Michigan Connected and Automated Vehicle Working Group

July 26, 2016

Meeting Packet

1. Agenda
2. Meeting Notes
3. Attendance List
4. Handouts
5. Presentations
Meeting Agenda

01:00 PM  Introductions and Update
Richard Wallace, Director, Transportation Systems Analysis Group, CAR

01:10 PM  Oakland County Welcome
Gary Piotrowicz, Deputy Managing Director/County Highway Engineer, Road Commission for Oakland County

01:15 PM  Overview of the Velocity Center Cyber Capabilities
Jennifer Tisdale, Cyber-Mobility Program Manager, Michigan Economic Development Corporation

01:35 PM  Using Simulation for Developing CAV Applications
Jeff Blackburn, Sales Manager, TASS International

01:55 PM  Connected & Autonomous Vehicles: Developing the Skills that Your Organization Needs to Thrive
Elaina Farnsworth, CEO, Mobile Comply

02:15 PM  CityMobil2
Adriano Alessandrini, Researcher, University of Florence

02:30 PM  Networking Break

02:45 PM  AutoMobili-D at the NAIAS
Marla Wise, Senior Director of Business Development, The Fulkerson Group

03:05 PM  Local Connected Vehicle Deployment Strategies
Matt Gibb, Deputy Oakland County Executive

03:15 PM  Update on Michigan CAV Efforts
Michelle Mueller, Sr. Project Manager, MDOT

03:40 PM  Communications and Traffic Monitoring Upgrade for Adaptive Signals
Ahmad Jawad, Signal Systems Engineer, Road Commission for Oakland County

04:00 PM  Adjourn
The Michigan Connected and Automated Vehicle Working Group held its summer meeting on July 26, 2016 at the Oakland County Executive Office Building.

Meeting Notes

Richard Wallace, Director of the Transportation Systems Analysis group at the Center for Automotive Research (CAR), started the meeting by detailing the meeting agenda and working group mission, as well as presenting noteworthy connected and automated vehicle (CAV) news and upcoming CAV events. For the latter, Richard highlighted the first fatal crash involving a Tesla in Autopilot mode, the U.S. Army automated truck platooning using DSRC in Michigan, and China’s moratorium on autonomous vehicle testing on public roads.

Gary Piotrowicz, Deputy Managing Director/County Highway Engineer at the Road Commission for Oakland County, welcomed the Working Group to the meeting and spoke about the importance of Oakland County’s efforts in deploying infrastructure for connected vehicles.

Following Mr. Piotrowicz’s presentation, Jennifer Tisdale, Cyber-Mobility Program Manager for the Michigan Economic Development Corporation, provided a brief overview of Michigan’s Cyber Program. The initiative was launched in 2011 by the Governor and focuses on economic development, talent attraction and training. The Cyber Program concentrates mainly on the automotive, defense, and aerospace sectors. Jennifer Tisdale also talked about the Michigan Cyber Range, which provides an unclassified environment for education, training, and testing in cyber-security.

Jeff Blackburn, Sales Manager at TASS International, emphasized the importance of using simulation for developing CAV applications. Simulation is complementary with testing on public roads and test tracks. It allows for cost-efficient and fast testing and helps identify edge cases that need further testing in real-world conditions. Jeff Blackburn then gave an overview of PreScan (SiL Testing), a testing tool developed by TASS International.

Elaina Farnsworth, CEO of Mobile Comply, talked about the actions needed to build the skills needed as the automotive industry moves toward the development of CAV. Mobile Comply is working towards bridging the knowledge gap in the industry, by providing training modules for professionals and education initiatives for students, through partnerships with the industry and communities.

Adriano Alessandrini, Researcher at the University of Florence, provided an overview of CityMobil2, a major European project on autonomous driving. The project consisted of demonstrations of autonomous transit shuttles operating on predetermined routes in several European cities. By the end of the project, the autonomous shuttles had carried more than 60,000 passengers.
Marla Wise, Senior Director of Business Development at The Fulkerson Group, talked about the organization of the AutoMobili-D exhibit at the North American International Auto Show (NAIAS) 2017. AutoMobili-D will be located in the new Cobo Center Atrium and the adjoining Hall E exhibition area and hosted during Press Week at the NAIAS, between January 8 – 12, 2017. The exhibit will cover: connected car technologies, autonomous driving, e-mobility, urban mobility, and mobility services.

Matt Gibb, Deputy Oakland County Executive presented the county’s local connected vehicle deployment strategies. The first goal, according to the county’s strategy, is to create the organizational structure of a regional deployment authority that would bring together state, county, and local authorities. The second goal is to design a system where data, spectrum, and technology can be monetized for revenue to support deployment.

Michele Mueller, Sr. Project Manager at MDOT, gave an update on Michigan CAV efforts and highlighted the truck platooning demonstration on I-69 performed by TARDEC in collaboration with MDOT. She also provided information about the Planet M branding initiative developed in collaboration with MEDC. The website dedicated to this initiative (www.planetm.com) aims at becoming a key source of information on CAV in Michigan.

Ahmad Jawad, Signal Systems Engineer at the Road Commission for Oakland County closed the meeting with a presentation on the communications and traffic monitoring upgrade for adaptive signals in Oakland County.

*MDOT maintains a webpage dedicated to its work related to CAV technologies ([http://www.michigan.gov/mdot/0,1607,7-151-9621_11041_38217---,00.html](http://www.michigan.gov/mdot/0,1607,7-151-9621_11041_38217---,00.html)). The page includes documents, presentations, and other materials that may be of interest to CAV stakeholders. Meeting packets containing materials (e.g., agenda, meeting notes, attendance, and presentation slides) from past Michigan Connected and Automated Vehicle Working Group meetings can also be found on the page in the bottom right corner under the heading Connected Vehicles Working Group.*
Michigan Connected and Automated Vehicle Working Group

Attendance List

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SUMMARY PLAN

AN AUTHORITY FOR REGIONAL DEPLOYMENT

Introduction

Connected transportation systems have a great potential to impact both mobility and transportation safety, resulting in reduced congestion and reductions in travel delay. Much of the work done to date has focused on the technical aspects of the deployment to ensure that individual deployments function as intended. One of the gaps associated with deployment of infrastructure, however, is how to deploy connected vehicle infrastructure across a region that involves multiple jurisdictions and time frames. There is a critical need to ensure that CV deployments occur in a uniform manner across these jurisdictions in terms of licensing, application deployment, data use and sharing and partnerships to ensure that drivers have a consistent experience.

In 2014, Brooks Patterson, Oakland County Executive, initiated the Oakland County Connected Vehicle Task Force (OCCV TF) and charged the task force with defining a business plan leading to the implementation of CV technologies across Oakland County. As a result of this directive, the Task Force has been wrestling with many of these deployment challenges in a county that includes roads owned and maintained by the Michigan Department of Transportation, the Road Commission for Oakland County and over 30 local cities and townships. While the concept presented in this white paper is specific to Michigan, the broad concepts are applicable for any deployment region with multiple owning and operating jurisdictions in the area.

Individual, limited or small scale deployments of CV infrastructure require significant planning to ensure that the design meets the required objectives, that the procurement and installation are performed as designed and that the operations are consistent. As these deployments scale in size to cover a larger geographic area,
the complexities of design, implementation and operations become increasingly difficult, especially where there are multiple jurisdictions involved and when the deployments will be spread over a significant time period, frequently encompassing multiple generations of hardware and software. To meet these challenges, the entities focused on connected vehicles in Oakland County are in the process of forming a formal enterprise to provide these coordination activities and to work towards implementing business models that will be used to offset a percentage of the deployment and operations costs of CV infrastructure.

**The enterprise consists of four different entities:**

**Michigan Department of Transportation (MDOT):** MDOT owns and operates the majority of the high volume roadways in Oakland County, including the freeways and corridors such as Telegraph Road and Woodward Avenue. These roadways service the highest volumes of traffic in Oakland County.

**Road Commission for Oakland County (RCOC):** RCOC owns and operates the majority of the remaining roadways in Oakland County and has operational authority over the signalized MDOT corridors and provides maintenance services on all MDOT facilities under contract to MDOT. The roads RCOC is responsible for include both high volume facilities that in some places may serve higher volumes than MDOT facilities and in other places serve significantly less, including a number of unpaved facilities. RCOC is completely independent of Oakland County.

**Local Governments:** There are approximately 30 local governmental entities in Oakland County responsible for road operations and maintenance at the local level. These agencies are oversee the lowest volume roadways but also the roads and intersections that are often the start or end of a trip near housing, shopping and recreational areas. While the engineers overseeing the local street network are very experienced and knowledgeable, their ability to keep up with the latest technologies and standards is often hindered by a lack of resources available for training or participation and attendance at national events where CV technologies are being widely discussed.

**Oakland County:** Oakland County is responsible for overseeing all activities in the county, including a many public services and economic development. While Oakland County does not oversee transportation infrastructure in the county, they carry sizeable political clout in the region and provide a neutral home to serve as an arbiter of sorts in the area.
Organizational Structure

The OCCV TF has proposed to implement an organizational structure to ensure a uniform deployment throughout Oakland County that can support the needs of the travelling public (safe and efficient transportation), foster innovation and be used to support economic development. The proposal is to create a Connected Vehicle Authority that will support deployment. Each entity will be responsible for the following:

MDOT: MDOT has invested a significant amount of resources in the development of their technical capabilities, and as a result, will be the lead entity for all technical activities. MDOT will be responsible for the development and maintenance of specifications and requirements for all CV infrastructure components, channel allocations and security credential activities and will hopefully develop a Qualified Products List for CV infrastructure components to ensure interoperability across the county. MDOT will also be responsible for the initial data management for all CV deployments within the County as a result of their sizeable investment in the DUAP program (a county wide data management and access plan will need to be developed that may include the addition of 3P partnerships). MDOT will be responsible for the FCC licensing of all 5.9 GHz DSRC units on public right-of-way within the county. Finally, MDOT will be responsible for the development of a county-wide CV deployment plan for MDOT facilities and the design, deployment, maintenance and operations of those units, barring a 3P investment.

RCOC: While RCOC has invested considerably in CV technology and is considered a national leader in this space, RCOC has limitations due to their staff size and budget. Because RCOC has a significant maintenance and operational requirement on MDOT facilities in Oakland County, RCOC will be integrally involved in the development of the MDOT deployment plan, providing reviews and inputs to the plan. Additionally, RCOC will take the lead on developing a county-wide plan for the deployment of CV infrastructure that integrates the MDOT plan with both county and local streets. The intent of the plan is to provide a uniform and focused deployment and to identify priorities for deployment, regardless of the ownership of the facility. Like MDOT, RCOC will be responsible for the design, deployment and operations of CV infrastructure on RCOC roadways and will provide support to the local agencies to ensure that their deployments meet the needs of the transportation community as a whole.

