

Overview of Vehicle Infrastructure Integration (VII)

5.9GHz DSRC and Tolling Implications



Washington State
Transportation Commission

The information herein comes from public sources (including some vendors), technical articles, and various reports. It is also the result of hundreds of industry discussions and interviews.

Tim McGuckin has worked in the NPO sector for 16 years, in transport-related trade associations with an increasing emphasis on technology. ATA, ITSA, AAMVA, IBTTA and OmniAir constitute Tim's practice.

Tim takes an impartial view and is vendor neutral. He believes that most worthwhile technologies are open access, scalable, interchangeable and complementary. In the end, the vehicle will comprise several protocols, each communicating with various off-board infrastructures depending on the application requested.

However, the ongoing objective at OmniAir is to drive the Consortium's mission: the advance of open, interoperable DSRC technology.

Supporting this objective comes easy to Tim for two reasons: 1) he works best when he pursuing what he believes in; and, 2) based on his experience, 5.9GHz DSRC is the appropriate next-generation toll technology for technical and policy reasons (and even better when DSRC is complemented by GPS functionality as V2I systems evolve).

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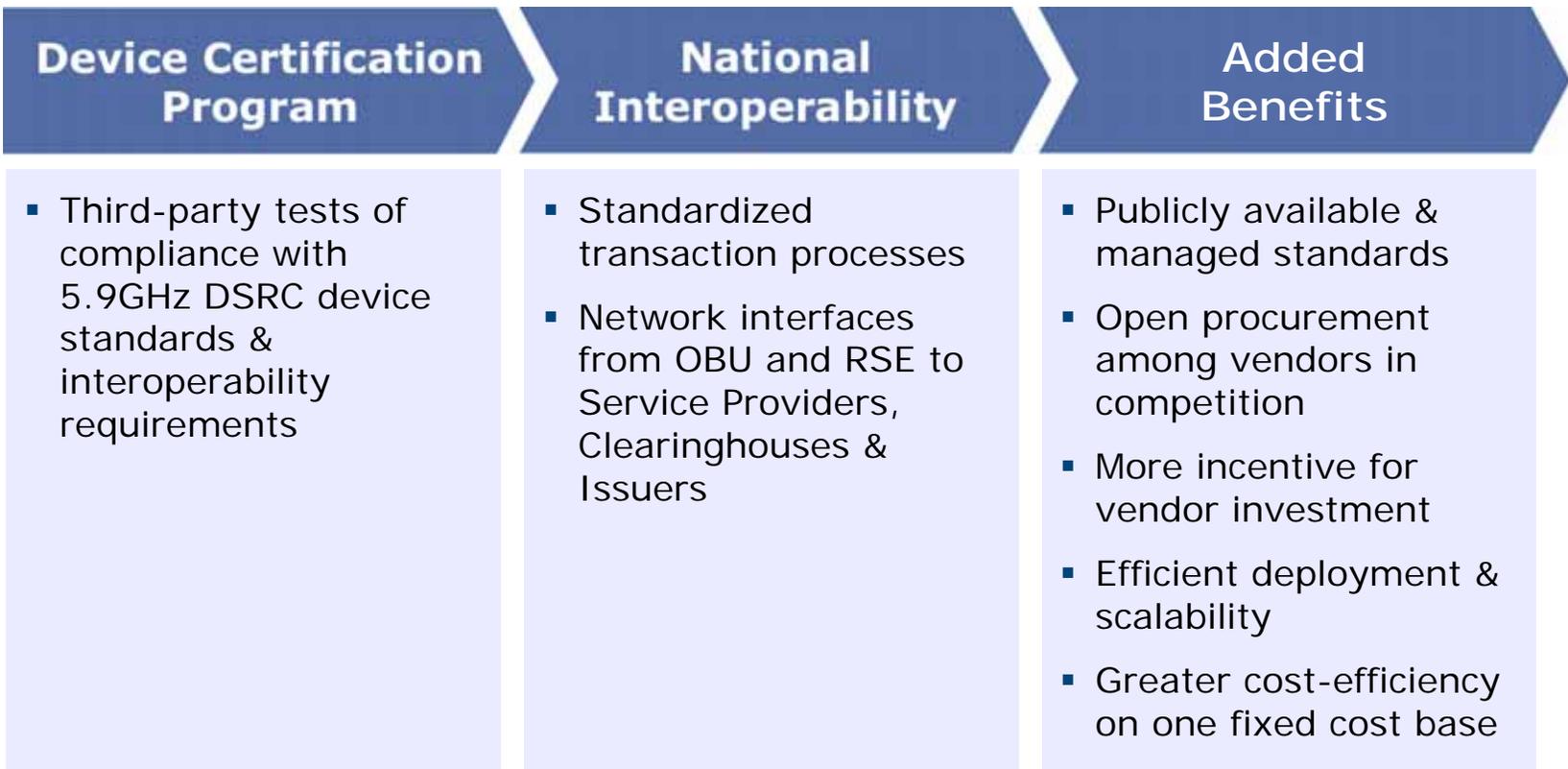
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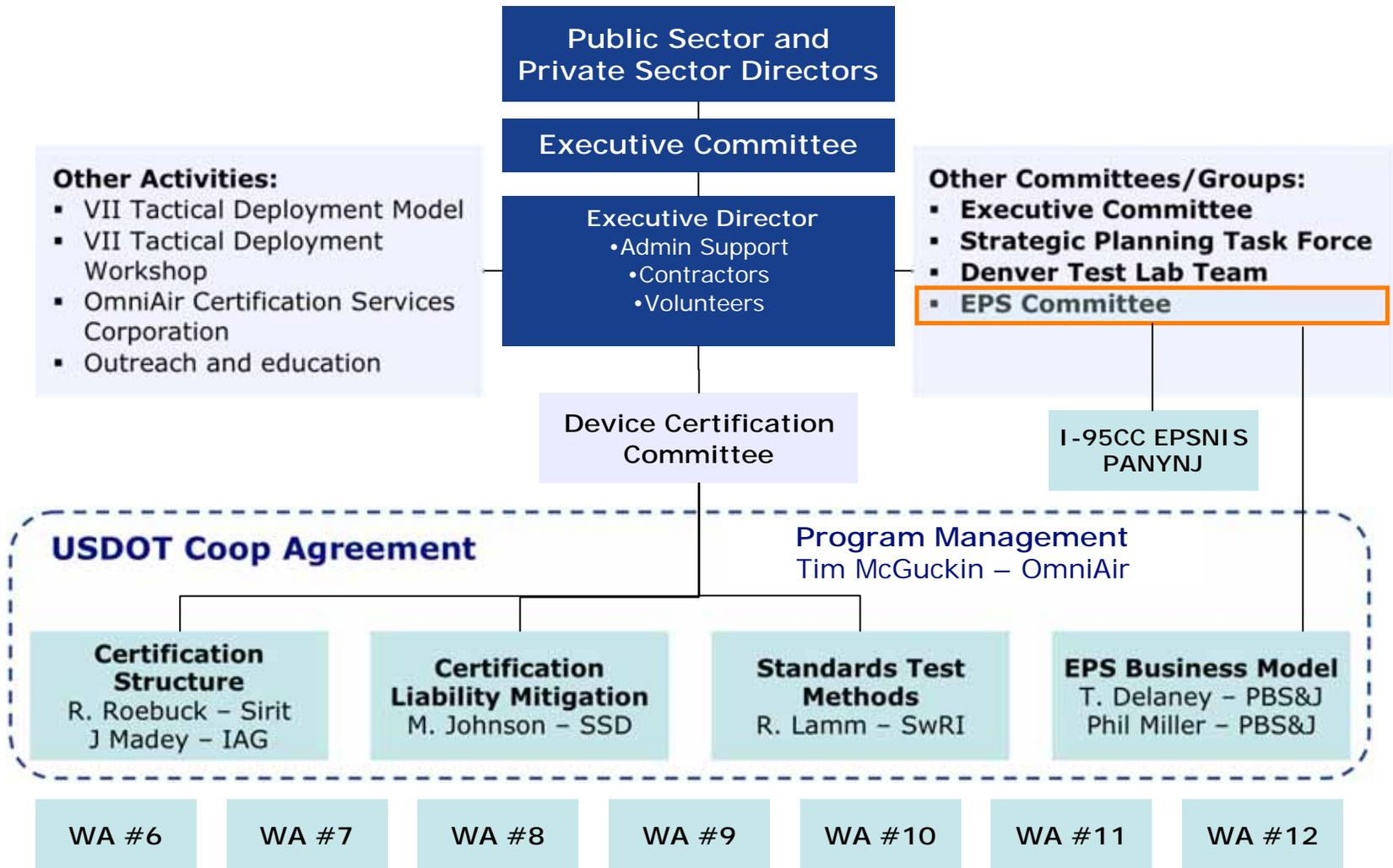
Overview



