UNITED STATES
DEPARTMENT OF TRANSPORTATION

Intelligent Transportation Systems
Joint Programs Office

The Potential Benefits of Dynamic Mobility Applications (DMA)

DCM/DMA 2013 Winter Webinar Series

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Webinar Purpose

- Informational webinar presenting the activities being conducted to assess the potential impacts of mobility applications:
  - The assessment plan
  - Preliminary results from the first stages, including an estimate of congestion reduction benefits
  - A status update on the next key activity: the joint DMA-ATDM Analysis, Modeling and Simulation (AMS) Testbed
    - DMA: Dynamic Mobility Applications
    - ATDM: Active Transportation and Demand Management

Webinar Agenda

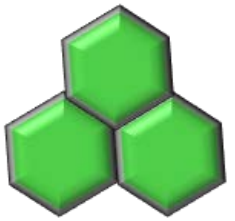
- Introduction (*Kate Hartman*)
  - Overview of Dynamic Mobility Applications (DMA)
  - DMA impact assessment
- Overview of performance measures and target goals for DMA (*Brian Cronin*)
- Results from a preliminary study of congestion impacts of DMA (*Brian Cronin*)
- Update on the DMA – Active Transportation and Demand Management (ATDM) Analysis, Modeling and Simulation (AMS) effort (*James Colyar*)
- Summary (*Kate Hartman*)

Dynamic Mobility Applications

- The Dynamic Mobility Applications (DMA) Program seeks to create applications that fully leverage frequently collected and rapidly disseminated multi-source data gathered from connected travelers, vehicles and infrastructure, and that increase efficiency and improve individual mobility while reducing negative environmental impacts and safety risks

DMA Program Vision and Objectives

- **Vision**: Expedite development, testing, commercialization and deployment of innovative mobility applications that:
  - Maximize system productivity
  - Enhance mobility of individuals within the system
- **Objectives**
  - Create applications using frequently collected and rapidly disseminated multi-source data from connected travelers, vehicles (automobiles, transit, freight) and infrastructure
  - Develop and assess applications showing potential to improve nature, accuracy, precision and/or speed of dynamic decision making
  - Demonstrate promising applications predicted to significantly improve capability of transportation systems
  - Determine required infrastructure for transformative applications implementation, along with associated costs and benefits

