnel (Shane Owens, 386-943-5314) to figure it out.
   b. **Physical Connectivity –** Open pull boxes to ensure Physical Connectivity to demark.

5. **Cabinets** - The layout of the cabinets and space needed will depend on, but not be limited to: existing devices within the cabinet, additional devices to provide ATSPM (detection devices selected to include detection on all approaches), and coordination with maintaining agencies. The designer should provide options to the maintaining agency, taking into account available alternatives and costs associated with deployment and maintenance. Cabinet Type 6 determination should be conducted during design. If a cabinet is replaced or newly installed, a Type 6 cabinet should be used.