Oakland County: Oakland County will be the “home” for the authority. As a result, Oakland County will take primary responsibility for using the CV deployment in
Oakland County for economic development purposes by attracting new business into Oakland County. For CV Test Bed related activities, Oakland County will work directly with those entities wishing to expand or change deployments to secure private sector funding from those entities as needed. The Authority, through Oakland County, will coordinate bid opportunities for countywide services, including hardware, security, data management, etc. and will serve as a bid entity for hardware, installation, operations and testing of CV elements in support of the local agencies to ensure a uniform deployment and operations as well as interoperability. The Authority will also take the lead on documentation development, including white papers, lessons learned documents, etc. Finally, the Authority, since it is an independent entity, will be able to take the lead in the pursuit of grants and other funding opportunities, including County-Wide 3P initiatives that support deployment and operation of CV infrastructure across multiple jurisdictions.

Local Agencies: Once MDOT publishes agreed upon specifications, and RCOC has an agreed upon countywide deployment plan, the local agencies will be responsible for deploying CV infrastructure in their right-of-way using these two documents as a guide. To achieve discounts from magnitude of scale, the Authority will support procurement activities as needed.

This organization generally supports the planning and deployment activities associated with CV infrastructure activities. It is understood that there are additional roles that will require coordination amongst all partners with one agency as the lead for those activities. The Authority will work to support the following:

Monitoring: The majority of CV infrastructure deployments are eventually going to be considered safety-critical, requiring them to be online and broadcasting accurate data 24x7x365. As a result, monitoring these devices 24x7x365 will be critical. MDOT currently staffs the SEMTOC full-time and would be the likely choice to support this activity, but SEMTOC is currently focused on freeway operations and not arterial operations. RCOC has a traffic operations center as well, but it is not staffed full-time. One of the early actions by the Authority will be to identify both the requirements for monitoring and response activities as well as the cost and funding requirements for the ongoing monitoring.

Data: It is assumed that MDOT will be the primary repository of basic data (BSM, Probe/VehSitData, Infrastructure messages) through their DUAP system. Other data using the IP gateway functionality of the RSU is anticipated to be encrypted and sent directly to the intended recipient. A second early action by the Authority
will be to develop guidelines for the sharing, storage and maintenance of the data collected from all of the agencies, as well as issuing an RFI/RFP to support these activities with the intent being to move the costs associated with data management to a third party in exchange for data access.

Application Selection: Some of the early CV documents identified well over 100 CV applications that could be deployed at the roadside or in the back-end. It is anticipated that MDOT and RCOC would lead a working group as part of the development of a county-wide plan to identify and select the appropriate applications for deployment in the field as well as in the back-end system.

Configuration management and control: Over the course of the next 20-30 years, there will be multiple software upgrades and updates as well as new applications identified that take advantage of vehicle connectivity. These updates and patches need to be tested and deployed in a timely manner. It is anticipated that MDOT will take the lead on the testing of updates and patches (and the certification of devices) and that once MDOT has approved the update, the Authority would approve the update for deployment across the County. This includes updates to standards, specifications and qualified product lists as well.

Innovation and Testing: As the system is deployed across the county and as the Authority identifies new development opportunities, it is anticipated that new components, technologies and business models will emerge that could ultimately be used to support the deployment and operations of connected vehicles in Oakland County. The Authority will work with MDOT and RCOC to identify test sites and test procedures in conjunction with the developer to ensure that the needs of the developers are met to prove their concepts while still maintaining the safe operations of the overall system. In some instances, these tests will need to be performed at off-site locations, including M-City and the Advanced Mobility Center prior to on-road testing and demonstrations.
June 29, 2016

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, D.C. 20554

VIA ELECTRONIC DELIVERY

Re: ET Docket No. 13-49
Revised of Part 15 of the Commissioner's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band

Ms. Dortch,

By this submission, The Oakland County Connected Vehicle Task Force\(^1\) and the supporting entities that have co-signed this letter respectfully respond to your Public Notice FCC 16-68 of June 1, 2016, inviting interested parties to update and refresh the record on the status of potential spectrum sharing solutions between proposed Unlicensed National Information Infrastructure (U-NII) devices and Dedicated Short Range Communications (DSRC) operations in the 5.850-5.925 GHz (U-NII-4) band.

Beginning in the middle of p. 7 of FCC 16-68, a number of important questions are raised. We believe that these questions can be satisfactorily answered on the basis of a methodology that does not rely on spectrum sharing but rather on a technological ecosystem that preserves the integrity of the DSRC spectrum and leverages the existing protocol architecture (IEEE 802.11p, IEEE 1609) so as to enable applications that can generate the revenues needed to fund the deployment of roadside infrastructure (RSUs). We offer a detailed response to these questions further below in this submission, but first we present an overview of the background, rationale and policy goals of our proposed methodology, an outline of which is provided in the Attachment.

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\(^1\) Oakland County, Michigan is home to 75 of the top 100 global automotive suppliers and more than 50% of the R&D centers bringing connected/autonomous technology to market. The Task Force, convened by the County Executive, is a collaboration of more than 15 public and private entities striving to build a sustainable business case for CAV Vtol deployment. Its membership includes ROOC and MDOT representation and chief technology officers from entities such as Lear, HNTB, IHS, and Mobile Comply.
Overview

We are acutely aware of the imperative that the rising value of spectrum imposes on our industry. We understand that the allocation of the DSRC spectrum comes with an obligation to ensure that the full benefits of its use, both in terms of safety and mobility on our roadways, are realized as quickly as possible. We believe that this obligation is shared by both the automotive industry and the public sector entities with jurisdiction over the building and maintenance of our roadways.

The Oakland County Connected Vehicle Task Force was established with the express purpose of formulating a business model and a technological ecosystem, based entirely on the DNA of DSRC and the WAVE (IEEE 1609 and 802.11p) standards, whereby the different constraints under which the private and public sectors must operate are reconciled. As the jurisdiction with the highest concentration of automotive industry corporate presence in the United States, our public officials are particularly well-placed to appreciate the needs of both sectors. There is an urgent desire to harness the full power of DSRC technology without imposing a burden on taxpayers, while simultaneously creating conditions that motivate the private sector to continue to invest in innovation built on the DSRC platform. The extraordinary level of response to the USDOT Smart Cities Challenge issued last December by Secretary Foxx clearly demonstrates that our goals reflect those of many other jurisdictions throughout the country.

From the outset, our view has been that the DSRC spectrum is essentially a public good which, if exploited in a way that maximizes its market value, provides the means to bridge the funding gap for deployment of roadside infrastructure that has been recognized by most DSRC stakeholders as the most important question needing resolution in order to move forward. We also believe that the tools required to accomplish this can be developed based on the inherent capabilities designed into the WAVE standards. Our formula for reaching these goals is straightforward:

- Propose the establishment of a regional public sector authority to oversee the deployment and maintenance of DSRC infrastructure

- Encourage the private sector to create tools to leverage the non-safety-critical DSRC channels (Service Channels), particularly aimed at exploiting the insatiable consumer demand for mobile wireless Internet services.

- Require all the access points (RSU) and clients (OBU) to adhere strictly to the existing 5.9 GHz DSRC communications protocol. This ensures that both non-safety of life and imminent crash avoidance applications are simultaneously supported as originally envisioned in the band plan and avoids compromising the substantial investment in development and testing incurred by both the federal government and the automotive industry during the last decade.

- Seek to establish policies placing a priority on the need for re-investment in DSRC infrastructure of revenues associated with provision of Internet connectivity services, while enabling the private sector to profit from development of the tools and their application in providing market-driven services.
• Create an ecosystem favorable to the rapid introduction of aftermarket on-board units (OBUs) which (we believe) is essential for accelerating the timetable by which the full benefits of DSRC V2V and V2I can be realized.

• Establish a foundation on which an infrastructure Authority and/or Network Operator can grow to encompass the region of southeast Michigan and hopefully demonstrate a functional model for other regions to follow.

• Demonstrate that this method can become a template for both inter-governmental cooperation, as well as public-private partnership that can be used throughout the United States.

FCC 16-68 Q&A

We are proposing an approach to use of the DSRC spectrum that would preserve the existing FCC licensing rules. With this approach, devices not licensed for DSRC are never allowed access to DSRC spectrum. If a Smartphone or Tablet runs an application that can be routed by a neighboring OBU through an available Service Channel, we can monitor the resulting consumption of bandwidth, which become the basis of our ability to leverage part of the spectrum and therefore aim for financial self-sustainability.

Our proposal calls for Internet traffic from a 3rd party device to be redirected to the IPv6 interface defined in WAVE, but since it is the OBU that actually transmits and receives at the PHY level of the protocol stack, there is absolutely no interference with time critical applications. Prioritization of this traffic and channel selection for its transmission is carried out by the WME (WAVE Management Entity), in accordance with the policies governed by IEEE 1609.4. In other words, all Internet traffic carried either for applications running in the OBU itself, or on behalf of 3rd party devices, is subject to the policies governing the infrastructure operation, which will ensure that whenever and wherever Service Channels are needed for safety-of-life, collision avoidance or any other time-critical traffic management applications, lower priority traffic will be superseded by the more important traffic.

Under our proposed scheme, many of the questions put forward in FCC 16-68 become moot. Nevertheless we have chosen to offer commentary on all of the questions which are excerpted from FCC 16-68 and reproduced below in italics and then followed by our response.

As described above, each proposed sharing approach relies on a different mechanism to avoid co-channel operations when DSRC channels are in use at a given location. We now seek comment on the merits of these two approaches. What are the benefits and drawbacks of each approach?

Neither of the currently proposed spectrum sharing approaches offer financial benefits to “roadway management” jurisdictions for funding the all-important roadside infrastructure. We do not believe that there are any benefits, with either of these proposals, which would outweigh the benefits of our approach in terms of providing revenue tools to local roadway management authorities and/or Network Operators for deployment and operation of DSRC infrastructure.
Would one approach be better than the other (e.g., minimize the risks of interference to DSRC more effectively while providing a comparable degree of meaningful access to spectrum for unlicensed devices)?