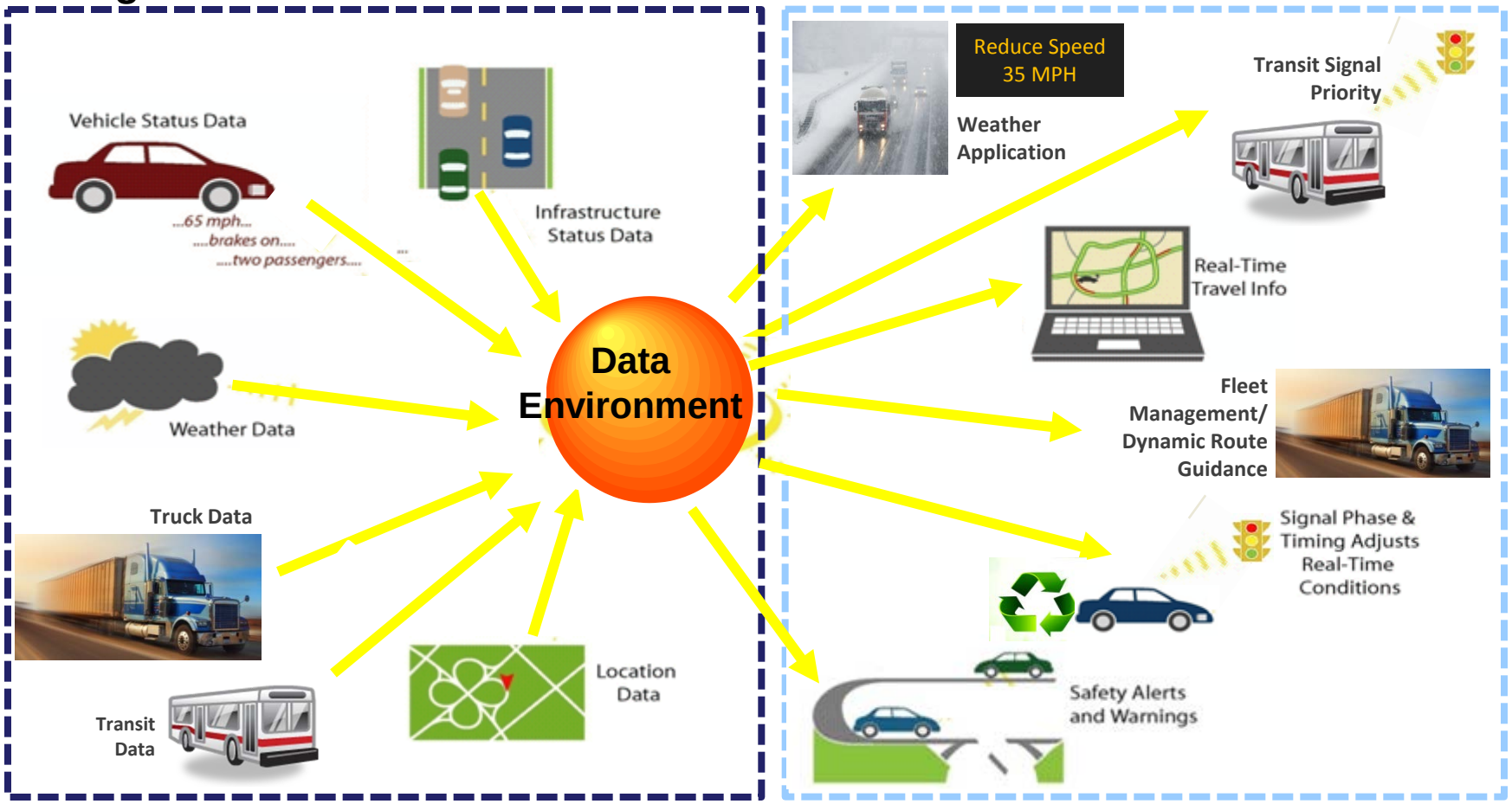


Transformative Mobility Applications

The Mobility Program

Real-time Data Capture and Management

Dynamic Mobility Applications



Dynamic Mobility Application Bundles

MMITSS:
Multimodal Intelligent Traffic Signal System

Ben McKeever

INFLO:
Intelligent Network Flow Optimization

Mohammed Yousuf

R.E.S.C.U.M.E.:
Response, Emergency Staging and Communications, Uniform Management, and Evacuation

