AMS Testbed Development to Support Evaluation DMA and ATDM Programs

DMA Stakeholder Engagement

Booz Allen Hamilton

May 15, 2014

Agenda

▸ Project Overview and Status Update
▸ DMA Program Research Questions Prioritization
▸ Mapping of DMA Applications to Testbeds
▸ Questions/Discussions

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DMA/ATDM AMS Testbeds
- Project Overview

- ▶ Testbeds will be virtual computer based environments in a laboratory setting, to create models/tools that can capture impacts of implementing concepts, bundles, and strategies associated with the DMA and ATDM Programs
  - – Will be as close to real-world as possible by modeling an actual metropolitan region's transportation system and transportation demand (e.g., persons, vehicles, transit)
  - – Modeling conducted will not be directly connected to the systems, algorithms, or TMC operators
  - – Will leverage existing and previous AMS capabilities and modeling efforts

- ▶ Testbeds will support a detailed and integrated evaluation of DMA and ATDM concepts, before initiating costly large-scale field deployments and testing:
  - – System-wide impacts of individual DMA applications, DMA bundles, logical combinations of DMA bundles when applied in a connected environment
  - – System-wide impacts of ATDM strategies when implemented individually and in logical combinations, as well as under different operational conditions
  - – Impacts of the DMA bundles and ATDM strategies when prediction and active management are coupled with data capture and communications technologies

Project Stages

▸ **Stage 1: AMS Testbed Selection**
  – Develop Testbed requirements
  – Conduct preliminary selection of AMS Testbeds
  – Final AMS Testbeds Selection (Recommendation)
 – **Develop Testbed specific Analysis Plans** ⬅ *We are here*

▸ **Stage 2: Develop Evaluation Methodology**
  – Combine Testbed specific analysis plans developed in Stage1 to develop a final evaluation plan

▸ **Stage 3: Modeling, Analysis, and Reporting**
  – Develop and calibrate Testbed models, including data collection
  – Evaluate DMA and ATDM strategies using Testbeds once calibration is complete
  – Report the relevant findings and summarize them in to reports
  – Recommend next-step research for continuation of the DMA/ADTM future projects

