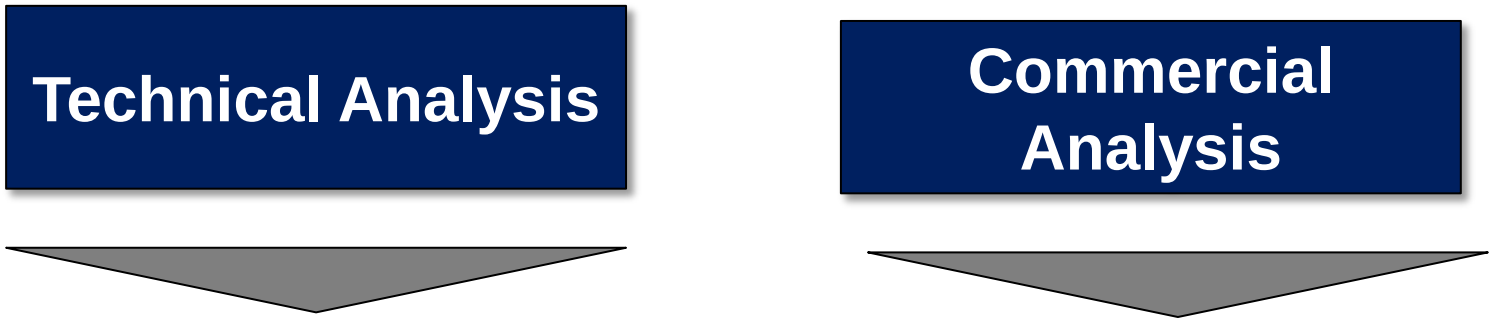
High Level Options for Secure Communications Data Delivery Systems

April 19, 2012
Washington, DC

Outline

- Communications Data Delivery System (CDDS) Stages of Work
- Summary of Proposed Certificate Management Communication Needs
- Technical Review
- Commercial/Financial Review
- Next Steps

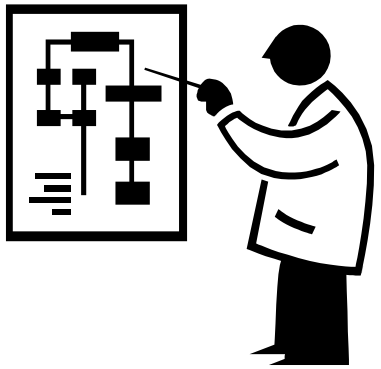
Technical and Commercial Analysis Components



Combined, these two analyses will provide high-level options for secure communications data delivery systems

Technical Analysis Components

- Communication Needs
  - V2V
  - V2I
  - Security Management
- Technology Analysis
  - Technologies available
- Data Communication
  - Message sizes
  - Required equipment and communication links



Commercial Analysis Components

- Scenario Analysis
  - *Two Hybrids*
  - *All DSRC*
  - *Phased Deployment*
- Benefit Analysis: Focus on Costs and Business Models
- Network Analyses
  - Issues and tradeoffs
- Challenges and Opportunities
  - Potential third party cost mitigation opportunities

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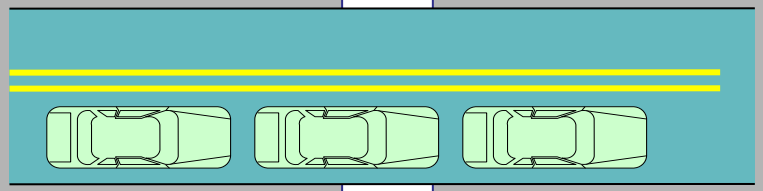
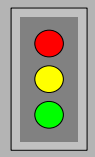
Characteristics of Communications Types

Vehicle To Vehicle



- Safety Messages
- Exchanges certificates (security payload)