Linda Dodge

Enable ATIS:
Enable Advanced Traveler Information Systems

Bob Rupert

IDTO:
Intelligent Dynamic Transit Operations

Ron Boenau

FRATIS:
Freight Advanced Traveler Information Systems

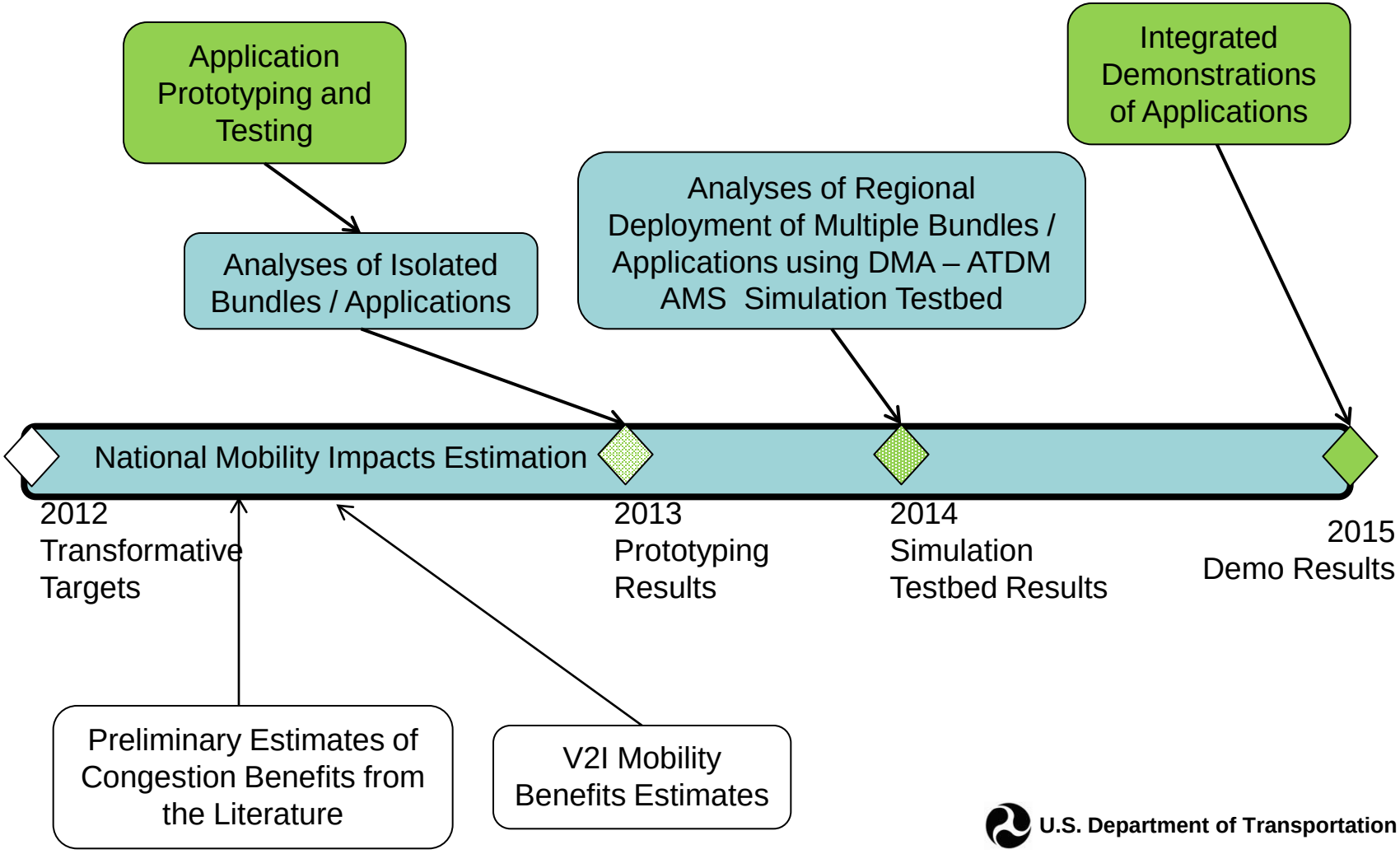
Randy Butler

Other Programs: **ICM** **ATDM**

Weather

DMA Impact Assessment Activities

The DMA program includes an ongoing set of activities to develop and continually refine estimates of the impact mobility applications:



Performance Measures and Target Goals

- Performance metrics have been defined for each high priority mobility application in each bundle
- Target goals have been set for each application bundle and in some cases for specific applications
- Target goals have been set for three time periods:
  - Near-term: next 5 years
  - Mid-term: 5-10 years out
  - Long-term: > 10 years out
- The initial target goals were vetted by ITS stakeholders at the Mobility Workshop held in April of 2012.
- More information on the aspirational goals for each bundle is available at: http://www.its.dot.gov/presentations/MWII5_Bundles_v4_files/frame.htm

Performance Measures and Aspirational Goals

Long Term Performance Goals for M-ISIG:

Performance Measure	> 10 Years Target Goal
Overall Vehicle Delay	Reduce by 25%
Throughput	Increase by 15%
Queue Length	Reduce by 15%
Average Pedestrian Wait Time	Reduce by 20%
Average Transit Delay	Reduce by 35%
Average Commercial Vehicle Delay	Reduce by 15%
Average Emergency Vehicle Delay	Reduce by 40%
Extent of System-Wide Congestion (i.e., failure to clear queue in a cycle)	Reduce by 25%
Duration of System-Wide Congestion	Reduce by 40%
Duration of Response to a Traffic Incident (overall incident clearance time)	Reduce Total Response Time by 30%

