TECHNICAL MEMO

VII Data Characteristics for Traffic Management and Traveler Information Strawman Measures Explanation Memo

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1. PURPOSE

This memo describes the rationale used in selecting the Strawman Measures that were identified during the VII Data Characteristics for Traffic Management and Traveler Information Task progress briefing held 27 June 2006. These measures are shown in Table 1. These measures are proposed as the prioritized list for further analysis during the task. This memo also includes a categorization and listing of measures/variables that are left for later analysis.

TABLE 1 Prioritized List of Strawman Measures

General Measure	Specifics
Travel Time	• Between roadside equipment (RSE) locations • On specific links
Speed Profiles	• Mainline freeway • Arterials
Queue Length	• Arterial • Freeway • Ramp
Volume	• Freeway • Ramp • Arterial
Turning Movements	• Arterial • Freeway to Ramp

2. PRIORITIZED STRAWMAN MEASURES

The measures in Table 1 were selected because they affect multiple applications, discussed in the task's first white paper, "*Data Needs Assessment* (22 June 2006)" and shown in Table 2. The first three exploit VII capabilities and are not easily obtained with existing point sensors. The last two affect several applications yet are also likely the biggest challenges to effectively measure and estimate without a large percentage of instrumented VII vehicles. A critical element for the analytical component of this task is to determine how much historical data at various penetration rates are needed to effectively estimate volume and the percentages of turning vehicles.

The current priority ranking incorporates expressed FHWA assessment of interest and importance, as well as the number of related applications.

TABLE 2 Prioritized Measures and Their Applications

Italics are used if it is an "enhanced" (non-essential) measure for the application.

Measures	Applications
Travel Time	Traffic signal timing plan computation (off-line), traffic responsive operation, transit priority, ACS "Lite", adaptive signal control, off-line computation of ramp metering rates, ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control, adaptive variable message sign control, variable speed limits, lane control (mainline metering), automatic incident detection, decision support tools for freeways, dynamic traffic control in work zones, corridor management: load balancing using pre-determined plans, corridor management: planning applications, corridor management: real-time load balancing, traveler information, enhanced traveler information
Speed Profiles (Should lead to other measures like space mean speed)	Adaptive signal control, *ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control,* variable speed limits, lane control (mainline metering), automatic incident detection, decision support tools for freeways, dynamic traffic control in work zones, corridor management: load balancing using pre-determined plans, corridor management: planning applications, traveler information, enhanced traveler information
Queue Length (Derived from stop location.)	Traffic signal timing plan computation (off-line), traffic responsive operation, *transit priority, ACS "Lite",* adaptive signal control, enhanced actuated control, work zone signal control, *off-line computation of ramp metering rates, metering of a series of ramps,* single ramp adaptive control, *adaptive variable message sign control, lane control (mainline metering), automatic incident detection, dynamic traffic control in work zones,* corridor management: load balancing using pre-determined plans
Volume	Traffic signal timing plan computation (off-line), traffic responsive operation, transit priority, ACS "Lite", adaptive signal control, enhanced actuated control, work zone signal control, off-line computation of ramp metering rates, ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control, *adaptive variable message sign control, variable speed limits, lane control (mainline metering), dynamic traffic control in work zones, corridor management: load balancing using pre-determined plans,* corridor management: planning applications, corridor management: real-time load balancing
Turning Movements	Traffic signal timing plan computation (off-line), traffic responsive operation, ACS "Lite", adaptive signal control, enhanced actuated control

A comprehensive analysis of the five measures presented in Table 1 is a significant undertaking relative to the resources allocated to this task. In addition to the different facility types, the measures could be analyzed under different conditions (peak, off-peak, inclement

weather, low traffic volumes, etc.). Different probe message strategies may result in different estimates. Different aggregation, smoothing, weighting and other statistical strategies may be adopted for each variable, each facility, and each traffic scenario. Finally, a goal of the analysis is to show how well measures are estimated at different VII market penetration rates. One federal expert recommends identifying the percentage of vehicles expected to be equipped on "Day 1" and every 2-3 years after that and basing the estimates on those percentages. But it is difficult to specify now what those percentages will be. There are so many different combinations of networks, statistical strategies, probe message processes and VII-equipped penetration rates, that it will likely be difficult to "completely" analyze any of the five measures listed above during the current project time period. However, the analytical work currently taking shape around these five measures will provide FHWA with at least an initial assessment of these issues and some in-depth analysis in key areas of concern.

The task's first white paper, "*Data Needs Assessment* (June 22, 2006)" identifies 40 variables needed for 22 arterial management, freeway management, corridor management and traveler information applications. As identified in the task's second white paper, "*Identification of VII Probe Data Addressing Traffic Management and Traveler Information Needs* (June 9, 2006)," many of these can not be directly or indirectly obtained from VII and will likely be obtained from external sources. Many of the needed data items that can not be obtained from VII are related to the transit priority application. The measures listed in the Directly Obtained from VII and Requiring Derivation from VII tables include the five measures listed above and four other categories of variables: variables closely related to the five strawman measures, automatic incident-detection related variables, weather/infrastructure-related variables, and difficult to estimate with VII variables with few applications.

3. ADDITIONAL MEASURES OF INTEREST

Additional measures and their applications are presented in Table 3.