Vehicle To Infrastructure



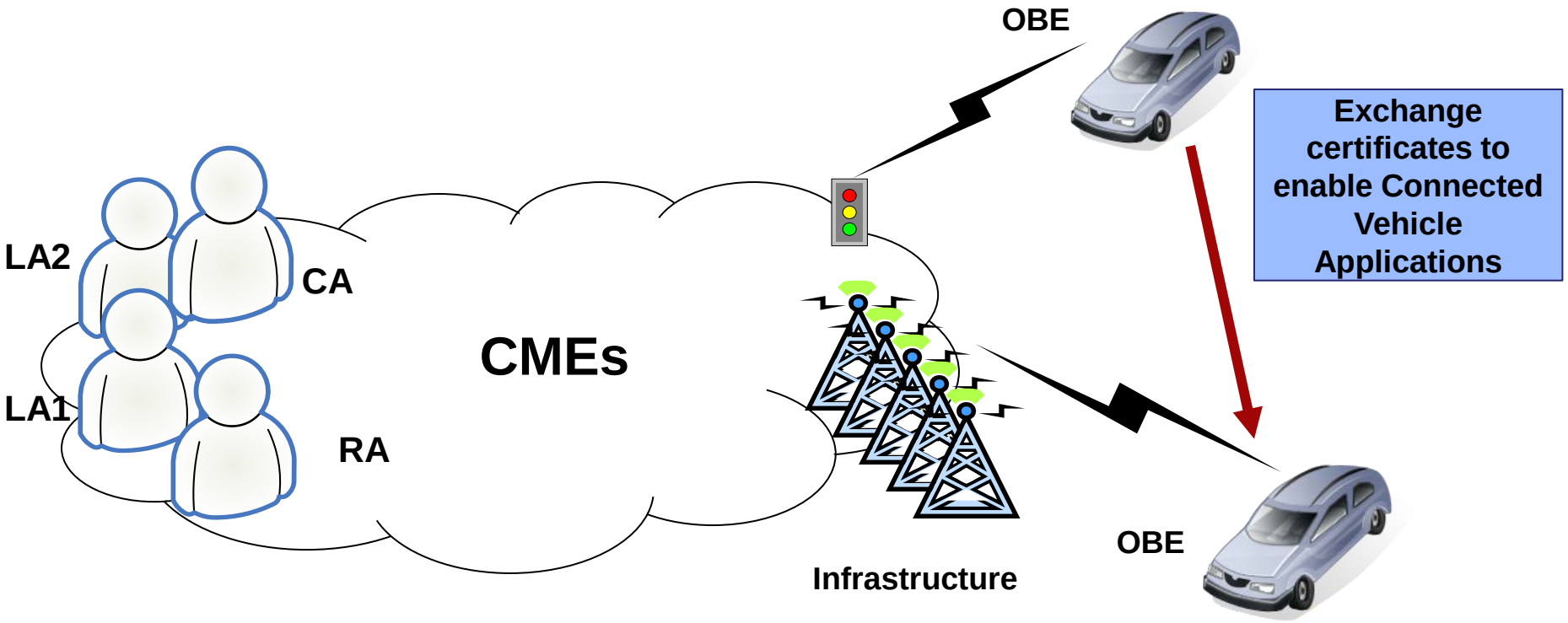
- Dynamic Mobility Applications may span signal phase and timing through tolling transactions

Security Management

- Security credentials for mobile terminals (vehicles) updated and managed
- Unique V2I communication: not generally location oriented
- Volume of data may be substantial

Communication exchanges are distinct, which complicates a "one-size fits all" approach

CME from the On Board Equipment (OBE) Perspective



Communications between OBE and CMEs			
Requests for and distribution of annual certificates	Requests for and distribution of monthly decryption keys	Misbehavior Reports from OBEs to CMEs	Certificate Revocation Lists (CRLs_ from CMEs to OBEs