The OmniAir Consortium aims to advance the national deployment of interoperable DSRC systems – the basis of VII – through the OmniAir Certification Program, leading to further benefits



Organizational Hierarchy & Work Areas



Proposed in fall 2008

Key Stakeholders

OmniAir Members



























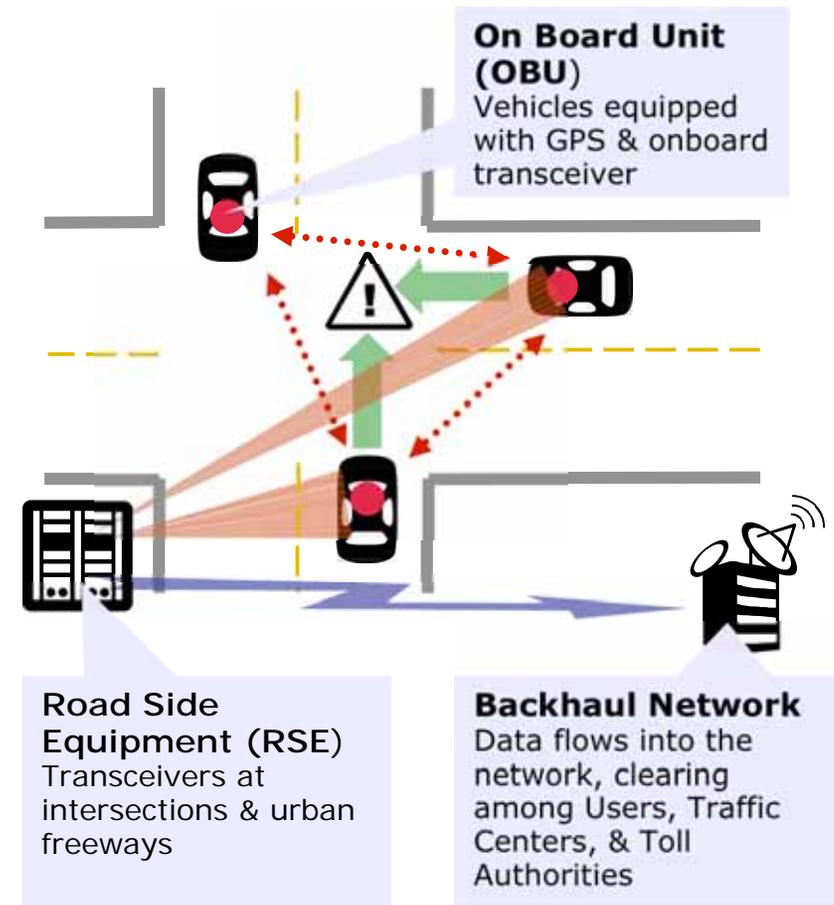






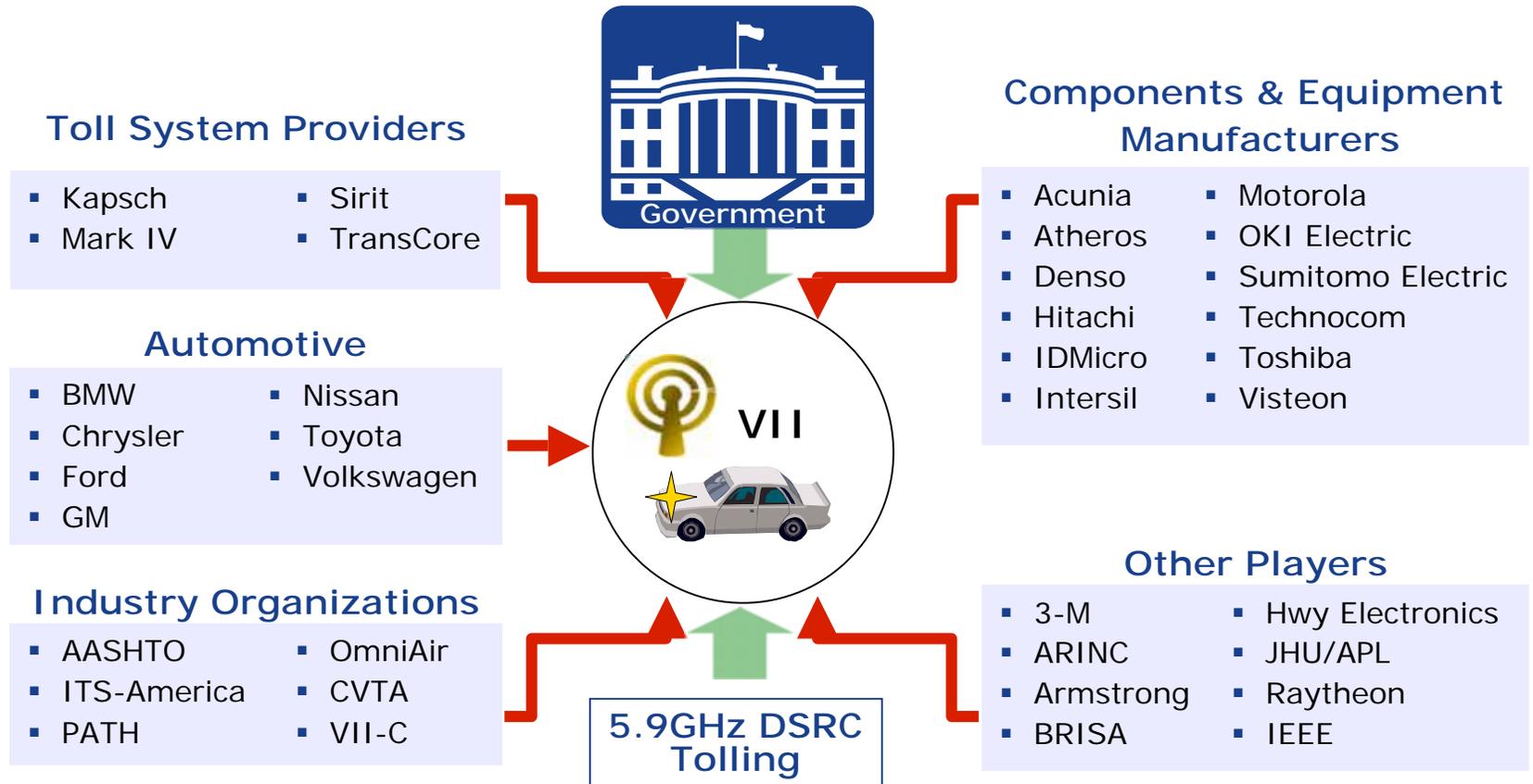

Basic Architecture

