IntelliDrive[SM] Dynamic Mobility Applications

I. Candidate Application Concept Template

The United States Department of Transportation (USDOT) initiated the IntelliDrive[SM] Dynamic Mobility Applications Program to develop applications that transform mobility by providing transportation managers and systems operators with real-time monitoring and management tools to manage mobility between and across modes more effectively, and travelers the ability for dynamic decision making. To this end, the Dynamic Mobility Applications Program is inviting stakeholders to submit ideas for transformative applications that show the potential to improve the nature, accuracy, precision and/or speed of dynamic decision making by both system managers and system users.

This is not a request for proposals. The USDOT Dynamic Mobility Applications team will work with stakeholders from the public and private sectors, and the academia to prioritize the collection of *suggested applications of interest* either for further development or for testing in Phase II of the Program.

Please submit on-line or send your completed form to *DMA-Template@dot.gov* by 31 July 2010. The USDOT Dynamic Mobility Applications team may contact you for additional details. An example of a filled out template is given in Section II for your reference. Definitions of terms used in the template are given in Section III.

II. Candidate Application Concept Example

1. Contributor
   Traffic City TMC
   Anywhere, ST
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2. Name of candidate application of interest

   Dynamic freeway speed harmonization

3. Problem addressed by the application

   Will improve throughput and reduce risk of collision by optimizing for lane-specific speed limits on a freeway facility that maximizes vehicle throughput at key bottlenecks and minimizes spatial and temporal variations in speed within and upstream of the bottleneck.

   [*Check all that apply*]

   1. Individual (traveler) benefits
      - ☐ increased accessibility
      - ☐ reduced cost of travel
      - ☑ reduced delay/travel time
      - ☑ reduced environmental impacts
      - ☑ increased safety
      - ☐ increased security
      - ☐ increased travel reliability
      - ☐ Other_____
      - ☐ reduced agency costs
      - ☑ reduced environmental impacts
      - ☐ increased goods throughput
      - ☑ increased person throughput

   2. System efficiency

- ☐ increased ridership/vehicle occupancy
- ☑ increased safety
- ☐ increased security
- ☐ increased system reliability
- ☐ Other_____

3. Mode
   - ☑ roadway
   - ☐ transit
   - ☐ freight
   - ☐ parking
   - ☐ non-motorized (pedestrians, bicycles)

4. Application description

The suggested approach is a freeway management application that will constantly monitor traffic data captured from multiple sources, and calculate a target speed for vehicles. Target speeds (and enforced speed limits) may vary by location, e.g., distance upstream of a recurrent bottleneck as well as by lane. Provision of target speeds can be initiated when detected congestion exceeds a pre-defined threshold or when congestion is impending.

When implemented, the dynamic speed harmonization application will result in smooth transitions across time and space, thereby reducing collisions from shockwave propagation, unanticipated changes in speed, and abrupt lanes changes and decelerations. In addition, more uniform travel speeds and following distances between vehicles are typically associated with higher maximum vehicle throughput and reduced risk of freeway breakdown.

The suggested dynamic speed harmonization application requires a traffic management system that captures and analyzes data from vehicles and roadside sensors to identify target speeds. Traffic data will be captured from various sources, including instrumented facilities (sensors, RSE (Roadside Equipment)), IntelliDrive-enabled vehicles (light vehicles, transit, freight), GPS (Global Positioning System) devices, and mobile communication devices. Weather data will be captured from RWIS (Road Weather Information System) stations, and IntelliDrive-enabled vehicles. Vehicle mix, current lane-specific speeds, and estimates of current traction and glare conditions must be identified from these data.

The application will monitor real-time traffic and weather data to check if lane-specific speeds within a pre-specified zone indicate the onset of congestion or an increased risk of freeway breakdown conditions. If congestion precursors such as, unstable flow patterns, are either detected (in the near-term) or predicted (in the longer-term), the speed harmonization application will calculate and communicate target speeds within as well as upstream of the impending bottleneck. The target lane-specific speeds will be calculated every minute by comparing archived, historical data and real-time data to minimize speed variations and delay breakdown. Identified target speeds by freeway segment and lane will be communicated to motorists through dynamic signs placed on overhead gantries or provided in-vehicle. Where applicable, the reason for slow down will also be posted on variable message signs (VMS) on the sign gantries.