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AMS Project Timeline
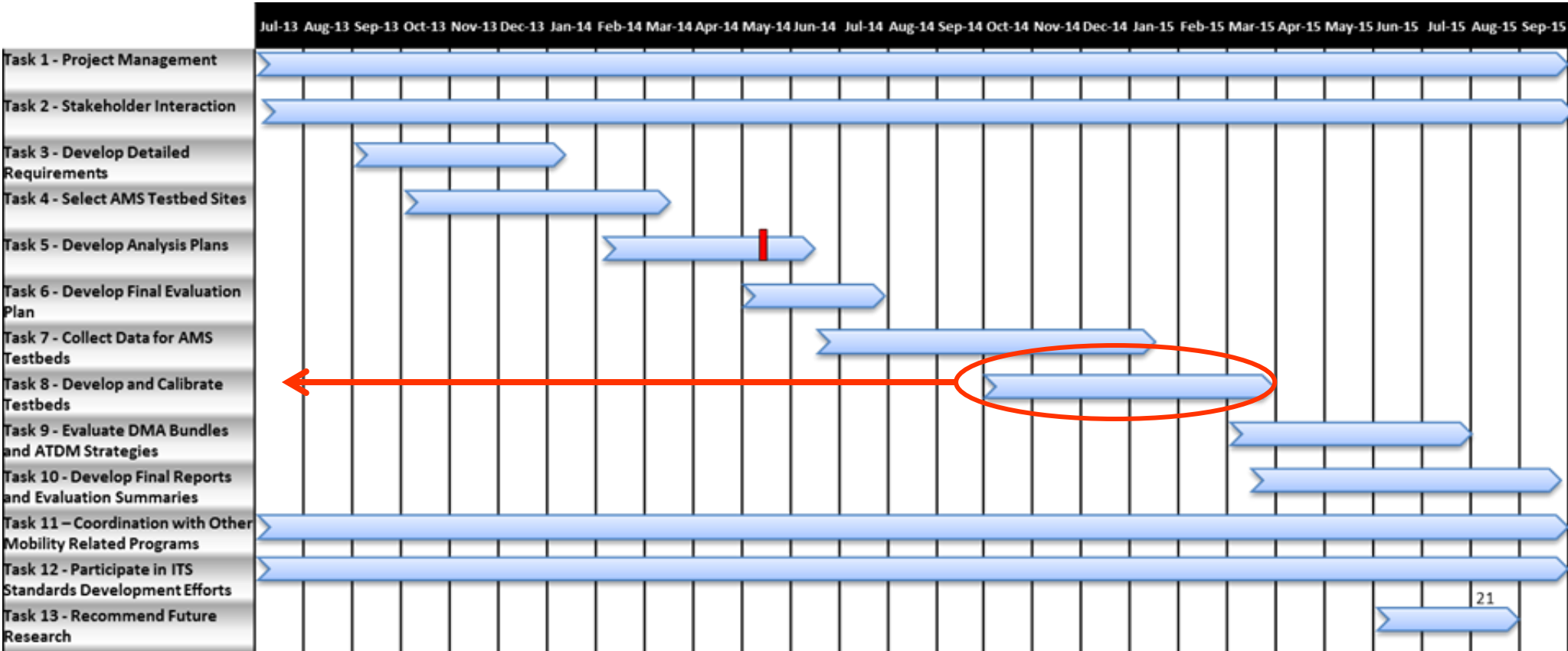
Candidate Testbeds Evaluated
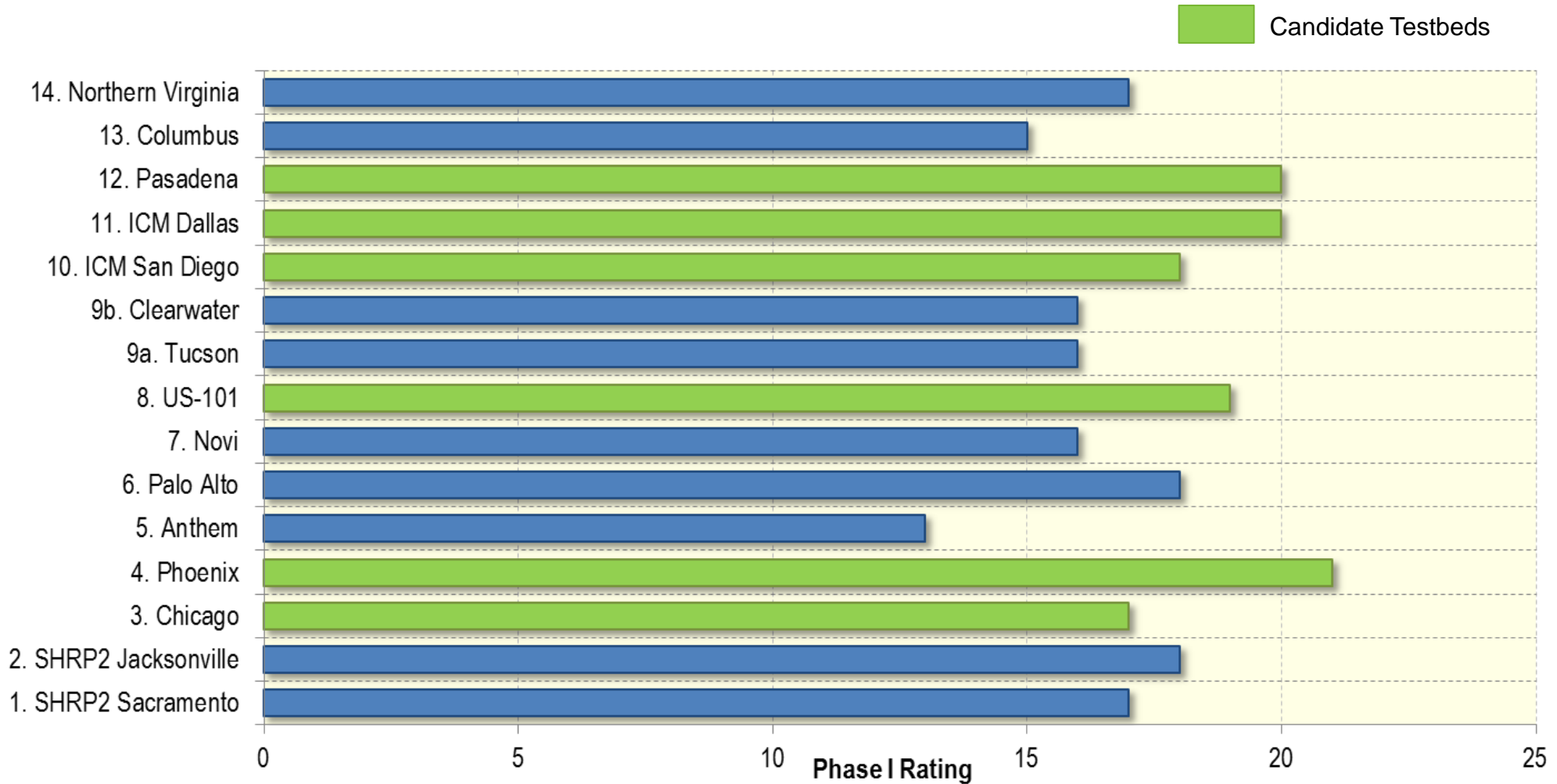
Selected Testbeds