For reasons explained further below, we are skeptical that the “detect and vacate” method will perform adequately when tested with a realistic number of DSRC and UNII devices. So whereas we oppose both schemes, when compared to each other, “re-channelization” is better than “detect-and-vacate” but presents other challenges to the transportation industry already working to deploy hardware.

For either approach, is it necessary for the Commission to specify all the details of the interference avoidance mechanism in the FCC rules or can this be addressed by relying primarily on industry standards bodies to develop the specific sharing methods?

The failure of the IEEE 802.11p “Tiger Team” to reach a consensus on the question of spectrum sharing does not augur well for the idea of deferring to standards bodies to establish an interference avoidance mechanism.

If the former, what specific technical details need to be specified in the FCC rules (e.g., out of bound emissions, noise tolerance, detection threshold, channel vacate time, etc.)?

Since we advocate against spectrum sharing at the PHY level, establishing a new set of rules is unnecessary. However, we wish to point out that the “detect and vacate” method specifies that “detection” applies only to the preamble of an IEEE 802.11p packet transmission. During the remainder of the time required for its transmission, the IEEE 802.11p packet could be exposed to co-channel interference from U-NII devices. In order to avoid this exposure, U-NII devices would have to remain silent for the period of time (measured relative to the last detected 802.11p preamble) required for transmitting the maximum possible size of an 802.11p packet. But it is not clear whether the Cisco solution takes this into account. Furthermore, it would appear that the “vacate” part of the operation is delayed until after the end of any current U-NII transmission. It is therefore reasonable to speculate that, for a large number of U-NII devices within range of DSRC devices, this behavior may result in some significant loss of throughput for DSRC.

Has industry agreed upon performance indicators for DSRC, and if so, what are these metrics and is there a process to hold products to these performance levels?

We believe this was all established within the framework of Collision-Avoidance Metrics Partnership (CAMP) – but would be better answered by OEM’s and Tier 1 Suppliers.

We also seek comment on how the choice of avoidance protocol affects the deployment and performance of DSRC. Would “re-channelization” require any change in the design of the DSRC electronic components contained in DSRC prototypes or just require a change in the processing of the data?

In principle, it should be possible to accommodate, in software, the different widths for safety and non-safety channels within a single DSRC PHY. We should point out however that this would appear to be of little consequence to the originator of the re-channelization scheme. Qualcomm introduced a new
chipset early this year that supports 5 GHz WiFi, LTE and DSRC, a platform aimed at enabling Internet connectivity from the car through cellular communications while confining DSRC capability to safety applications. In this context, there is no need for the DSRC Service Channels, so the result is a de facto dedication of the spectrum to WiFi. Meanwhile vehicles enabled for DSRC but without the dual mode capability offered by Qualcomm, would have to contend for the two 20 MHz Service Channels, thereby reducing the capacity to provide mobile Internet services through the DSRC infrastructure and limiting the capacity to pay for infrastructure through leveraging of the Service Channels. We also have serious concerns that the integration of unlicensed WiFi and DSRC Medium Access Control (MAC) layers in the same platform creates a new cyber-attack surface that could undermine the extensive security provisions designed into WAVE.

We seek comment on whether changing the channel plan would require re-testing of DSRC and, if so, precisely what would need to be done, why, and in what timeframe? Commenters responding to this question should provide specific information about why the completed tests are not applicable to re-channelization, how any new tests will differ from those already performed, and the relevant timeframes for completing these specific tasks.

We believe that this question would be better answered by OEM’s, Tier One Suppliers and others working diligently in the pursuit of deploying vehicle hardware and infrastructure test beds. Further, any testing, studies or analyses that have been performed regarding DSRC capabilities, Wi-Fi performance, interference studies or the potential benefits or drawbacks of sharing, which are relied upon by stakeholders in this proceeding, either in the past or going forward, need to be filed in the record to be considered. Additionally, has any testing been done regarding DSRC self-interference or potential harmful interference with satellite and government co-channel or adjacent users? [Any such information filed should include the test plans, results, and underlying data needed to fully evaluate the submission. If there are data or reports that are not public, parties should describe the data and reports and explain why it is necessary to submit this information confidentially].

We believe this that testing was also carried out within CAMP but also feel that this question would be better answered by OEM’s, Tier One Suppliers and others working diligently in the pursuit of deploying vehicle hardware and infrastructure test beds.

We also seek comment on what DSRC-related use cases should be expected and permitted in this band. Commenters should provide specific information regarding what DSRC applications are anticipated, what are the projected spectrum needs for each application, and how would the commenter classify each (i.e., safety, non-safety, time critical or not)?

We believe that the most significant use case is now the provision of mobile Internet services offered to non-DSRC devices which have attached themselves to a DSRC OBU. This establishes a foundation for providing Internet Connectivity over Service Channels when applications use the IPv6 interface to the WAVE stack, whether they are running locally or routed through the OBU from a neighboring device in the vehicle. The Internet Connectivity services are announced by RSUs using WAVE Service Advertisements (WSAs). Furthermore, individual infrastructure authorities would have the discretion to offer service from specific RSUs at specific times, giving them the freedom to implement their own
policy options. When policy dictates that these services be suspended to make way, on the supporting Service Channels, for higher priority applications, the OBU can detect that the Provider Service Identifier (PSID) has been removed from the WSAs it receives from the RSU and then change the "transmitter profile" it registers with its MAC Layer Management Entity (MLME) so that the WME no longer allows IPv6 traffic on the Service Channel in question.

Obviously these mobile Internet services are not time critical nor are they safety-related (except in the most general possible sense when supporting such purposes as real-time navigation). However, they are critical to enabling infrastructure authorities to finance their own roadside deployments.

*Should the DSRC offerings provided on a priority or exclusive basis be restricted to safety-of-life or crash avoidance purposes?*

The WAVE standards already allow for prioritization of different services based on the Provider Service Identifier (PSID) identified in the WSA. IEEE 1609.12 provides a standardized framework for allocation of a PSID. In other words, the flexibility to establish whether a specific service should have priority or exclusivity is already built into the system specifications. We believe that there is no need for a "one size fits all" set of rules.

*What are the technical or policy reasons for differentiating between safety-of-life and non-safety-of-life applications?*

The technical reasons are clear. Non-safety-of-life applications should never have a deleterious impact on the latency of safety-of-life applications. The policy reason is that we believe that the use of non-safety-of-life spectrum should be managed in a way that leads to funding of infrastructure.

*Are there meaningful distinctions between DSRC applications that are safety-related and those that are not, such as applications that are time critical?*

Possibly; e.g. the benefit of time-critical Signal Phase and Timing (SPaT) messages from signalized intersections applies as much to optimizing mobility (reduced travel time, greenhouse gas emissions, etc.) as to improving safety.

*For parties that advocate for re-channelization, is there a natural bifurcation point if we decide to separate safety-related and non-safety-related DSRC? For instance, while entertainment, social media, maps, and parking applications are not safety-related, what is a good definition for a feature or service to be considered truly a safety-of-life use?*

We do not believe that there is a natural bifurcation point. We strongly believe that the establishment of any "bifurcation point" would irreversibly eliminate the option to re-allocate non-safety related channels to accommodate the future potential needs of time-critical applications. For instance, there may be a future requirement to remove the SPaT messaging load from the V2V channel (172) and re-allocate it to a Service Channel. The potential to develop safe and reliable vehicle autonomy is likely to be enhanced with the availability of low latency signalling from roadside infrastructure, not only intersection controllers but also movable infrastructure such as lane closure signals. We must maintain the flexibility, as the needs of urban traffic congestion and autonomous vehicle engineering arise, to
meet these needs by assigning a Service Channel that currently only carries traffic that is not time-critical. This will not be possible if unlicensed devices are allowed to operate in these channels.

*How does our current band plan and these sharing approaches match up with international efforts for safety-related DSRC systems?*

We believe that this question would be better answered by OEM’s, Tier One Suppliers and others working diligently in the pursuit of deploying vehicle hardware and infrastructure test beds.

*To help us fully evaluate the potential effects of re-channelization, please provide the projected timeframe for introduction of DSRC deployments under the current channel plan. What market penetration (e.g., percentage of cars on the road) is needed for DSRC to reliably provide safety-of-life functions or prevent vehicle-to-vehicle collisions?*

The conventional wisdom is that concrete benefits are realizable with less than 25% penetration. However it is important to realize that aftermarket devices can accelerate the rate of penetration and the potential exists to introduce these in the very short term. Given the need for a new iteration of testing, we believe that re-channelization would introduce unwarranted delay in the development of the V2V market and push the realization of safety benefits further into the future.

*What are the projected timeframes for achieving the penetration levels needed for each safety-of-life or crash avoidance function to be effective?*

The time horizon for achieving “critical mass” needed for safety benefits is inter-dependent with the deployment of roadside infrastructure. We believe that these are linked in a “virtuous circle”.

*Will these penetration levels be met by equipment that is native to the automobile or through standalone or retrofit devices? Would these timeframes change if re-channelization occurs and by how much?*

As previously indicated, aftermarket devices are necessary to achieve the required penetration levels sooner rather than later. But whereas the near-term availability of aftermarket equipment may be nullified by the adoption of the re-channelization scheme and the testing required for it, we cannot gauge the impact on timeframes.

*In the meantime, what other spectrum bands, driver-assist technologies, and commercial offerings are providing similar services to those envisioned using DSRC?*

The relationship of ADAS (advanced driver assist systems) to DSRC is discussed throughout the so-called “V2V Readiness Report” published by NHTSA in August of 2014. The general view expressed in this report, and which is echoed in the automotive industry, is that ADAS and DSRC are complementary, and not necessarily substitutes for one another. However, in the case of ATIS (advanced traveller information services) envisioned using DSRC, particularly with respect to real-time navigation, it is widely accepted that LTE-based commercial services (e.g. WAZE) have made significant progress in providing equivalent functionality. Nevertheless, we believe that in this area, LTE and DSRC can be complementary rather than competitive, where the common ground is found in
the standardized messaging formats established by SAE J-2735. The complementarity of LTE and DSRC is a basic tenet of the USDOT Connected Vehicle Reference Information Architecture (CVRIA), to which we intend to adhere to in our infrastructure deployment and operations plan.

*Is it possible that autonomous car and other technologies could bypass DSRC safety-of-life capabilities prior to reaching a sufficient technology penetration to make this service effective?*

We prefer to view this question from the perspective of the complementarity of DSRC and vehicle autonomy. The development of reliable vehicle autonomy is linked to the availability of DSRC infrastructure. Whereas fully autonomous vehicles (Level 5) must be independent of DSRC infrastructure, the intermediate levels on the path to full autonomy can all benefit from both DSRC infrastructure and a growing fleet of DSRC-enabled vehicles.