Benefits of Dynamic Mobility Applications: Preliminary Estimates from the Literature

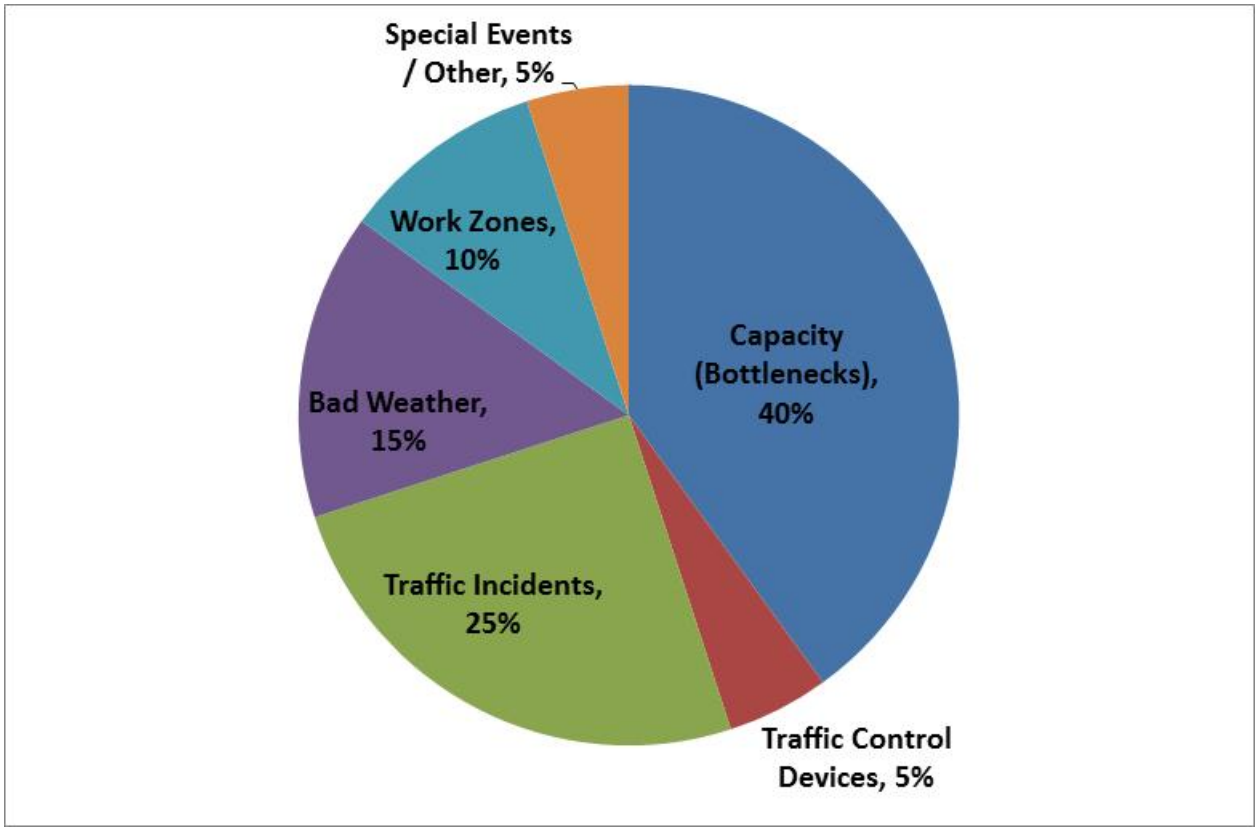
- **Purpose of study:** Use currently available quantitative information to develop a rough estimate of the potential benefits of mobility applications
- **Scope:** Although mobility applications will provide safety and environmental benefits as well, the scope was limited to mobility benefits (including transit and freight).
- **Approach:** Search the literature for quantitative information on the potential mobility benefits of the connected vehicle Dynamic Mobility Applications (DMA) or similar applications.
  - Benefits can come from new applications, e.g., Cooperative Adaptive Cruise Control
  - Benefits can come from wide deployment of existing technologies, enabled by lower cost of deployment, e.g., Ramp Metering