Potential Characteristics of Signed Connected Vehicle Messages

Message Transaction	Overall Size (Byte)	Send	Receive	Freq
Basic Safety Message	528	OBE	OBE	10 Hz
Max WSM	1500	I/V	V/I	~10 Hz
Certificate Update Request	**533**	**OBE**	**RA**	**Annual**
Certificate Bundle	**15,572,040 or more**	**RA**	**OBE**	**Annual**
Certificate Decryption Request	**362**	**OBE**	**RA**	**Monthly**
Certificate Decryption Reply	**378**	**RA**	**OBE**	**Monthly**
Misbehavior Report	**854**	**OBE**	**MDMA**	**Variable**
CRL Request	**336**	**OBE**	**CA/RA**	**Daily**
CRL	**Variable**	**CA/RA**	**OBE**	**Daily**

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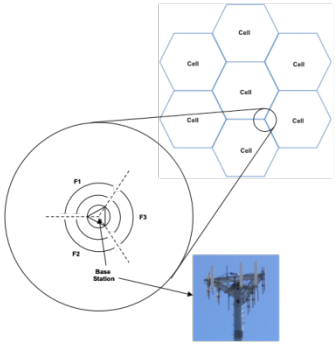
Different Ways of Providing Communications: Cellular

Cellular/Long-Term Evolution (LTE) Technology

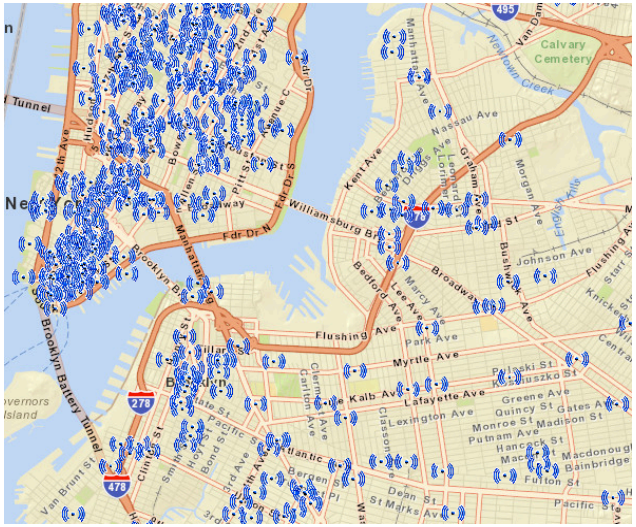


Typical Cellular System Arrangement

- Wide area two-way mobile communications
- Voice and data-oriented
- Provides high-speed data transfer rates to a large subscriber base simultaneously
- Growth expected to continue at an exponential rate (tenfold in the next five years)
- Commercially operated. Implies service contracts or other business arrangements