- Vehicle-to-vehicle and vehicle-to-infrastructure communication delivering:
 - Increased safety through collision avoidance and accident prevention
 - Traffic management through applications including signal optimization and in-vehicle signage
 - Commercial benefit through payment applications related to tolling, parking and mobility



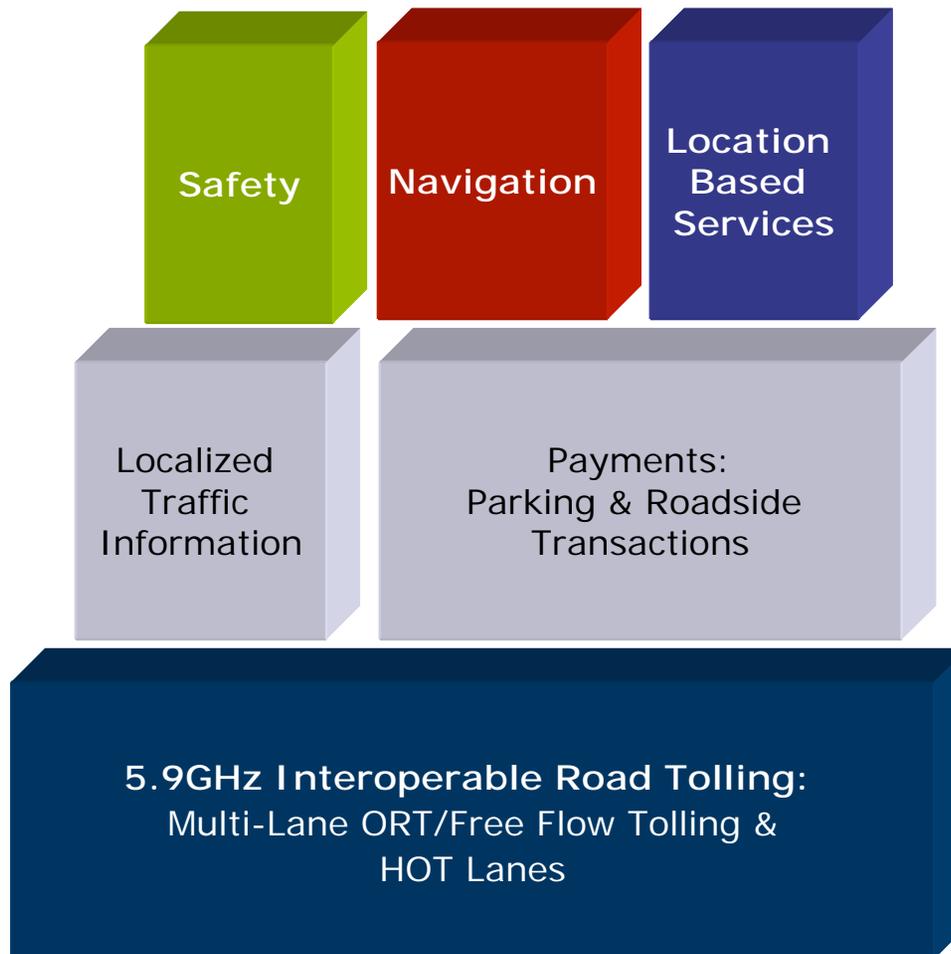
VII depends on an interoperable standard to enable communication among different system members