Sources of Information

- Reviewed 45 resources, including:
  - Mobility Application Bundles Concepts of Operation
  - Mobility Application Bundles literature surveys
  - The ITS Knowledge Resources Portal
  - ICM study Reports
  - Over a dozen additional papers and reports

Causes of Congestion

- In order to calculate national benefits, the percentage improvement for each application had to be prorated by the type(s) of congestion they reduce:



Causes of Congestion (*Source: Federal Highway Administration*)

Major Caveats and Assumptions

- Data was *very* limited. Despite a desire to develop national estimates on delay, travel time variability, capacity increases, etc., in the end, only developed estimates on the percent reduction in congestion.
- Not all applications apply to all roadway types, some are limited to signalized arterials, others to freeways.
  - Assumed ½ of all congestion occurs on arterials, ½ on freeways, with negligible delay on unsignalized minor roads
- When multiple applications yield benefits on the same type of roadway, assumptions must be made about their interactions.
  - Double-counting was avoided
  - Assumption is that each application is independent
  - Example: assume three mobility applications have each been separately shown to reduce congestion by 33%. Aggregate remaining congestion is taken to be (1-0.33)*(1-0.33)*(1-0.33) = 30% of congestion, e.g., a 70% reduction.

Major Caveats and Assumptions

- If only travel time reduction was reported, the delay reduction was set equal to the travel time reduction
  - Delay reduction percentage will always be greater than the travel time percentage reduction
- If only capacity increase information was available, the delay reduction is taken to be the inverse of the capacity increase (e.g., a doubling of capacity is assumed to reduce delay by 50%)
  - Conservative estimate, as delay often increases more rapidly as capacity limits are reached.
- If no quantitative data was available for an application, it is not included in the calculations

Example Calculation: Intelligent Traffic Signal Control (ISIG) Application

- Arterials are assumed to account for 50% of delays due to congestion, freeways the remaining 50%
- Literature (*Quantifying the Benefits of Coordinated Actuated Traffic Signal Systems: A Case Study*) indicated that real-time optimization of signal controls can provide a 30% reduction in arterial delay
- Other analysis had shown that Cooperative Adaptive Cruise Control (CACC) and Speed Harmonization could reduce delays due to congestion on freeways by 34%
- Combined benefit of ISIG, CACC, and Speed Harmonization is then:

$$30\%\ ADR\ x\ 50\%\left(\frac{DR}{ADR}\right) + 34\%\ FDR\ x\ 50\%\left(\frac{DR}{FDR}\right) = 32\%\ DR$$

$$ADR = Arterial\ Delay\ Reduction$$

$$DR = Total\ Delay\ Reduction$$

$$FDR = Freeway\ Delay\ Reduction$$

Results

- Mobility applications will reduce the impact of all six causes of congestion while simultaneously increasing safety and benefiting the environment.
- Based on the limited data currently available from modeling and field trials of similar applications, ***full deployment of the set of mobility applications may be capable of eliminating over 1/3rd of the travel time delay caused by congestion.***
- While outside the scope of this study, the Dynamic Mobility Applications will also reduce crashes, improve safety, and provide emissions reductions
- Report documenting the analysis is currently in the publication process.