▸ **US 101** is a **small freeway/arterial** Testbed

  – Low risk, small testbed, can be used to test scenarios quickly

▸ **Pasadena** is a **city/small region** Testbed

  – Good location for both ATM and DMA concepts

▸ **ICM Dallas** is a **corridor** Testbed

  – Suitable to test predictive methods envisioned for ATDM

▸ **Phoenix** is a **large region** Testbed

  – Ideal for modeling regional impacts of a portfolio of applications independently and in combinations

▸ **Reserve** Testbeds

  – Chicago (Weather), SHRP2 Sacramento, ICM San Diego, Northern Virginia

Anticipated Support from DMA Bundle Prototypes/Projects

▸ Share **schedules** for implementing the prototypes/projects, to help identify coordination points as we begin to develop a detailed schedule for the Testbeds

    a) **When will the design details become available to help develop the simulation scenarios?**

    b) **When can interim and final versions of any algorithms and prototype source codes be expected?**

        ▪ Algorithms to be reused in the Testbeds to the extent possible, to minimize development of new algorithms

    c) **When will the data from the testing phase become available to support validation and calibration process?**

▸ Provide details on **target impacts** that will be studied in the prototypes/projects, to help assess the extent to which the DMA program's target impacts need to be modeled and analyzed in the Testbeds

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DMA Research Questions Categories

I. Connected Vehicle Technology vs. Legacy Systems

II. Synergies and Conflicts

III. Operational Conditions, Modes, Facility Types with Most Benefit

IV. Messaging Protocols

V. Communications Technology

VI. Communications Latency and Errors

VII. RSE/DSRC Footprint

VIII. Prediction and Active Management Investment

IX. Deployment Readiness

X. Policy

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DMA Research Questions Prioritization

▸ Purpose

– Help the AMS team identify the areas of high priority focus

– Develop the Testbed specific analysis plan to address the high priority areas

▸ Process

– Stakeholders asked to use the following priority scale to rate each question

- ▪ *High:* top 50% → 13 questions
- ▪ *Medium:* middle 25% → 6 questions
- ▪ *Low:* bottom 25% → 6 questions
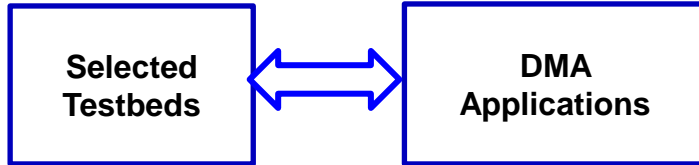
Prioritization Results: Top DMA Research Questions

Rank	DMA Research Question
1	What is the marginal benefit if data from **connected vehicle** technology are **augmented** with data from legacy systems or vice-versa?
2	What DMA bundles or combinations of bundles yield the most benefits for specific **operational conditions**?
3	Which technology or **combination of technologies** best supports the DMA bundles in terms of benefit-cost analysis?
4	What DMA applications, bundles, or combinations of **bundles complement or conflict with each other**?
4	What are **the tradeoffs between deployment costs and benefits** for specific DMA bundles and combinations of bundles?
4	Under what **operational conditions** are specific bundles the most beneficial?
7	At what levels of **market penetration** of connected vehicle technology do the DMA bundles (collectively or independently) become effective?
8	What are the **impacts of future deployments** of the DMA bundles in the near, mid, and long term (varying market penetration, RSE deployment density, and other connected vehicle assumptions)?
9	What are the impacts of **communication latency** on benefits?
10	Under what **operational conditions** do particular combinations of DMA bundles conflict with each other?
10	Will a nomadic device that is capable of communicating via both DSRC as well as cellular meet the needs of the DMA bundles? When is **DSRC needed and when will cellular suffice**?