VII involves a series of industry players, while the government has invested considerable resources



Government supports VII through multiple funding sources, while tolling funds infrastructure deployment

Deployment Path: Tolling is the commercial foundation that drives investment, migrating to VII



- As roadside and in-vehicle infrastructure is deployed, full functionality of safety, navigation and other location based services is achieved
- Localized applications develop as infrastructure is deployed, and payment application continue to drive infrastructure deployment towards the VII vision
- 5.9GHz DSRC ORT (Multi-Lane Free Flow) tolling and HOT Lane systems are commercially viable, driving investment in infrastructure to enable VII deployment



5.9GHz DSRC Status



5.9 GHz DSRC development is driven by standards development and multiple proof-of-concept projects

Standards The building blocks of DSRC

- IEEE 1609.2-4 – approved for trial use
- IEEE 802.11p (the com link)
- SAE J2735 – approved for trial use
- OmniAir – 1609.2-4 Test Methods complete
- OmniAir – DSRC Certification Structure nearly finished

Projects VII/DSRC in Practice

- USDOT: POC projects (Michigan & California)
- ITS World Congress DSRC Live Demonstrations
- USDOT: RITA SAFE TRIP-21 Connected Traveler
- OmniAir: VTD Denver Test Bed
- OmniAir: Independent Certification Services entity
- OmniAir: VII Tactical Deployment Workshop (May 09)

USDOT projects highlight the significant time and resources the government puts behind 5.9GHz DSRC

The DSRC operating environment today has an appetite for more demonstrated VII progress

VII Progress:

- While VII has not yet received the recognition by Congress it deserves, RITA/USDOT is expected to demonstrate VII progress in the run-up to the federal transportation re-authorization.
- The "SAFE-TRIP-21" RFI sought to develop ideas on VII deployment that can be demonstrated now.
- Demonstrating VII is critical since the 75MHz of public spectrum is coveted by other players currently squeezed for frequency: wireless carriers
- Worldwide momentum: Australia, China, and Europe are migrating to 5.9GHz DSRC as a global standard

Where does VII stand in the 'stimulus' bill? Congress, if interested in 'smart' investments, will support VII activities and facilitate progress.

More and more transactions are cashless payments—from mobile phones to contactless credit cards

Greater User and System Needs

- Need for interoperable systems supporting open procurement
- Multiple users & complex system interfaces
- Transactions across Toll Roads, HOT Lanes, parking, & congestion pricing
- Payment applications for peripheral/roadside transactions
- Greater need for privacy protection

A Limited Legacy System

- 915 MHz ORT requires extensive infrastructure to compensate for lack of capacity
- Limited range and simple 'spot' reading limits HOT Lane capability
- Lower bandwidth and transmission speed reduce payment options
- 915 MHz has minimal security, putting systems at risk of fraud, spoofing and loss of privacy
- Video creates higher operating expenses

5.9GHz DSRC

- Interoperability creates open procurement from multiple bidders in competition
- With greater bandwidth and speed, 5.9GHz DSRC clears large transaction volumes quickly
- Banking-grade system security

5.9GHz DSRC is a step-change to meet evolving needs & the only solution with sufficient (bank-level) security