DMA-ATDM AMS Testbed

- Both ATDM and DMA programs have invested significant resources in the development of advanced concepts and foundational research
- An AMS (Analysis, Modeling, and Simulation) Testbed provides a virtual computer-based simulation environment for targeted, integrated testing prior to field deployment
- An AMS Testbed is used in analysis to identify the impacts of:
  - predictive, more active systems management (ATDM Strategies)
  - integrating transformative applications enabled by new data from wirelessly connected vehicles, travelers, and infrastructure (DMA Applications)
- Proceeding in 2 Phases:
  - Testbed Planning (current)
  - Testbed Development and Evaluation (upcoming)

AMS Testbed Planning Project Objectives

- Plan for **multiple** Analysis, Modeling, and Simulation (AMS) Testbeds to support the DMA and ATDM Programs in evaluating and demonstrating the impacts of deploying application bundles and strategies in a simulation environment:
  - Identify AMS Requirements for a portfolio of Testbeds
  - Develop preliminary evaluation plans, one each for the DMA and ATDM Programs
  - Develop a framework for an AMS Testbed
  - Conduct an initial screening of AMS Testbed locations

Testbed Planning Objective #1: AMS Testbed Requirements

- **Purpose**
  - Develop requirements for a portfolio of AMS Testbeds that support the DMA and ATDM Programs

- **Approach**
  - Review materials previously developed for ATDM and DMA Programs:
    - AMS ConOps; AMS Capability Assessment; AMS Analysis Plans
    - DMA Analytical Needs Assessment
  - Define requirements for the ATDM analysis packages and DMA bundles
    - Assign to each requirement a priority, which is a function of the technical risk and criticality of the requirement
  - Engage internal and external stakeholders to solicit feedback

- **Status and schedule:**
  - Internal informational webinar held on 18 December, 7 January
  - External stakeholder workshop held at TRB on 13 January
  - Finalized requirements in late March 2013

Testbed Planning Objective #2: AMS Testbed Preliminary Evaluation Plans

- **Purpose**
  - Develop two preliminary evaluation plans, one each for the DMA and ATDM Programs to:
    - evaluate the impacts of the DMA bundles/ATDM strategies
    - identify potential conflicts and synergies between the bundles/strategies

- **Approach**
  - Discuss of evaluation objectives and hypotheses with internal stakeholders from the DMA and ATDM Programs separately
  - Plans considered "preliminary", used as input and finalized during AMS Testbed Development/Evaluation task

- **Status and schedule:**
  - Draft Plans complete in early April 2013
  - Final Plans to be complete in May 2013