*Does the 5.850-5.895 MHz portion of the band potentially offer the most value for unlicensed operations?*

No. As previously stated, we believe that “unlicensed operations” should be enabled at the Internet layer, not by allowing actual spectrum sharing but by granting access to mobile Internet services (advertised by RSUs) for non-DSRC devices attached to OBUs.

*What are the advantages and disadvantages of combining the non-safety-related channels into larger channels?*

Larger channels provide for greater throughput but at shorter distances. The re-channelization scheme therefore appears well-suited to a technology platform that enables an in-vehicle WiFi access point (AP) with an LTE connection to the Internet. But where the connectivity to the Internet is established through DSRC, a narrower channel width is more effective at the longer distances typically separating the vehicle from the RSUs that are equivalent to WiFi APs. So there are disadvantages to the re-channelization scheme on several levels. The larger channels are less effective in providing Internet connectivity through DSRC infrastructure and, as we have already indicated above, the unlicensed use of non-safety-related spectrum reduces the effective bandwidth available to pay for DSRC infrastructure.

*How should portions of the band not required for safety-of-life applications be shared among DSRC and unlicensed operations?*

As previously indicated, we believe that “sharing” should be enabled at the Internet layer and that actual sharing of spectrum at the PHY layer should be avoided.

*For instance, should non-safety of life DSRC applications share the lower re-channelized band on an equal basis with unlicensed operators or have some priority?*

If we define an “unlicensed operator” as simply a device with connectivity to the IoT through a licensed device, re-channelization is unnecessary. Non-safety DSRC and non-DSRC applications can effectively share the Service Channels of the DSRC spectrum. Also, the IEEE 1609 suite of specifications (particularly IEEE 1609.4) already provide mechanisms for prioritization of applications
If commercial or other non-safety DSRC applications have priority access to the band, is a detect-and-vacate protocol necessary or does the IEEE 802.11 standard or other protocols allow for prioritization of DSRC traffic without the need to vacate non-safety channels for a pre-determined time period?

It is the “detect-and-vacate” obligation imposed on unlicensed devices (assuming that it will work effectively) that is supposed to be the guarantor that DSRC applications (regardless of criticality) have “priority access to the band”. Without “detect-and-vacate”, ensuring access to the band would be analogous to trying to ensure safety at a blind intersection where the traffic lights are not working.

In addition, we invite interested parties to suggest other approaches that would facilitate unlicensed use of the 5.850-5.925 GHz band without causing harmful interference to DSRC operations. Would a hybrid approach taking elements from both the “detect and avoid” and the “re-channelization” proposals create benefits for both DSRC and U-NII users?

For example, are there advantages to an approach where unlicensed users and DSRC non-safety of life applications would share access to the lower 45 megahertz of DSRC spectrum, while unlicensed devices would use a “detect and avoid” approach to avoid, and thus protect, co-channel safety-of-life DSRC operations in the upper 30 megahertz of spectrum?

We do not believe that this would be beneficial for several reasons. First, there is a fundamental “opportunity cost” to allowing unlicensed devices to operate on spectrum that could otherwise be leveraged by infrastructure authorities. The alternative we propose is superior to this concept, for the financial reasons already cited. But even if the opportunity cost was not a factor, one of the benefits of re-channelization is that it obviates the need for “detect and vacate” hardware in U-NII devices. Allowing co-channel operations in the upper 30 MHz would simply re-introduce that need, thus nullifying the benefit sought by re-channelization.

Is it feasible to develop a “hybrid chip” that would implement a DSRC standard receiver for detection purposes to allow unlicensed use, if the spectrum is clear?

As indicated previously, Qualcomm announced this kind of product at CES in January 2016, supporting both 5 GHz WiFi and DSRC.

Would it be viable to employ an approach based on use of a database to control access to the spectrum similar to that used for the Citizens Broadband Band Radio Service at 3.5 GHz or for White Space devices in the TV and 600 MHz Service bands?

Not only would it be viable, it would be necessary so that the infrastructure authority would have the option to apply billing charges for bandwidth.
The undersigned do hereby support and ask that the comments and responses set forth herein be made part of the record and given due consideration by the Commission.

L. Brooks Patterson  
Oakland County Executive

Fred Nader – Chairman  
Oakland County Connected Vehicle Task Force

Dennis G. Kolar, P.E.  
Managing Director  
Road Commission for Oakland County

Kirk Steudle, P.E.  
Director  
Michigan Department of Transportation

Elaina Parnsworth  
CEO, Mobile Comply

Gregory D. Krueger, P.E.  
Associate Vice President - HNTB Corp.  
Emerging Technology Program Director

Paul Haelterman  
Vice President & Managing Director  
Automotive Advisory Services  
IHS Automotive

Martin Nathanson  
CTO  
Paxgrid Telemetric Systems

Doug Patton  
Executive Vice President, Engineering Division  
Chief Technical Officer  
DENSO International America

Jim Santilli  
Chief Executive Officer  
Traffic Improvement Assoc. of Michigan

Praveen Singh  
Vice President Connectivity  
Lear Corporation

Jeff Varick  
President and Founder  
Brandmotion LLC
The figure above provides a very high level view of the functional and process architecture of the OCCV proposal.

In step 1, a third party device attaches itself to an OBU through a WiFi PeertoPeer (WiFi Direct) interface, using the "discovery" and "address configuration" methods specified in IPv6. The WiFi Direct interface may operate in 5 GHz but not overlapping the DSRC spectrum.

In step 2, the third party device wants to send IPv6 traffic to a remote Internet host, so it routes it through the OBU.

Step 3 shows a periodic WAVE Service Advertisement (WSA) from the RSU, identifying which services are locally available. Infrastructure authority/operator may make a policy-based decision to enable/disable Internet Connectivity. The process 3a running in the OBU implements this policy by reconfiguring the channels available for selection in the MAC Layer Management Entity (MLME).

In step 4, if the most recent WSA indicates that the service is available, the OBU routes the IPv6 traffic to the RSU, using the Service Channel specified for this.
In step 5, if the RSU is currently configured to support Internet Connectivity, it routes the IPv6 traffic to the Internet towards the remote host.

The reverse communications path, from the cloud to the RSU to the OBU and then back to the external 3rd party, can be illustrated simply by reversing the direction of the arrows and the numbering of the steps.

Step 6 illustrates the instance of a non-safety-of-life application, resident in the OBU, generating IPv6 traffic. This path of communications is identical to the path for IPv6 traffic from the external (3rd party) device, demonstrating that all IPv6 traffic is governed by the same MAC and PHY protocols.
Michigan Connected and Automated Vehicle Working Group

Presentations
Michigan Connected and Automated Vehicle Working Group

Oakland County Executive Building
Waterford, MI

July 26, 2016
Meeting Agenda

01:00 PM  Introductions and Update  
Richard Wallace, Director, Transportation Systems Analysis Group, CAR

01:10 PM  Oakland County Welcome  
Gary Piotrowicz, Deputy Managing Director/County Highway Engineer, Road Commission for Oakland County

01:15 PM  Overview of the Velocity Center Cyber Capabilities  
Jennifer Tisdale, Cyber-Mobility Program Manager, Michigan Economic Development Corporation

01:35 PM  Using Simulation for Developing CAV Applications  
Jeff Blackburn, Sales Manager, TASS International

01:55 PM  Connected & Autonomous Vehicles: Developing the Skills that Your Organization Needs to Thrive  
Elaina Farnsworth, CEO, Mobile Comply

02:15 PM  Local Connected Vehicle Deployment Strategies  
Matt Gibb, Deputy Oakland County Executive

02:30 PM  Networking Break  

02:45 PM  AutoMobili-D at the NAIAS  
Marla Wise, Senior Director of Business Development, The Fulkerson Group

03:05 PM  CityMobil2  
Adriano Alessandrini, Researcher, Centre for Transport and Logistics of the University of Rome La Sapienza

03:15 PM  Update on Michigan CAV Efforts  
Matt Smith, Statewide ITS Manager, MDOT

03:40 PM  Communications and Traffic Monitoring Upgrade for Adaptive Signals  
Ahmad Jawad, Signal Systems Engineer, Road Commission for Oakland County

04:00 PM  Adjourn
Working Group Mission

Cooperatively pursue projects and other activities that are best accomplished through partnerships between multiple agencies, companies, universities, and other organizations and that ultimately advance Michigan’s leadership position in connected and automated vehicle research, deployment, and operations.

Goals

- Benefit our state and our industry (automotive and more)
- Enhance safety and mobility in Michigan and beyond
Noteworthy News

• News emerged of first fatal crash involving a Tesla in Autopilot mode (and several more crashes, non-fatal, also revealed)

• Columbus announced as the winner of the USDOT Smart Cities Challenge
  • https://www.transportation.gov/smartcity

• IHS forecasts 21 million in sales of fully autonomous vehicles globally in 2035 (and cumulative total of nearly 76 million)

• U.S. Army is testing automated truck platoons using DSRC in Michigan
  • http://www.driverlesstransportation.com/army-test-dsrc-michigans-i69-13435

• China issues moratorium on autonomous vehicle testing on public roads
  • http://www.thedetroitbureau.com/2016/07/china-shuts-down-autonomous-testing-on-highways/
Upcoming Connected and Automated Vehicle Events

• CAR Management Briefing Seminars, August 1-4, Acme, MI
• Autonomous Vehicles Event, August 22-24, Detroit
• World Mobility Leadership Forum, September 28-29, Detroit
• TU-Automotive ADAS & Autonomous, October 3-4, Novi
• CVTA’s 7th Summit on the Future of the Connected Vehicle, October 5-6, Detroit
• ITS World Congress, October 10-14, Melbourne, Australia
• Autonomous Vehicle Safety Regulation World Congress, October 25-26, Novi
• Transportation Research Board, January 8-12, 2017, Washington, DC
• North American International Auto Show, January 8-22, Detroit
The Foundation

• 2011 Governor Snyder launched the Michigan Cyber Initiative

• The Initiative created an award-winning website to educate citizens, businesses and governments

• Created the Michigan Cyber Command (MI State Police) for law enforcement usage to respond to “cyber events”

• Partnership with the Merit Network (Ann Arbor) to establish the MI Cyber Range and formation of the Michigan Cyber Civilian Corps

• In 2015 we updated Michigan Cyber Initiative to cite the economic development of cyber security in Michigan via:
  ➢ Michigan’s strong entrepreneurial culture
  ➢ High-tech Talent and Cyber Talent Development
  ➢ Automotive Industry
  ➢ Defense Industry
  ➢ International / National Business Attraction

www.michigan.gov/cybersecurity
Primary objective has been to execute against the Governor’s Cyber Initiative with the following objectives:

- Define the area of cybersecurity in which Michigan has the most growth opportunity.