DSRC Technology Performance

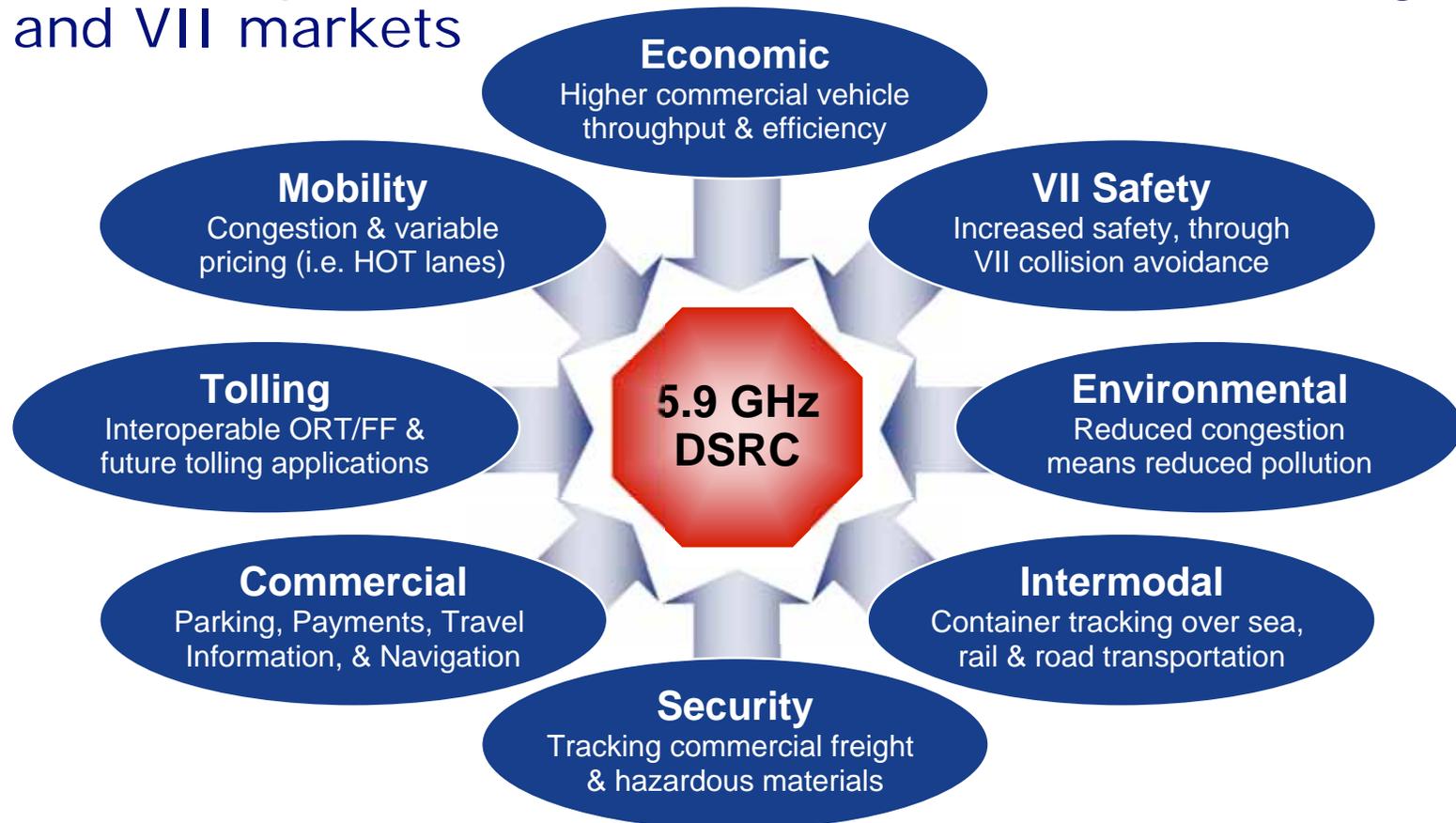


5.9 GHz DSRC delivers significant advantages over legacy 915 MHz systems

	5.9 GHz	915 MHz
Protocols	IEEE, open standard (802.11p)	Multiple versions, most proprietary
Data Rate	3 MBit/s to 27 Mbit/s & 54 MBit/s (w/ 2 channels)	In the range of 500 Kbits/s
Range	Up to 1,000 meters	Approximately 10-20 meters
Max. Transmit Power (EIRP)	+ 33 dBm (2 W)	+ 33 dBm (2 W), + 36 dBm (4 W)
Competitive multi-vendor market	Expected – Standard open to all vendors (ex. EU CEN ► 5 vendors)	Limited to Title 21 suppliers (2)
Reliability of bi-directional data	High. Designed to meet these requirements	Weak
Capabilities to shape communication zones	Very good	Limited
Size of antennae	Smaller	Larger
“Built-in” localization capabilities	Very good	N/A
Security & Encryption	Up to 256 bit AES encryption	Weak or not implemented