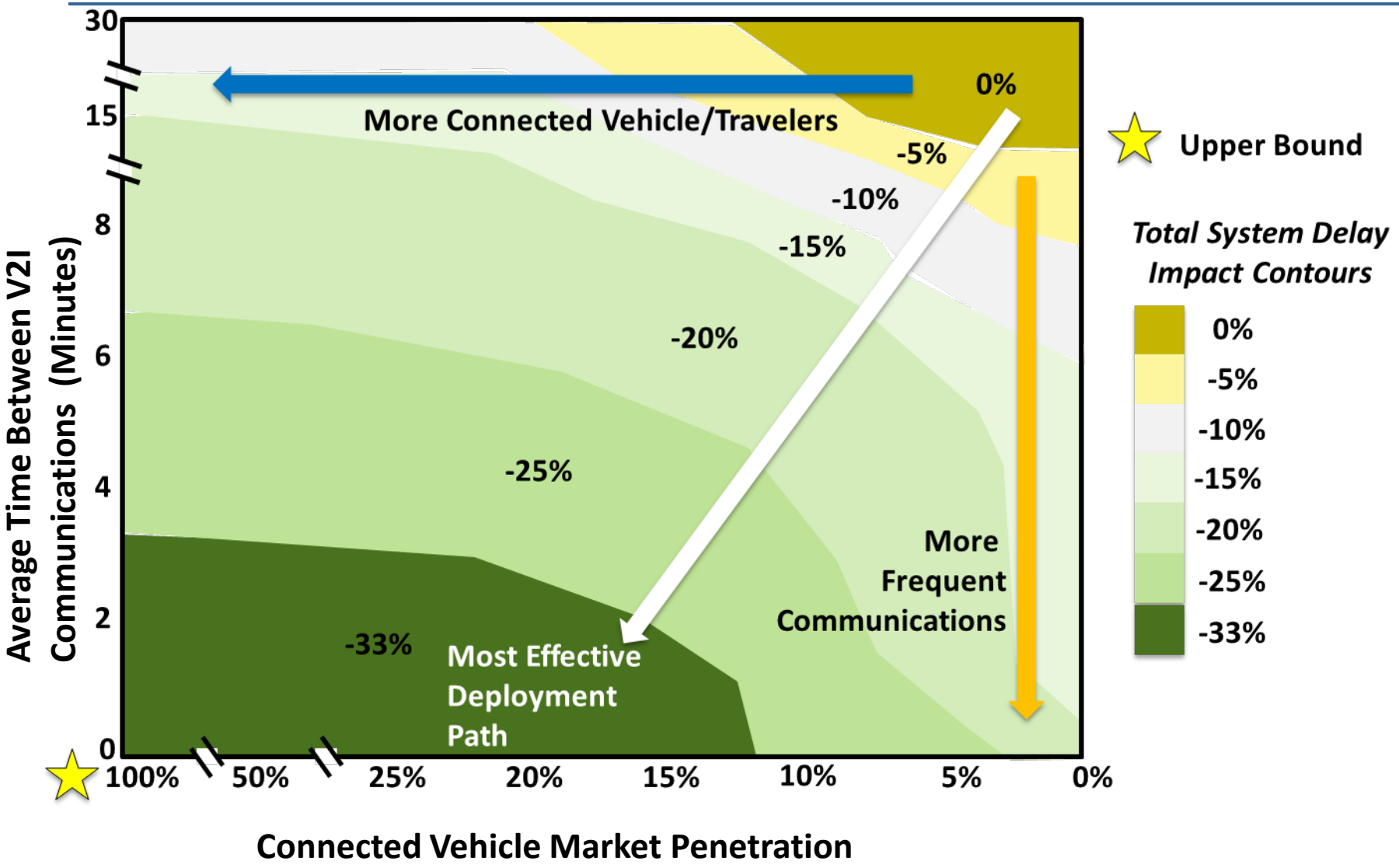
Testbed Planning Objective #3: AMS Testbed Framework

- **Purpose**
  - Establish a framework for developing an AMS Testbed
- **Approach**
  - Framework will unlikely serve needs of all AMS Testbeds; each AMS Testbed activity will tailor the framework according to the needs of the portfolio of bundles/strategies being modeled
  - Solicit input from AMS expert stakeholders on framework
- **Status and Schedule:**
  - Draft AMS Testbed Framework Report complete in early April 2013
  - Final AMS Testbed Framework Report to be complete in May 2013

Testbed Planning Objective #4: AMS Testbed Initial Screening

- **Purpose**
  - Conduct a screening of AMS Testbed locations, and shortlist 7 to 10 candidates
- **Approach**
  - Develop screening criteria for shortlisting candidate testbeds:
    - Sufficient geographic scope (spatial scale) and temporal scale
    - Multi-modal to capture mode shifts and transit operations
    - Capable of generating data needed for AMS
- **Status and Schedule:**
  - Draft AMS Testbed Initial Screening Report completed in early April 2013
  - Final Testbed Initial Screening Report to be complete in May 2013

What the AMS Testbed Can Reveal: Effect of Increased Connected Vehicle Market Penetration on Impacts



Webinar Summary (1 of 2)

- Connected vehicle mobility applications will provide substantial mobility, safety, and environmental benefits
- Performance measures have been defined, and target goals set
- A multi-faceted program is underway to develop and continually refine quantitative estimates of the benefits
  - These estimates will be used to support investment decisions regarding both research and deployment
- Based on the limited data currently available, full deployment of mobility applications may be capable of eliminating over 1/3rd of the travel delay that is caused by congestion

Webinar Summary (2 of 2)

- Next Steps:
  - V2I Mobility Benefits Estimates (results in summer 2013)
  - Completion of AMS Testbed Planning (November 2013)
  - Application prototyping and testing (FRATIS underway, others to begin later this year)
  - National Mobility Impacts Estimation (task order award pending)

For more information …

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