- Apply holistic approach to cyber programs to include: Business Development & Attraction, Talent Development, and Marketing efforts for cohesion between MEDC business units

- Identify Michigan target industries such as Automotive, Defense, Mobility and Aerospace as primary concentrations for Michigan’s unique cyber offerings

- Assist in the creation of the Cyber Training Centers

- Align with TACOM / TARDEC, DoD programs and Defense OEMs with cybersecurity programs highlighting dual use technologies

- Support cyber STEM focused programs for Michigan (9-12th grades)

- Further the Development of the Michigan Cyber Range expansion hubs (*Velocity Grand Opening was March 18th!*)

- Provide a cost-effective resource for MI businesses to grow in the cybersecurity / mobility industry
**MEDC CYBER PROGRAM: Current Situation**

- **MCR expansion hub for aviation** and UAS funded by MEDC Defense Center, West Michigan

- **2-3 additional MI Cyber Range hubs, funded via OEA grant**

- **Karl Heimer**, Special (technical) Advisor, MEDC to develop Council of Interest, Automotive / Defense
  - Engage MI Universities / Colleges for cyber curriculum development specific to automotive, aerospace, etc.

- MEDC Cyber Program support to BDMs, Bus. Attraction, Export, Aerospace, Mobility, Automotive, Defense teams

- **Concentrated support to TARDEC for dual use technologies**

- Participation, creation, integration of MEDC / SOM cyber programs into industry conferences including defense, auto, aero, mobility *Harmonized message*

- Continued coordination with federal agencies, state/local government and partners / stakeholders requiring cyber program support to cyber businesses and talent in Michigan

- **Cyber & Mobility MEDC sponsored Marketing campaign(s)**
  - Inclusion of “We Run on Brainpower” and “Planet M”
Protect and Grow Initiative

- Insulate Michigan from possible Base Realignment and Closure (BRAC)
- SWOT Analysis and 17 Recommendations for MI economic growth

DoD Office of Economic Adjustment Grant

- $5.9 Million Grant, $1.2 Million dedicated to Cyber Hub expansion
- MEDC provided match funding of $300K
- Multiple partners
- Varying and Complimentary Task Orders, managed by WIN
**Mission:** To support the growth of emerging markets and industries by providing Assistance to firms and workers in a 13 county region in southeast Michigan affected by reduced spending by the Department of Defense.

**Areas of Concentration:**

- Lightweight Materials
- Autonomous / Mobility Platforms
- Connected Life Technologies
- 2-3 Michigan Cyber Range Expansion hubs
- Cyber-Mobility technologies
PROTECT AND GROW

RECOMMENDATIONS

1. Maximize the Michigan Congressional Delegation's Federal Influence and Support for Military Installations
2. Promote and Safeguard Acquisition, Technology, and Logistics (ATL) Capabilities at the Detroit Arsenal
3. Invest State Resources to Enhance Military Installations and Defense and Homeland Security Missions
4. Expanding Training Ranges and Opportunities
5. Pursue Opportunities and Branding to Lead the Nation in DOD and State
6. Leading the Nation in DOD/State Cyber Operations Integration
7. Strengthen and Promote Link Between Defense and Domestic Auto; Establish Autonomous Vehicle Corridor on I-69
8. Establish Innovation Center at the Detroit Arsenal
9. Connect Veteran Talent to Michigan Industry
10. Leverage Partnership Opportunities Between Academia, Industry, Local Government and DOD/DHS Entities Within the State
11. Publicize the Importance of the Soo Locks to National Security and Advocate for Funding
13. Build and Promote an Asset Database to Leverage In-State Testing and Evaluation Capabilities
14. Secure East Coast Missile Defense Ground Based Interceptor Site at the Fort Custer Training Center
15. Study the Fiscal Impacts of Reinstating R&D Tax Credits
16. Sponsored Renewable Energy Solutions
17. Target and Invest Resources in the following areas of growth: Aerospace, Advanced Manufacturing, 3-D Printing, and Autonomous Systems

Want to know more?
www.ArsenalofInnovation.com
Protect & Grow Cyber-centric Recommendations

- Training Ranges including Cyber Ranges
- Pursue or Create statewide Branding to lead DoD / DHS efforts
- Strengthen & Promote link between Defense and Commercial Automotive
- Grow and Promote I-69 Smart Corridor
- Establish Innovation Center at/for TARDEC concentration on security of autonomous platforms
- Lead Nation in Cyber Operations
- Invest in areas of growth: Aerospace, Advanced Manufacturing, 3D Printing, Autonomous Systems concentrating on the security of platforms
Michigan Cyber Range… Powered by the Merit Network

The Michigan Cyber Range (MCR) provides a secure, unclassified (private) sandbox environment for education, testing and training.

**Education:** 17 professional certifications including certified ethical hacking, penetration testing

**Training:** Ideal environment for Red/Blue (offensive/defensive) exercises

**Testing:** Merit’s large, private internet provision through the largest private fiber network is a safe environment testing the security of software technology
Michigan’s First Cyber Incubator
MEDC Cyber Recommendations in *ACTION*

- Cyber Program Manager to **unify MI Defense Center and MEDC Auto office - Mobility**
- **Senior Technical Advisor, Karl Heimer** coordinates with MEDC Cyber Program Manager
- SAE Cyber Auto Challenge, support and coordination
- TARDEC Support & CRADA
- **American Center for Mobility, Willow Run**, Cyber initiative implementation
- **Cyber Challenges** focused on Defense, Auto, Aerospace, Autonomous, Connected Life
- 2-3 **MI Cyber Range expansion hubs**, OEA and MEDC funded, FY16-18
- **MDOT I-69 Smart Corridor**, PR/Marketing and messaging
- **MI Cyber Campaign Trail** >>> Promoting Business & Talent Growth and Attraction

- **ITS America**, San Jose
- **Black Hat**, Las Vegas
- **Management Briefing Seminar (MBS)**, Traverse City
- **CES**, Las Vegas
- **North American International Cyber Summit**, Detroit
- **North American International Auto Show**, *featuring Mobili-D*, Detroit
- **NDIA Cyber-Defense Summit**, Troy
- **SBDC “Small Business, Big Threat” Program**, statewide
Mackinac Policy Conference June 2016:

Steve Arwood, CEO of the MEDC, and Dr. Paul Rogers, TARDEC Director, signed the Cooperative Research and Development Agreement (CRADA), defining the collaboration between the two organizations, including:

- Testing and Evaluating autonomous defense vehicles on I-69
- Transportation Cybersecurity
- Next generation alternative energy development
MEDC Cyber Program: The Highlights
QUESTIONS?

Jennifer Tisdale
Cyber Program Manager
Michigan Economic Development Corporation
on behalf of the Michigan Defense Center & Automotive office
Mobile: 517-599-2892
Email: tisdalej1@Michigan.org
USING SIMULATION FOR DEVELOPING CAV APPLICATIONS

JEFF BLACKBURN
TASS INTERNATIONAL

www.tassinternational.com
Shameless Self Promotion

SAE Class, C1603
“Introduction to Active Safety Systems”

August 2 & 3, Troy, Michigan
November 29 & 30, Troy, Michigan
The Halting Problem

• "On Computable Numbers, with an Application to the "Entscheidungsproblem" (decision problem) (1936) Alan Turing

• Asks whether it is possible to absolutely determine whether a non-trivial program given some input(s) will ever stop

• No solution

• The halting problem for Turing machines (or Turing complete languages) is undecidable

• Non-trivial software cannot be absolutely or conclusively tested
How safe is safe enough?

• The safety of human drivers is a critical benchmark against which to compare the safety of autonomous vehicles
• Americans drive nearly 3 trillion miles every year *
• In 2013 there were 2.3 million reported injuries* (failure rate of 77 injuries per 100 million miles)
• In 2013 there were 32,719 reported fatalities* (failure rate of 1.09 fatalities per 100 million miles)

• *(Bureau of Transportation Statistics, 2015)
How safe is safe enough?

Failure-Free Miles Needed to Demonstrate Maximum Failure Rates

To demonstrate a failure rate of 1.09 fatalities per 100 million miles

- Fleet of 100 autonomous vehicles
- Test driven 24 hours a day, 365 days a year at an average speed of 25 mph
- 12.5 years

"Driving to Safety - How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?"
Kalra & Paddock, RAND Corporation, Santa Monica, CA - 2016
How safe is safe enough?

Miles Needed to Demonstrate with 95% Confidence that the Autonomous Vehicle Failure Rate Is Lower than the Human Driver Failure Rate

To demonstrate a failure rate of .872 fatalities per 100 million miles (20% improvement over human driver)

• Fleet of 100 autonomous vehicles
• Test driven 24 hours a day, 365 days a year at an average speed of 25 mph
• 225 years

“Driving to Safety - How Many Miles of Driving Would It Take to Demonstrate Autonomous Vehicle Reliability?” Kalra & Paddock, RAND Corporation, Santa Monica, CA - 2016
What is Due Care?

All possible active safety scenarios ~ infinite
Test Coverage

All real-world states of a specific system (an ideal fully deterministic simulation model would be capable of testing exactly these states).

Test coverage with real world tests (on road driving).

Test coverage with purpose built advanced test tracks (create edge cases of interest).

Test coverage with inexpensive and fast simulation models (create unlimited edge cases of interest). Some impossible to create in any other way.
Software Testing

• Should always add value
• Adding value increases quality or reliability
• Increasing quality or reliability means finding and fixing bugs
• Don’t test to show a program works
• No added value
• Test to find errors and correct
• Affects the selection of test data and cases
• Writing thorough test cases forces one to think through inputs, outputs, and error conditions
Software Testing

- Testing constraints
  - White box
  - Black box
  - Grey box

- Testing levels
  - Unit
  - Integration
  - Interface
  - System

- Testing methods
  - Static code analysis
  - Formal methods
  - Dynamic code testing
  - Software in the Loop (SiL)
Deterministic and Random Scenarios

Deterministic scenarios include variations in actors, roads, lane markings, trajectories, buildings, etc.