5. Potential benefits and impacts

    1. Near-term impacts

    In the near term, target speeds will be estimated using a “reactive” algorithm. Congestion will be detected rather than predicted using speed data captured from existing sources.

Lane-specific target speeds will be estimated every minute. In the near-term, target speeds will be posted on overhead signs every minute if a speed differential of more than 5 mph is estimated between the old and new target speeds. Even in the near term, motorists will be warned of potential bottlenecks and will be able to slow down or change lanes to avoid congestion and reduce the risk of collisions. The dynamic speed harmonization application will result in smoother traffic flow, increased throughput and reduced collisions.

2. Long-term impacts

In the longer term, once there is sufficient market penetration of IntelliDrive-enabled vehicles, the suggested system will predict impending congestion, using the rich data environment. Target speeds will be estimated by lane and posted on overhead signs where gantries are deployed. In addition, the target speeds will also be transmitted from RSEs to vehicles within range, and from vehicle to vehicle. This will not only inform motorists of impending congestion but also of potential backward queue propagation.

Potential enhancements of dynamic speed harmonization enabled by IntelliDrive data include: target speed calculation considering vehicle weight and traction conditions, target lane identification considering vehicle size and performance, synergies with automated cruise control technologies for increased precision of target speed compliance, and dynamic discounting of congestion pricing charges for target speed compliant vehicles.

6. High-level application needs

    1. Data needs

        - Lane-specific speeds every minute for the facility where dynamic speed harmonization is implemented
        - Accurate vehicle positioning and roadway geometry data to precisely capture the location of the vehicle by lane
        - Roadway traction and glare data
        - Vehicle weight and performance data

    2. Communications needs

        In the near term, the suggested dynamic speed harmonization application will make use of existing communications network to allow communications between the Traffic Management Centers (TMC) to each field device. In addition, center-to-center communications with local jurisdictions, transit agencies, law enforcement, and between TMCs will also be needed. Center-to-center communications with the law enforcement will be needed to inform them of the prevailing speed limits with speed harmonization. If an operational segment traverses multiple jurisdictions, data sharing will become critical, thereby necessitating center-to-center communications between the two regional TMCs. Center-to-center communications will be needed with transit agencies to inform them of traffic conditions that may affect their routes, and with local jurisdictions, to alleviate any spillback from the arterial onto the freeway. These requirements are expected to have limited latency requirements, but may have critical security and cost requirements.

        In the long term, low-latency wireless communication will be required to communicate target speeds to vehicles. Vehicles themselves may potentially be used to further propagate target speeds to other vehicles.

    3. Infrastructure needs

        In the near term, the application will make use of existing sensors. Sign gantries will need to be deployed every half a mile in recurrent congestion areas. In the long term, the application will mostly make use of RSEs. Target speeds will mostly be provided in-vehicle.

    4. Other needs

        None.

7. Is the suggested application of interest a modification or enhancement of existing/ongoing research that you have conducted?

    ☐ Yes If yes, specify:
    Project title _____
    Sponsoring organization _____

    ☑ No

III. Definition of Terms

IntelliDrive:	interoperable networked wireless communications among vehicles (light vehicles, transit, and freight), the infrastructure, and travelers' personal communications devices
Mobility application:	an application that increases the efficiency of the system and enhances the mobility of individuals (travelers) within the system
Stakeholder:	a direct or indirect user of the surface transportation system and transportation system managers. In the case of the Dynamic Mobility Applications Program, stakeholder groups are identified by those who utilize developed mobility applications and those impacted by the deployment of a particular mobility application.
System efficiency:	the capability of the surface transportation system to transport goods and travelers reliably and safely and with the lowest possible environmental impact and most efficient use of energy
Transformative application:	an application that enables a transformative effect on surface transportation system performance, i.e., it significantly raises the capability of the surface transportation system to transport goods and travelers reliably and safely and with the lowest possible environmental impact and most efficient use of energy