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Testbeds - DMA Applications Matching Process

STEPS   **MATCHING**

STEP 1
- Selected Testbeds ⟷ DMA Applications

STEP 2
- Selected Testbeds ⟷ Research Questions
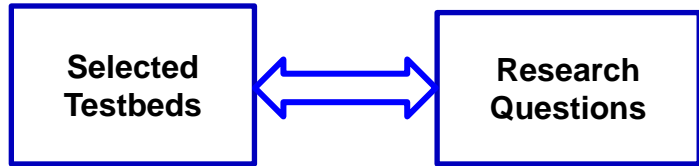
STEP 3
- Selected Testbeds ⟷ Research Questions
- DMA Applications

1. Investigate the high-level needs of every **DMA Application;** for example:
Q-warn needs: ~Freeway network. ~Meso DTA with lane considerations or Microsimulation models. ~Dyamic behavior models for route choice an driving decisions.

2. Match one (or more) Testbed with every DMA **application** based on the Testbeds' capabilities (e.g., US 101)
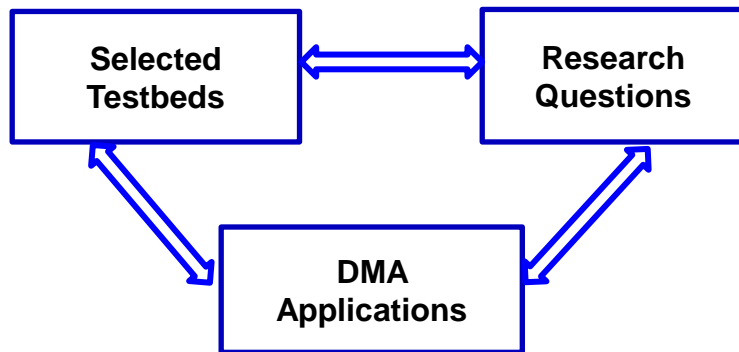
1. Investigate the high-level needs of every **research question**; for example:
Which DMA bundle or combinations of bundles will be most beneficial for certain modes and under what operational conditions?
This research question needs a regional network that has the ability to model multiples modes (pedestrian, car, bus, etc.)

2. Match one (or more) Testbed with every DMA **research question** based on the Testbeds' capabilities (e.g., Phoenix Testbed)

Matching DMA Applications to Testbeds (Preliminary)

Bundle	Application	US 101	Phoenix	Dallas	Pasadena
Enable ATIS	Multimodal Real-Time Traveler Information (ATIS)	-	Yes	-	-
	Smart Park-and-Ride (S-PARK)				
	Universal Map Application (T-MAP)				
	Real-Time Route-Specific Weather Information (WX-INFO)				
INFLO	Queue Warning (Q-WARN)	Yes	Yes	-	Yes
	Dynamic Speed Harmonization (SPD-HARM)	Yes	Yes	-	-
	Cooperative Adaptive Cruise Control (CACC)	Yes	Yes	-	-
MMITSS	Intelligent Traffic Signal System (ISIG)	Yes	-	-	Yes
	Transit Signal Priority (TSP)	Yes	-	-	Yes
	Mobile Accessible Pedestrian Signal System (PED-SIG)	Yes	-	-	-
	Emergency Vehicle Preemption (PREEMPT)	Yes	-	-	-
	Freight Signal Priority (FSP)	Yes	-	-	-
IDTO	Connection Protection (T-CONNECT)	-	Yes	-	-
	Dynamic Transit Operations (T-DISP)	-	Yes	-	-
	Dynamic Ridesharing (D-RIDE)	-	Yes	-	-
FRATIS	Freight Real-Time Traveler Information with Performance Monitoring (F-ATIS)	-	Yes	-	-
	Drayage Optimization (DR-OPT)				
	Freight Dynamic Route Guidance (F-DRG)	-	Yes	-	-
R.E.S.C. U.M.E.	Emergency Communications and Evacuation (EVAC)				
	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESPSTG)				
	Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)	-	Yes	-	-

DMA Prototypes: Anticipated Completion Dates and Availability of Algorithms & Data

Bundle	Application	PD to be completed
RESCUME	EVAC	NOT ADDRESSED
	RES- STG	TBD
	INC-ZONE	TBD
EnableATIS	ATIS	TBD
	S-PARK	NOT ADDRESSED
	T-MAP	NOT ADDRESSED
	WX-INFO	NOT ADDRESSED
INFLO	Q-WARN	11/30/2014
	SPD-HARM	
	CACC	NOT ADDRESSED
MMITSS	ISIG	AZ - 02/13/2015
	TSP	CA - 03/06/2015
	PED-SIG	
	PREEMPT	
	FSP	
IDTO	T-CONNECT	OH - 10/31/2014
	T-DISP	FL - TBD
	D-RIDE	
FRATIS	F-ATIS	CA - 8/31/2014
	DR-OPT	FL - 12/31/2014
	F-DRG	TX - 8/15/2014

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