Random scenarios include variations due to car motion, sensor noise, environmental effects, signal fade, multi-path, crosstalk, etc.
SiL Testing - PreScan

1. Build scenario
2. Model sensors
3. Add control system
4. Run experiment
PreScan

Mcity – PreScan video
Sensor Models

V2x communication: DSRC Receiver & Transmitter

- Using the DSRC Receiver (Rx) and Transmitter (Tx) sensors, data between actors can be exchanged using a selected DSRC protocol and selected message types.
- Currently, the SAE J2735 protocol and its basic safety message (BSM) part 1, and the event driven hazard warning messages in part 2 are supported. This is the standard for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) safety applications in the USA.
PreScan Sensor Models

Transmitter / Receiver Models - Simulink

- DSRC Transmitter & Receiver
  - Data between actors exchanged using a selected DSRC protocol and selected message types
  - SAE J2735 and its basic safety message (BSM) (part 1 and 2) supported
Probability Density functions for packet loss

- Simulates packet loss depending on:
  - Physical obstructions
  - Distance
  - Five pre-defined scenarios
This example shows the variability due to signal multipathing, signal fade with distance, and transmission baud rate.
CAV Examples

DSRC with Probability density function video
PreScan combined with octoBox for DSRC radio testing
Questions?

jeff.blackburn@tassinternational.com
734-262-4043
Connected & Autonomous Vehicles: Developing the Skills that your Organization Needs to Thrive
Today we discuss...

Connected & Autonomous Vehicles: Developing the Skills that your Organization Needs to Thrive

What’s going on in the industry?

Stakeholders, who’s involved?

What’s going on with the workforce?

What’s the answer?

Strategic education & training paths to success
What is going on in the industry?

1. Convergence of many technologies and industries
2. Bidirectional communication using any protocol
3. Access to any device, inside and outside the vehicle
4. Standards are still in development
5. Technology is rapidly changing; security is becoming a focus
6. and the list goes on...
What is going on in the industry?

- Connected Vehicles are:
  - Wireless network enabled
  - Communicate with devices inside and outside the vehicle
  - Complex set of various electronic components
- Vision of Connected Vehicles
  - Accident prevention
  - Enhance safety and mobility
  - Provide environmental benefits
- Modes of communications
  - Within vehicle communication
  - Vehicle-to-Personal gadget communication
  - Vehicle-to-Vehicle communication
  - Vehicle-to-Infrastructure communication
- Add NFC, Cellular, WiFi, BT, DSRC
- Connected vehicle is combination of any/all:
  - Cellular
  - WiFi
  - DSRC
  - NFC (BT, other)
  - Radar
  - Optics
Who is involved?

- Consumers
- Automotive Industry
- Application Provider
- Wireless Carriers
- Transportation
What’s going on with the workforce?
Knowledge Gap
What’s going on with the workforce?

Employers need talent…

Workforce needs training…

2015 CAR Industry Report
* Applicants with the desired skills are hard to find. 80% of respondents have difficulty finding talent in the region.

Higher Education Institutions
* Higher education are challenged to prepare students for jobs that may not even exist yet.

Converging industry
Professionals in the automotive industry may not be trained in mobile technologies. Software and telecommunication carries may not be trained in the business of automotive. Transportation professionals may not be trained in connected technologies. What about interoperability?

2 Higher Education: https://youtu.be/uqZlO0Y17Y
What will it take?

Strong Partnerships
Industry
Public Sector
Education

Educating Existing Workforce

Educating Future Workforce
Why is education important?
Educate Strategically
**FASTTRACK**
Introduction to the engineering, systems and business implications of connected and autonomous vehicles suitable for all audiences.

**CONNECTED VEHICLE PROFESSIONAL**
The industry credential for engineers developing or working with connected and autonomous vehicles.

**CONNECTED VEHICLE OVERVIEW**
Streamlined courses for technical and management participants new to connected vehicles.
CONNECTED VEHICLE FOCUSED
Half day courses focused on specific aspects of connected vehicles. These are a great option to fill in specific skills gaps, or provide just in time education at the start of a new project.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVF501</td>
<td>Connected Vehicle Basics</td>
<td>4 hours</td>
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<tr>
<td>CVF504</td>
<td>Communications</td>
<td>4 hours</td>
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<tr>
<td>CVF507</td>
<td>Security Basics</td>
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<tr>
<td>CVF502</td>
<td>In-Vehicle Systems</td>
<td>4 hours</td>
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<tr>
<td>CVF505</td>
<td>Data, Updates &amp; OTA</td>
<td>4 hours</td>
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<tr>
<td>CVF508</td>
<td>Testing</td>
<td>4 hours</td>
</tr>
<tr>
<td>CVF503</td>
<td>Infrastructure (V2I)</td>
<td>4 hours</td>
</tr>
<tr>
<td>CVF506</td>
<td>Organizational Impact &amp; Smart Cities</td>
<td>4 hours</td>
</tr>
<tr>
<td>CVF509</td>
<td>Policy &amp; Regulation</td>
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</tbody>
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AUTONOMOUS VEHICLE FOCUSED
Half day courses focused on specific aspects of autonomous vehicles. These are a great option to fill in specific skills gaps, or provide just in time education at the start of a new project.

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</thead>
<tbody>
<tr>
<td>AVF601</td>
<td>Autonomy Basics</td>
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</tr>
<tr>
<td>AVF604</td>
<td>Data, Updates &amp; OTA</td>
<td>4 hours</td>
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<tr>
<td>AVF602</td>
<td>In-Vehicle Systems</td>
<td>4 hours</td>
</tr>
<tr>
<td>AVF605</td>
<td>Testing</td>
<td>4 hours</td>
</tr>
<tr>
<td>AVF603</td>
<td>Infrastructure (V2I)</td>
<td>4 hours</td>
</tr>
<tr>
<td>AVF606</td>
<td>Policy &amp; Regulation</td>
<td>4 hours</td>
</tr>
</tbody>
</table>
With strong partnerships...

Educating the workers of tomorrow...
With strong partnerships...

Educating the workers of today...
Thank You

For more information go to: www.mobilecomply.com

Email: info@mobilecomply.com

Elaina Farnsworth: efarnsworth@mobilecomply.com
Road transport automation for Oakland County meeting

Adriano Alessandrini
DICeA – University of Florence

26/07/2016
What CityMobil2 is

• A major European funded demonstration project
• 45 partners (7 universities and research centres, 8 technology providers, 12 cities)
• Conceived and coordinated by me
What CityMobil2 did

• Demonstrate Automated Road Transport Systems for 4 years in European cities
• Propose a safety assessment procedure which can be applied in national legal frameworks for certification
• Foresee long term socio-economic effects of different automation scenarios
Selected demo sites

- Lausanne (2014-15)
- La Rochelle (2014-15)
- San Sebastian (2016)
- Sophia Antipolis (2016)
- Leon (2014)
- Bordeaux ITS WC (2015)
- Oristano (2014)
- Trikala (2015)
- Warsaw TRA (2016)
- Stockholm (2016)
- Vantaa (2015)
- Warsaw TRA (2016)
The news video of the Oristano demo
December 2014 inauguration of La Rochelle CityMobil2 ARTS demonstration
CityMobil2 – Lausanne demo
Vantaa
Trikala

Driverless buses on the streets of the innovative city of Trikala
How many passengers have we carried so far?

- Oristano (Italy) 2 580
- La Rochelle (France) 14 660
- Lausanne (Switzerland) 7 000
- Vantaa (Finland) 19 000
- Trikala (Greece) 12 150
- Antibes (France) 4 000
- San Sebastian (Spain) 3 500

- Total 60 000+
What did we learn?

• Full-automation is feasible today
  – Not by progressively aiding the drivers
  – Not with Google cars which pretend to rely entirely on the technology on board
  – With an integrated approach which uses a simple automation technology and careful consideration of the environment

• It opens unprecedented market possibilities
  – Last mile transport services can become profitable
  – Personalization of mobility transforms last mile transport services in service enablers
ARTS Demonstrations: the tip of the iceberg

ARTS public operation

Staff training
System operational tests
System/vehicle setup
Infrastructure building/adaptation
Legal authorization
Risk assessment/certification
Infrastructure design
System design
Transport study

…
ARTS Demonstrations: the tip of the iceberg

- ARTS public operation
- Staff training
- System operational tests
- System/vehicle setup
- Infrastructure building/adaptation
- Legal authorization
- Risk assessment/certification
- Infrastructure design
- System/route design
- Transport study
- ...

12-15 Months
ARTS Demonstrations: the tip of the iceberg

- ARTS public operation
- Staff training
- System operational tests
- System/vehicle setup
- Infrastructure building/adaptation
- Legal authorization
- Risk assessment/certification
- Infrastructure design
- System/route design
- Transport study

...
Few examples of what we learned: Safety and Priority?
Do you feel safe?

More safe

As Safe

Less Safe

La Rochelle | Lausanne | Trikala
---|---|---
No Road Markings | Road Markings

* * *

* * *

*
Who has priority?

Priority with Road Markings

- **Me**
- **ARTS**

% Respondents

- La Rochelle
- Lausanne
- Trikala

CityMobil2
How to safely integrate ARTS in cities
Our ideas forward

• What would we do with existing busses? Would it not be better to retrofit existing busses first?

• AutoKAB company was created on purpose

• Are existing transit operators ready to a big change in their business model?