Different Ways of Providing Communications: WiFi

WiFi Technology



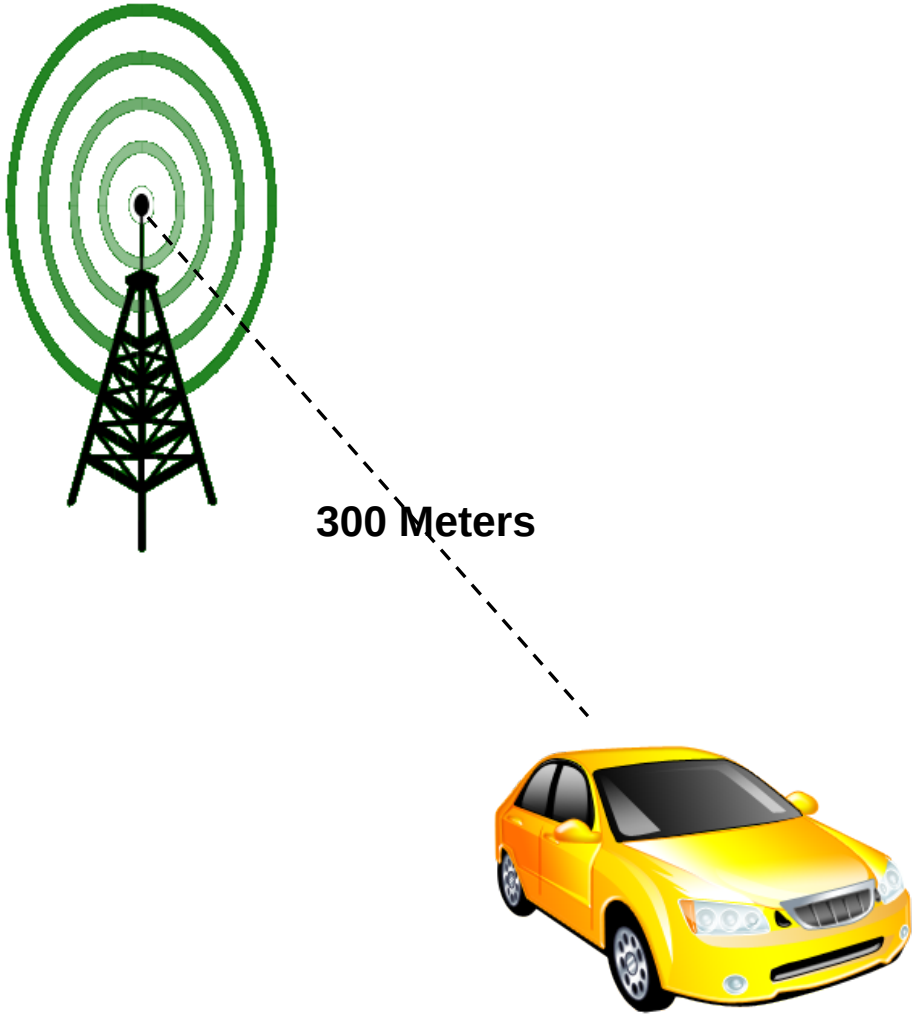
WiFi Hot Spot Distribution

- Wireless internet technology provides Internet access to devices in range of the base station footprint
- Typical ranges of about 100 feet. Can be increased for stationary users.
- Typically takes about 10 seconds to recognize devices in network
- Some certificate management functions difficult because moving vehicles pass through footprint too quickly

Different Ways of Providing Communications: DSRC

Dedicated Short-Range Communication (DSRC)

- Specialized form of WiFi developed specifically to data communications with moving vehicles
- Does not use a conventional "network", making setup time near zero
- Allows terminals to broadcast to all other devices in radio range
- Range of about 300 meters



Different Ways of Providing Communications: Other Tech

Other Technologies

- **WiMax** – Wide area system; Quickly becoming eclipsed by other technologies, such as LTE
- **Satellite Digital Audio Radio Service (SDARS**) – Very Wide Area (National). Broadcast only
- **HD Radio** – Wide area system; moderate data rate, very low cost. Broadcast only and infrastructure-based

Network Options Key Finding

KEY FINDING:

Best options for consideration, based on the various needs of the Connected Vehicle Environment are:

- **DSRC**
- **WiFi**
- **Cellular**

Advantages and Disadvantages of Network Options

Cellular

Advantages	Disadvantages	Recommendation
• Nationwide coverage • Universal equipment available	• Partnerships required with wireless carriers • Broadcast is problematic • Requires IP addressing *unless special arrangements can be made with carriers*	• Key element in analysis

Advantages and Disadvantages of Network Options

Advantages	Disadvantages	Recommendation
• Universal standard • Many hotspots available • High bandwidth	• Small coverage footprint of hotspots requires vehicles to be nearly stationary for most transactions • Disparate control and ownership of hotspots • Requires IP addressing and network setup (long attach delay)	• May be useful in certain roles

Advantages and Disadvantages of Network Options

DSRC

Advantages	Disadvantages	Recommendation
• WiFi-like standardization • Broadcast capability; *does not require IP addressing* • Nearly instantaneous network attach time • High bandwidth	• Not deployed • Small RF footprint limits size of data exchanges at higher speeds • Potential for channel congestion from high density V2V messaging	• Key element in analysis