5.9GHz delivers superior technical performance due to greater bandwidth, range, bi-directional communication, and security

5.9GHz technical superiority enables benefits that will drive the penetration of 5.9GHz DSRC in US tolling and VII markets



5.9GHz DSRC delivers a win-win outcome to a variety of stakeholders – from the user to the wider community

The 5 Ins-and-Outs of 5.9GHz open standards - further differentiating it from legacy 915 MHz systems

Open Procurement

- Open procurement in competition allows purchasing on the basis of vendor costs and value added
- Authorities are not held hostage by incumbent monopolies

Investment Incentives

- Competition leads vendors to invest in better solutions at lower costs
- Investment in 5.9 GHz roadside infrastructure incentivizes future roll out of 5.9 GHz in automobile fleets, enabling more cost effective ITS

Scalability

- 5.9 GHz DSRC can be extended across the entire network
- Applications and systems are seamlessly combined, while interoperability ensures effective revenue sharing

Operating Leverage

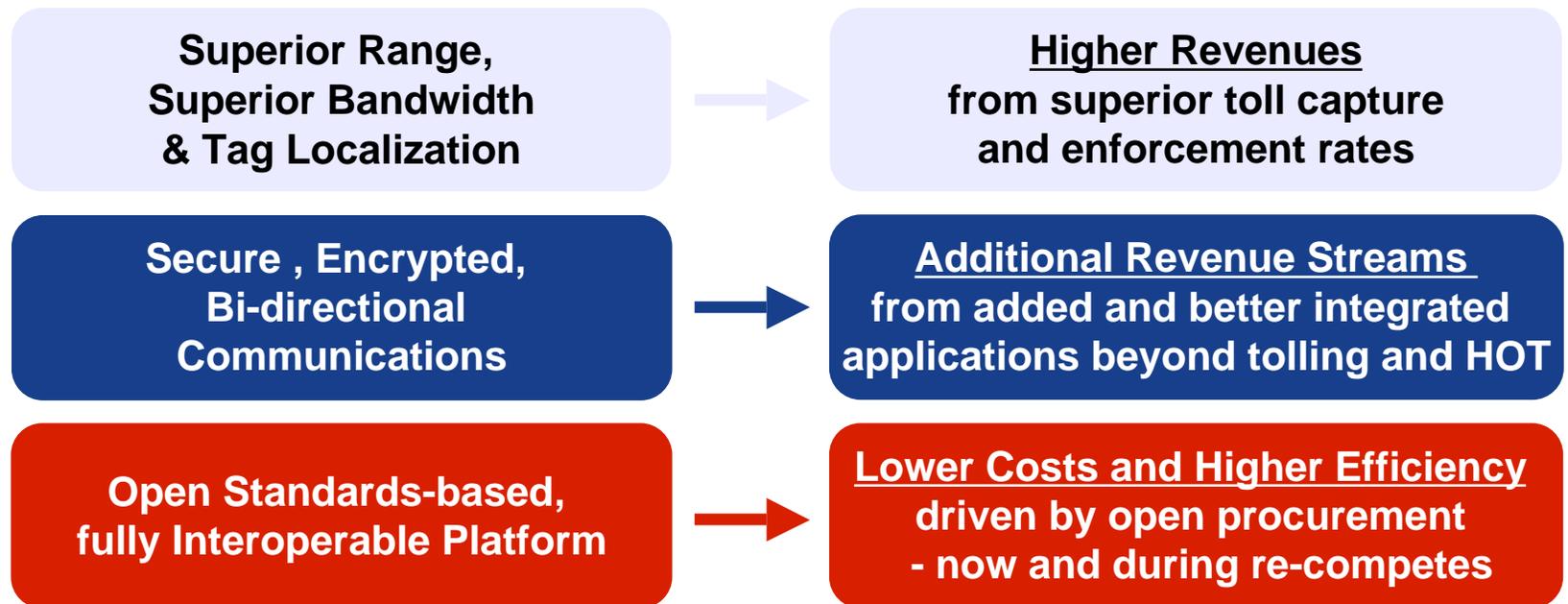
- Improved system accuracy to achieve higher net revenues
- Enables new payment mechanisms on one platform, driving greater net revenues and compliance while lowering operating costs

Banking-grade Security

- Security that protects user privacy for payments and related applications

These advantages empower toll operators and ensure vendors deliver value and cost-efficiency

Overall, 5.9GHz DSRC is a win-win standard for users, authorities and vendors alike, delivering superior performance and economics now and in the future