• A new ad-hoc integrated service provider company has been created: MEDIUM
Presents

North American International Auto Show

autoMOBILIO NAIAS DETROIT
AutoMobili-D Overview

• Mission is to create a global mobility center providing an in-depth look at the ever-changing world of automotive mobility

• Located in the new Cobo Center Atrium and the adjoining Hall E exhibition area

• Features up to 120,000 sq. ft. of dynamic display space bringing together key global players in new mobility to demonstrate and talk about leading mobility trends and technologies

• Hosted during Press Week at the North American International Auto Show (NAIAS) from January 8 – 12. NAIAS is one of the world’s leading auto shows attracting 5,000+ media and 40,000+ auto and transportation executives representing 2,000+ countries.
Atrium Entryway to AutoMobili-D
AutoMobili-D Atrium – Ground Floor View
Key Features of AutoMobili-D

- 50+ mobility exhibits and 50+ mobility start-ups to be seen by 5,000+ global media and automotive executives from around the world

- 20’ by 40’ presentation stage offering press conferences and mobility symposiums throughout NAIAS Press Week, 1/8/17 - 1/12/17

- Indoor demonstration area to showcase mobility technologies such as autonomous parking, lane assist, emergency braking and related innovations

- Outdoor track for real-life vehicle demonstrations and press briefings

- Opening night reception and keynote speech by noted mobility executive
Birds-Eye View of Hall E Exhibit Area
Hall E Exhibit Entryway
AutoMobili-D Hall E Overview

- Hall E will be segmented into communities that feature:
  - Connected Car Technologies
  - Autonomous Driving
  - E-Mobility
  - Urban Mobility
  - Mobility Services
- An autonomous vehicle test pad will be located in Hall E exhibit areas to provide demonstrations of featured technologies
- TechStars to host 50+ start-ups from around the nation specializing in the mobility sector
- An additional 50+ tech companies to be exhibiting as part of this initiative
The AutoMobili-D Exhibit Communities

Five core themes drive mobility – worldwide and at AutoMobili-D
Indoor Test Pad Area
AutoMobili-D Schedule

Sunday, January 8, 2017 – NAIAS Global Mobility Center Opening Day
3:30-5:00 PM  AutoMobili-D Exhibits Open
5:00-6:30 PM  VIP Opening Reception & Keynote Presentation
6:00 -7:30 PM  AutoMobili-D Open House/VIP Track Event

Monday, January 9, 2017 -  NAIAS First Press Day
12:00-6:00 PM  AutoMobili-D Exhibits Open
7:30 AM-2:30 PM  OEM Press Conferences
3:00-6:00 PM  AutoMobili-D Press Conferences

Tuesday, January 10, 2017 – NAIAS Second Press Day
12:00-6:00 PM  AutoMobili-D Exhibits Open
7:30 AM-2:30 PM  OEM Press Conferences
3:00-6:00 PM  AutoMobili-D Press Conferences

Wednesday, January 11, 2017 – NAIAS Industry Day
12:00 PM - 9:00 PM  AutoMobili-D Exhibits Open (panel discussions, symposiums, presentations delivered throughout the day)

Thursday, January 12, 2017– NAIAS Industry Day
7:00 AM - 9:00 PM  AutoMobili-D Exhibits Open (panel discussions, symposiums, presentations delivered throughout the day)
Key Facts About NAIAS - 2016

Press Preview
• 5,068 journalists from 60 different countries and 40 U.S. states
• 61 vehicle introductions

Industry Preview
• 39,788 people from 2,000 companies and 25 countries

Charity Preview
• Raised $5.2 million for eight Southeastern Michigan children’s charities
• Raised over $50 million in the past 10 years

Public Days
• Saw visits from President Obama, Secretary of Transportation Anthony Foxx and Administrator of the NHTSA Mark Rosekind
• Total attendance of 815,575

TOTAL ECONOMIC IMPACT FOR METRO DETROIT FROM 2016 SHOW WAS $430 MILLION
Most Influential Global Auto Shows - First Full Week of Show Coverage – GLOBAL

- Detroit 16
- Frankfurt 15
- Beijing 16
- Geneva 16
- Shanghai 15
- New York 16
- CES 16
- Los Angeles 15
- Tokyo 15
- Chicago 16

"A" Shows

"B" Shows

<table>
<thead>
<tr>
<th>Universe</th>
<th>Markets</th>
<th>Period</th>
<th>Measurement</th>
<th>Media Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>All product coverage w/explicit show reference</td>
<td>GLOBAL</td>
<td>First Full Week of Show Coverage</td>
<td>Message Contacts (Reach of Media Coverage)</td>
<td>Traditional Print, TV and Online</td>
</tr>
</tbody>
</table>
**Full Show Period | Visibility by Show – GLOBAL**

### # Articles

- **NAIAS 2016**: 8504
- **NYIAS 2016**: 4297
- **LAAS 2015**: 3360
- **CES 2016**: 3334
- **CAS 2016**: 1045

### # Vehicles Referenced in Coverage

- **NAIAS 2016**: 481
- **NYIAS 2016**: 344
- **LAAS 2015**: 329
- **CAS 2016**: 195
- **CES 2016**: 184

**KEY TAKEAWAYS:**

- NAIAS garners as many articles written as the other three domestic auto shows combined.
- With significant vehicle debuts from a wide range of platforms, more vehicles are referenced in coverage than any other show.
NAIAS remains the clear leader in terms of media coverage generated globally and garners as much coverage as the other three domestic auto shows combined.
NAIAS commanded share of voice across all significant automotive global regions.

USA
- 21%
- 13%
- 12%
- 5%
- 42%

G5
- 15%
- 43%
- 20%
- 14%
- 13%

China
- 16%
- 12%
- 5%
- 43%
- 48%

Global
- 16%
- 42%
- 20%
- 13%
- 18%
Marla Wise * marla@fulkersongroup.com * 586.747.0068
CONNECTED VEHICLE INDUSTRY SUMMIT

BUILDING A PLAN FOR DEPLOYMENT
“Well, tonight I am delighted to announce another technology first for Oakland County. A bold leap into the future of technology and smart cars. If successful, I will be placing Oakland County on the global map as the first county in the world to initiate a countywide Connected Car Ecosystem.”

“When people think of Autonomous Cars, they immediately think of Google. But when people think about Connected Vehicles, they will think Oakland County. Our history has been first in cars, and with this new initiative, will be first in Connected Cars.”

State of the County Address

L. Brooks Patterson
Oakland County Executive
Our Challenge
Questions

V-V & V-I technology is working in numerous operational applications…. So why is it not more broadly implemented?

How can a comprehensive, secure, fail proof, connected infrastructure be deployed without tax payer money?

If DSRC is never mandated, how do you even design a system?

Can SCAT signals be adapted to allow signal phase and timing commands in a connected vehicle?

What value does probe vehicle data really have, and how do we get data beyond basic safety messages in an anonymous environment? ….. Can we sell it?
Our Challenge

Facts

GPS does not work for all vehicle locations (I.E.: urban canyons, covered garages and subterranean roads)

The term “aftermarket” seems to be lost from the conversation, despite…

- 300 Million vehicles in current car park
- 220 Million vehicles with OBD-II
- 16 Million new vehicles per year
- New vehicle production alone will take more than 10 years to achieve reasonable density

In Oakland County there are not less than 35 different jurisdictional bodies having oversight of ROW

Industry is awaiting mandates and legislation that is endlessly delayed
Our Challenge

Reality

• BUILD A BUSINESS PLAN THAT CAN BE IMMEDIATELY IMPLEMENTED THAT CAPTURES REVENUE INTO A SYSTEM SUPPORTING DEPLOYMENT OF I.T.S. CONNECTED INFRASTRUCTURE, IT’S MAINTENANCE, AND FUTURE UPGRADE.

• ACHIEVE UNIFORMITY AMONGST THE MULTIPLE INTERESTED PARTIES AND JURISDICTIONS

• YOU ARE NOT ALLOWED TO USE THE COUNTY’S GENERAL FUND TAX DOLLARS
SAE J-2735

Aftermarket OBU

Front-End: Automotive Telematics Server

Roadside Alerts over LTE

HMI V2V and ATIS

Roadside Alerts
Intersection Status

ATP

PVD

BS

OBD-II CAN

SAE J-2735

Wave Aftermarket Product
Consumer Applications

- AAA (administration, accounting, authentication)

Cloud Service Providers

- Government (state mileage tax, emissions test)
- Usage-Based Insurance
- Parking Authority
- Electronic Service History

ATP Gateway

Activation of any service at discretion of consumer
ITS World Congress Demo
Communication Technology

- Wireless Access in Vehicular Environment (WAVE)
  - Providing Safety & Mobility Services using bi-directional communication between Vehicle and/or Infrastructure
  - Frequency Band: 5.855 ~ 5.925 GHz
  - Transmission Range: ~ 500 m
  - Date Rate: 6~27 Mbps

Automatic Events Detection System

- Video Detection System
- Radar Detector
- Detection Controller
- Automatic Tracking CCTV

Multiple-Lane Tolling System

- 1. Entry Detection
- 2. Communication Start
- 3. Car Number Detection
- 4. Car Type Detection
C-ITS Overall Plan

**Expressway** (V2I Service)
- 10% Penetration of OBU
- Basic Services (Safety Warning / ETC)
- Expressway 68%

**Metropolitan Area** (Advanced V2I, V2V)
- 50% Penetration of OBU
- Mandatory Equipment for Commercial Cars
- Vehicle Interworking Services
- Expressway 100%
- National Highway 16%
- Urban Roadway 12%

**Local Area** (Advanced V2V, V2P)
- 70% Penetration of OBU
- Mandatory Equipment for Individual Cars
- Autonomous Driving Supporting Services
- Expressway 100%
- National Highway 67%
- Urban Roadway 17%

Zero(0) Death from Traffic Accidents

Totally 3 billion Euros

Long term (‘26~’30)

Medium term (‘21~’25)

Short term (‘14~’20)
C-ITS Budget Plan

**Pilot Project**
- **Location**: 75km (Expressway, National Highway, Urban)
- **OBU**: 3,000 devices
- **Costs**: 14.7 million Euros
- **Period**: 2014 ~ 2016 (3 years)

**Short term - Introduction**
- **Location**: 3,494km (Expressway)
- **OBU**: 2 million devices
- **Costs**: 700 million Euros
- **Period**: 2017 ~ 2020 (4 years)

**Medium term - Expansion**
- **Location**: 11,870km (Metropolitan)
- **OBU**: 9 million devices
- **Costs**: 1.15 billion Euros
- **Period**: 2021 ~ 2025 (5 years)

**Long term - Maturity**
- **Location**: 10,332km (Local)
- **OBU**: 5 million devices
- **Costs**: 1.135 billion Euros
- **Period**: 2026 ~ 2030 (5 years)
TWO FUNDAMENTAL TRACKS OF EFFORT

Create the organizational structure of a regional deployment authority

- Define how technical specifications of deployment will be assigned and who will be in charge.
- Set an operational strategy with governing entities within the region.
- Establish sources of non-traditional funding.
- Encourage a role for the private sector.