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Scenario 1 of 4: Hybrid "Short Term"

Certificate Management	**Cellular**
V2I Mobility Data	**Cellular**
V2V and V2I Safety Data	**DSRC**

- Will examine using cellular data delivery for Certificate Management (CM) and V2I communications, and the DSRC network for the V2V communications
- Will examine potential efficiencies and costs of using two different networks for data delivery, and its ability to deliver CM functions

Scenario 2 of 4: Hybrid "End State"

Certificate Management	**Any and all opportunities: Cellular, WiFi and DSRC**
V2I Mobility Data	**Cellular**
V2V and V2I Safety Data	**DSRC**

- Rely on the wireless ecosystem to provide certificate data exchange needs
- Costs from the wireless carrier will likely be on a data usage basis, with a per-MB or per-GB cost
- *Must determine practicality: technical and deployment paths with data exchange functions important (e.g., OBE must have radio that can receive the right wireless connection)*

Scenario 3 of 4: All DSRC

Certificate Management	**DSRC**
V2I Mobility Data	**DSRC**
V2V and V2I Safety Data	**DSRC**

- Rely on DSRC to provide the wireless data communications needed for each of the operational functions of the certificate data exchange system
- Determine incremental or additional costs of building DSRC network to deliver certificate communication needs

Scenario 4 of 4: Phased Deployment

- **Phased Deployment option still under development**
- **Will likely still require some TBD frequency of CRL and misbehavior management communication.**

Potential Third Party Involvement in the CDDS

Major Areas Where Value to Third Parties May Be Present

- Making location data available to third parties in a way that protects personally identifiable information
- Monetizing any excess capacity that is delivered in the wireless network. Specialized services could be delivered to vehicles that the users could find potentially valuable
- Location-based services is a high-growth area

Additional Commercial and Financial Elements

Network Modeling Issues

Issues include:

- Bandwidth requirements
- Devices
- Coverage
- Time to Implement
- Network Management

Additional Commercial and Financial Elements

Network Deployment Challenges

- Two major costs and obstacles in deploying a robust network:
  - Network build
  - Device/user deployment
- Wireless networks capital intensive:
  - Must be built out to a sufficient coverage level
  - Must be fully built before deployment
- High device cost dampens the rapid, widespread proliferation of new users
- May be offset, depending on value to third parties

Additional Commercial and Financial Elements

Economic and Business Models

- Costs should generally be borne by the entities in the system that benefits the most from the network
  - Carriers
  - Potential third party partners
- Possible models:
  - Anonymous location data availability
  - Message exchange through excess capacity
  - Network maintenance in exchange for market data
  - Device company data collection and service provision benefits

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Scenarios to Consider

SCENARIO 1: Hybrid "Short Term"

SCENARIO 2: Hybrid "End State"

SCENARIO 3: All DSRC

SCENARIO 4: Phased roll out approach *(Under Development)*

Commercial/Financial Review

- Commercial analysis will determine the investment potential to stakeholders of the incremental deployment of a data delivery system
- Four scenarios will be considered for the final analysis:
  - Two hybrid scenarios
  - All DSRC
  - Phased deployment option
- Other economic models and challenges will be considered in the final analysis, to include:
  - Network deployment analysis
  - Cost mitigation strategies
  - Opportunities (such as Excess Capacity)

Three Stage Financial and Commercial Review Approach

Stage 1: Project Framework

- Establish metrics and objective measures
- Determine Options: baseline and others for analysis

Stage 2: Model Building

- Determine assumptions, variables, tradeoffs, risks and limitations
- Develop financial model
  - Stakeholder requirements
  - Coverage and performance metrics
  - Implementation strategies
  - Revenue models

Stage 3: Present and Review

- Construct and test final model
- Perform analyses
  - Comparative
  - Sensitivity
- Deliver recommendations and transfer model