There are several variables closely related to the strawman measures that may be attractive to analyze once the initial analyses are completed. Many of these are expected to be obtained directly from VII and/or the estimated strawman measures. These include the number of stops, stopped delay, stop location, space mean speed and travel time reliability. Experience gained from the analysis of the first five measures will be helpful in making some informed hypotheses about these measures, potentially to be confirmed in follow-on tasking from FHWA.

TABLE 3 Additional Measures and Their Applications

Italics are used if it is an "enhanced" (non-essential) measure for the application.

Measures	Applications
Space Mean Speed (Easily obtained from speed profiles.)	Traffic signal timing plan computation (off-line), *traffic responsive operation*, *transit priority*, *ACS "Lite"*, adaptive signal control, enhanced actuated control, work zone signal control, off-line computation of ramp metering rates, ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control, adaptive variable message sign control, variable speed limits, lane control (mainline metering), decision support tools for freeways, corridor management: load balancing using pre-determined plans, corridor management: planning applications, corridor management: real-time load balancing
Number of Stops	Traffic signal timing plan computation (off-line), traffic responsive operation, transit priority, ACS "Lite", adaptive signal control, enhanced actuated control, work zone signal control, ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control
Stopped Delay	Traffic signal timing plan computation (off-line), traffic responsive operation, transit priority, ACS "Lite", adaptive signal control, enhanced actuated control, work zone signal control, off-line computation of ramp metering rates

Measures	Applications
Stop Location (Used in queue length determination.)	*Traffic signal timing plan computation (off-line), traffic responsive operation, transit priority, ACS "Lite", adaptive signal control, work zone signal control, off-line computation of ramp metering rates, ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control, adaptive variable message sign control, variable speed limits, lane control (mainline metering), automatic incident detection, decision support tools for freeways, dynamic traffic control in work zones, corridor management: load balancing using pre-determined plans, corridor management: planning applications, corridor management: real-time load balancing, traveler information, enhanced traveler information*
Travel Time Reliability	Metering of a series of ramps, single ramp adaptive control, adaptive variable message sign control, variable speed limits, lane control (mainline metering), automatic incident detection, decision support tools for freeways, enhanced traveler information
Sharp Braking Location, Change Lanes	*Automatic incident detection (occurrence and location)*
Pavement Surface Condition, Sun Angle/Glare, Precipitation, Air Temperature	*Traffic responsive operation, ACS "Lite", adaptive signal control, variable speed limits,* enhanced traveler information
Occupancy	Traffic responsive operation
Saturation Flow Rate	Traffic signal timing plan computation (off-line), *transit priority,* ACS "Lite", adaptive signal control, enhanced actuated control, work zone signal control, *off-line computation of ramp metering rate*s, *ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control*
Capacity	Corridor management: planning applications, corridor management: real-time load balancing
Signal status, transit vehicle location, *number of transit riders, transit schedule*	Transit priority
Incidents/special events/work zone closures	*Adaptive signal control,* traveler information, *enhanced traveler information*

Measures	Applications
Opt-In O/D	*ACS "Lite", adaptive signal control, enhanced actuated control, ramp metering implementations in locations without current sensors, metering of a series of ramps, single ramp adaptive control, lane control (mainline metering), decision support tools for freeways, dynamic traffic control in work zones, corridor management: load balancing using pre-determined plans, corridor management: planning applications, corridor management: real-time load balancing, traveler information, enhanced traveler information*
Volumes on parallel routes	*Single ramp adaptive control, decision support tools for freeways*
Volume by vehicle type	*Corridor management: load balancing using pre-determined plans, corridor management: planning applications, corridor management: real-time load balancing*
National Weather Service Warnings, Watches and Advisories	*Enhanced traveler information*

Many applications will benefit from the availability of data that is unique to VII. For example, it is likely that the performance of adaptive signal control will be significantly enhanced with the availability of pavement condition and rainfall information. Similarly, VII can provide data which may vastly improve current algorithms for incident detection. VII can provide several measures that, used together, are likely to indicate the occurrence and location of an incident. If several vehicles report having to brake sharply, an incident may have occurred on the links preceding the RSE. If a larger number of vehicles than "normal" have changed lanes, an incident may have occurred. The periodic snapshots indicating that vehicles braked sharply, and/or changed lanes and the location of the stop snapshots should pinpoint the crash/incident location and the queue extending behind the incident. Further analysis is needed to test these hypotheses.

Several of the variables identified in the two white papers are weather or infrastructure-related and have secondary and tertiary impacts to the traffic management and traveler information applications described in the first white paper, "*Data Needs Assessment* (22 June 2006). These variables include pavement surface condition, sun angle/glare, precipitation, and air temperature.

Three of the remaining variables may be possible to estimate with VII but pose many algorithmic challenges. These variables are needed for few of the applications described in the "*Data Needs Assessment* (22 June 2006)" white paper (and presented in Table 2). These variables include occupancy, saturation flow rate and capacity. It is not likely that occupancy can be derived without a large percentage of equipped vehicles.

At the end of the current project (1 January 2007), we will have an analysis of the first five measures. Experience gained over the next few months may lead to the exploration of more tradeoffs for one or another of the five measures compared to the others. With this experience, we will know which of the five measures may benefit from more in-depth analysis and which additional measures warrant further exploration.