5.9GHz DSRC delivers superior performance, true interoperability, VII & ITS solutions using one fixed cost base. It is **One Infrastructure – Many Solutions**



Conclusion



5.9GHz DSRC versus 915MHz, Video, and GPS

	Present Systems		Emerging Solutions	
	915MHz	Video	GPS	5.9GHz DSRC
Current Situation	<ul style="list-style-type: none"> Very limited Interoperability Proprietary systems Payment systems limited to back-office solutions High infrastructure costs to support ORT Limited ITS integration 	<ul style="list-style-type: none"> No individual hardware or registration ~85% accurate plate reads in US required High back office operating costs Growing presence in the USA. High costs for multi-jurisdictional interoperability. 	<ul style="list-style-type: none"> Requires less infrastructure than DSRC tolling systems Enforcement and fraud detection are key issues to be resolved Higher operating expense due to communications costs 	<ul style="list-style-type: none"> Motivated by safety/ security Main objective: Interoperability Open standard Many potential applications Aftermarket devices encouraged by USDOT during VII roll-out
Assessment	<ul style="list-style-type: none"> Limited interoperability creates huge drawback Legacy systems Unable to support add-on applications High risk of fraud with lack of security 	<ul style="list-style-type: none"> Market for use as supplement to DSRC Unlikely to replace DSRC Given further advances in the video tolling, possible competition as „non invasive“ technology 	<ul style="list-style-type: none"> Communication costs change dramatically if combined with 5.9GHz Future GPS satellites will provide three times more satellites for greater position accuracy, reliability 	<ul style="list-style-type: none"> Provides new communication network capability spanning state and local boundaries for new era of interoperability Allows better integration of tolling and ITS on same open standards

5.9GHz DSRC:

- Delivers superior technical performance
- Enables open procurement in a competitive market
- Transfers bargaining power *back* to the operators in the bidding and re-compete process
- Allows greater integration with ITS and overall savings in infrastructure investment
- Provides banking-grade security on high transaction volumes

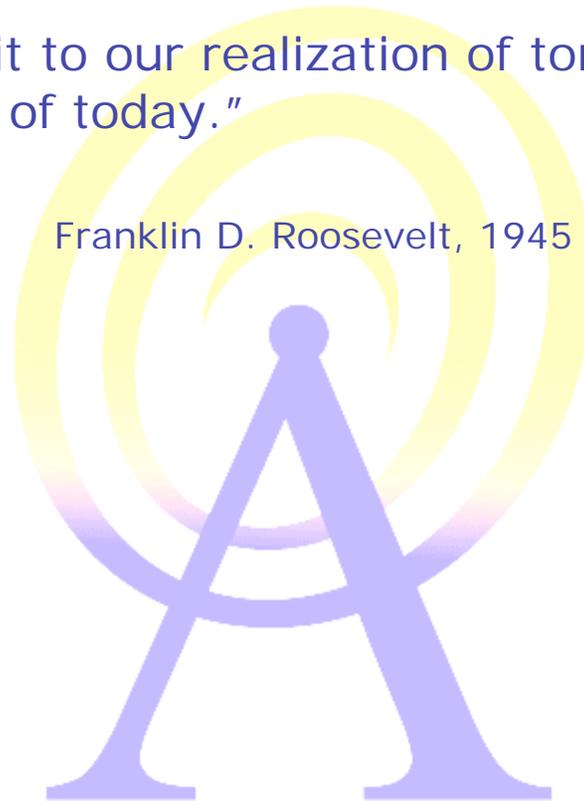
The alternatives do not come close:

- **915MHz** - limited scalability, multiple proprietary, incompatible technologies, and limited bandwidth capabilities
- **Video** – addresses interoperability only as a complement to an existing system, creating higher operating costs
- **GPS:** is several years away and carries added operating costs unless combined with 5.9GHz DSRC

- In a 'Greenfield' project, there is the benefit of additional time between source selection and deployment
 - More development time reduces risk, but 5.9GHz DSRC is a tested technology anyway – not an adventure
- Become a 'production configuration deployment' of 5.9GHZ DSRC
 - National Recognition & Potential for federal \$ for added VII testing (one technology, many functions).
- Foundation for growth
 - University/Research/State sector can use deployment site to develop VII features (patron feedback, probe data, data downloads, maintenance data)
 - High interest in innovation may bring even more industry to the region as stakeholders want to be near the action

"The only limit to our realization of tomorrow will be our doubts of today."

Franklin D. Roosevelt, 1945



Thank you for listening