Design a system where data, spectrum, and technology can be monetized for revenue to support deployment

- Define security and certificate processes that support a wide tier of suppliers and OEM’s.
- Determine the best application of analytics to find revenue sources outside of safety data.
- Find a role for the “after-market”
THE PURPOSE OF AN AUTHORITY

In order to have a functioning, maintained and updatable infrastructure several parties must be involved. To prove this, a pilot is being formed between MDOT, RCOC, Oakland County and Auburn Hills. When the working authority case is proven, the structure is then replicable into regions. Some of the essential functions of the authority include;

- Increase participation from infrastructure owners and operators, as well as, industry entities.
- Develop a Regional CV master plan.
- Develop a Regional CV operations plan.
- Develop Regional technical requirements and allocate the entity responsible for establishing the standards.
- Develop a Region wide data sharing and management plan.
- Evaluate and support funding opportunities.
A POSSIBLE DSRC BASED SOLUTION

- Establish conditions for accelerated growth of DSRC market.
  - Create inter-jurisdictional public authority to oversee infrastructure deployment and management
    - Template for the rest of US/Canada
  - Establish viable business model that enables DSRC infrastructure to be independent of taxpayer dollars
    - Maintain 100% compliance with IEEE WAVE and 802.11p specifications
    - Adhere as much as possible to USDOT/NHTSA recommendations.
  - Source aftermarket hardware from DSRC vendors and integrate with Smartphone apps to offer real consumer value
“Grow or Die” Dilemma
Why service channel monetization points to a way out.

• Spectrum-sharing proposals being reviewed by FCC are “death by a thousand cuts”.
• Even if spectrum-sharing proposals are not accepted by federal government now, if DSRC market does not grow faster than the current projections, spectrum-sharing proponents will continue to argue that spectrum is going unused with huge opportunity cost for U.S. economy. Eventually they will win if V2V market share grows too slowly.
• V2V NHTSA mandate is not enough. Growth can be accelerated through aftermarket.
• Aftermarket value propositions depend on infrastructure.
• Feds have no authority over infrastructure deployment (other than RSU licensing rules). Local jurisdictions need way to deploy infrastructure quickly without waiting for federal dollars.
• OCCV has a simple solution to monetizing DSRC spectrum without contravening any IEEE specs.
Spectrum-Sharing Threats
Detect and Vacate (Cisco)

• “detect and vacate” may not work in large-scale deployment.
• UNII devices will only vacate when they have finished their current transmission, so the notion that they “defer” to DSRC devices is misleading.
• Solution proposed only detects 802.11p frame preamble (according to docs provided by Denso) so in real-world scaled test, stochastic nature of 802.11p channel contention management may mean that UNII devices will often step all over DSRC frames that have already sent their preamble but are still transmitting. (This is why we are skeptical that scaled testing will go smoothly)
Spectrum-Sharing Threats Re-Channelization (Qualcomm)

• Former service channels reconfigured as two 20 MHz unlicensed (WiFi) channels.
• No flexibility to add V2V channels (in high traffic congestion scenarios on freeways).
• Many vendors may need to change RF interface hardware to support dual-mode (DSRC 10 MHz and WiFi 20 MHz) if they want to support use of WiFi. Qualcomm may already have such hardware so this may be a way for them to establish a de facto monopoly.
• DSRC spectrum allocation to the transportation industry is effectively shrunken from 75 to 30 MHz
Spectrum-Sharing Threats Nullification of Public Good

- DSRC spectrum allocation was for entire transportation sector, including public entities (roadway management) that have broader mandate that includes (efficiency of) mobility as well as safety.

- An option for local jurisdictions to fund infrastructure deployment and operation is to monetize service channels.

- This preserves the principle that the spectrum is effectively public good (we’re just converting it into money that infrastructure authorities can use instead of tax dollars)

- Proposals for unlicensed use of spectrum offer no way to monetize it.
Conclusions and Discussion
Deployment Plan
- Target Completion Late August
- Locations on Map / Application for Real Life Solution

Concept of Operations
- Red Light Violation, Work Zone and Weather
- Target Completion Late August

Partnership Opportunities
COMMUNICATIONS AND TRAFFIC MONITORING UPGRADE FOR ADAPTIVE SIGNAL SYSTEMS

July 27, 2016

Presenter: Ahmad Jawad
About RCOC

The Road Commission for Oakland County (RCOC) is the largest county road agency in the State of Michigan.

- 1,000,000+ Residents in Oakland County
- 2700 Miles of County Road
- 1500 Traffic Signals
- 20 Miles north of Detroit

Source: epodunk.com
ABOUT RCOC

OUR VISION

“Quality Life through Good Roads – We Care”

OUR MISSION

Provide the public with leadership in:

✓ Safe and Convenient Roads
✓ Sound Financial Management
✓ Respect for the Environment
✓ Sensitivity to community concerns
✓ Responsive and Dependable Service
“make better use of existing roadways by employing advanced traffic management technologies, to respond, in real time, to actual traffic flow, thus minimizing traffic congestion and improving safety on our roads.”
RCOC TRAFFIC OPERATIONS CENTER
FAST-TRAC OPERATION

✓ Designs and Administers State and Local projects for traffic signals.
✓ Supports arterial integration functions and transportation information management systems (TIMS)
✓ Supports advance real-time traffic information services via its traffic website.
✓ Manage all connected vehicle initiatives.
✓ Operates 2,200 state and local electrical devices.
  ○ 725 traffic signals on SCATS System (adding around 20-25 signals every year.)
Biggest user of SCATS in North America with over 700 Intersections on the SCATS system.

Key benefits of SCATS (as reviewed on a single corridor) are:
- Reduction in am peak congestion: -20%
- Reduction in pm congestion: -7%
- Reduction in off peak congestion: -32%
- Reduction in type of severity of crashes: 100%
**EXISTING CHALLENGES**

- Utilizing dedicated point to point analog lines for SCATS communications
- Costly maintenance for upkeep on dial-up
- Older /obsolete communication system and modules, difficult to maintain, more staff time
- Downtime/ inefficiency impacting reliability of system
- Increasing cost for the service at some signal locations was upward towards $7,000 per year
- Costly with minimum room for growth/new ventures
- SCATS requires very reliable cycle by cycle
- Communications to operate at an acceptable level
- Conducted a wireless communications study in 2005

Source: sanchitsunny.files.wordpress.com
94 signalized intersections (currently in process of upgrading communications at all 725 locations)

- 40 traffic signal communications only
- 54 traffic signal communications and proposed CCTV installations
COMMUNICATION UPGRADE
FIELD REVIEW

- Field review of the signal locations to determine
- Review of communication alternatives
- Review of existing communication agreements
Traffic Signal Controllers

✓ All traffic signal controllers at proposed CCTV locations are currently on SCATS.
✓ Existing EPAC controller capable of Ethernet communication.
✓ Controllers without Ethernet connection required upgrade.

Existing Communication Equipment

✓ Integrated Service for Digital Network (ISDN)
COMMUNICATION OPTIONS

✓ Fiber Optic Cable
  ❖ MDOT Owned
  ❖ County Owned

✓ Wireless Point-to-Point (PTP)

✓ Leased
  ❖ Cellular
COMMUNICATION SYSTEM ALTERNATIVES

OPTION #1
All Leased Cellular Network with VPN/MPLS

OPTION #2
Hybrid Wireless and Cellular

OPTION #3
Limited Hybrid Wireless and Cellular
OPTION 1: ALL LEASED CELLULAR NETWORKS WITH VPN/MPLS

- Cellular service already available for modem use
- Several service providers  
  - i.e. Sprint, AT&T and Verizon
- All data transferred through managed cellular network
- Video data transmitted through data warehouse
- Maintenance provided by service provider
OPTION 1: ALL LEASED CELLULAR NETWORKS WITH VPN/MPLS
Deployment of different technologies leverages existing infrastructure

Combination of licensed and unlicensed radios

Cellular and leased VPN/MPLS Services

Data transmitted via radio to existing MDOT Towers
Option 3: Limited Hybrid Wireless & Cellular

- Unlicensed wireless radios
- Cellular systems with VPN/MPLS
- No licensed backhaul system (option 2)
- CCTV transmitted via cellular modem
Upfront cost of Option #2 is more compared to Option #1

Recurring costs of Option #1 are higher than that of Option #2
  - It would take approximately 20+ years to fully recoup the upfront material costs of Option #2

Option #1 recurring fees are less and Option #3

Option #3 does include reducing the number of modems, but has larger maintenance costs

As equipment reaches their end of life newer equipment will need to ensure the traffic signal system remains operational

<table>
<thead>
<tr>
<th>Comparison of Options</th>
<th>Option #1</th>
<th>Option #2</th>
<th>Option 3</th>
<th>Difference 1&amp;2</th>
<th>Difference 1&amp;3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Capital Cost</td>
<td>$180,995.00</td>
<td>$594,995.00</td>
<td>$257,495.00</td>
<td>$414,000.00</td>
<td>$76,500.00</td>
</tr>
<tr>
<td>Annual Recurring Cost (Monthly Fee + Maintenance)</td>
<td>$111,540.00</td>
<td>$106,520.00</td>
<td>$110,620.00</td>
<td>$(5,020.00)</td>
<td>$(920.00)</td>
</tr>
<tr>
<td>Total 10-Year Cost (Capital + 10 * Annual)</td>
<td>$1,302,395.00</td>
<td>$1,660,195.00</td>
<td>$1,363,695.00</td>
<td>$357,800.00</td>
<td>$61,300.00</td>
</tr>
</tbody>
</table>
**FINAL SOLUTION**

✓ **Recommended to pursue Option #1**
  - A complete leased cellular system utilizing a leased VPN/MPLS service.
  - The best return on investment at this time will be implementing leased services and increase the data pipeline at the TOC.

✓ Pursuing Option #3 does result generally the same financial result, however the added complexity of maintaining a wireless network as compared to having the service vendor maintain the leased network may not be as attractive of an option.

✓ RCOC may opt to use their current leased communication provider, AT&T which offers them the ability to reach all traffic signal sites in the county that are located away from existing tower infrastructure for county owned solution.
BENEFITS

- Upgrade supports future growth.
- Significant cost savings (operations, staff time)
- Improved operational response for all stakeholders
- Leverage a public-private-partnership with AT&T
- Improved SCATS efficiencies
- Improve the visibility of the arterial system
- Flexibility to install/add new devices as needed
- Ready for future challenges V to I testing/ install
CONCLUSION / LESSONS LEARNED

✔ Able to support emerging transportation technologies, including connected vehicles
✔ Provides a framework to institutionalize the deployment of cellular infrastructure to support the entire system at minimal cost
✔ Running ITS projects under civil engineering umbrella is always a challenge due to different lifecycles

✔ Lessons learned from deployment:
  ❖ Consider overall network architecture for sharing with partners in the plan
  ❖ Develop a solid plan before execution
  ❖ Identify communication requirements for future growth including IPv6 requirements for CV
  ❖ Pre plan, plan and think long and hard before execution
  ❖ “The devil is in the details”, Know your strengths and weaknesses, utilize specialists/consultants support for development of a detailed plan before execution
QUESTIONS / COMMENTS?

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