

Connected Car

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May 27, 2015

Agenda

- Introduction
- Industry Landscape
- Industry Architecture & Implications
- US DoT Reference Architecture
- M2M++
- Lifestyle Delivery
- Solution Architecture
- Wrap-up

Mission, Charter

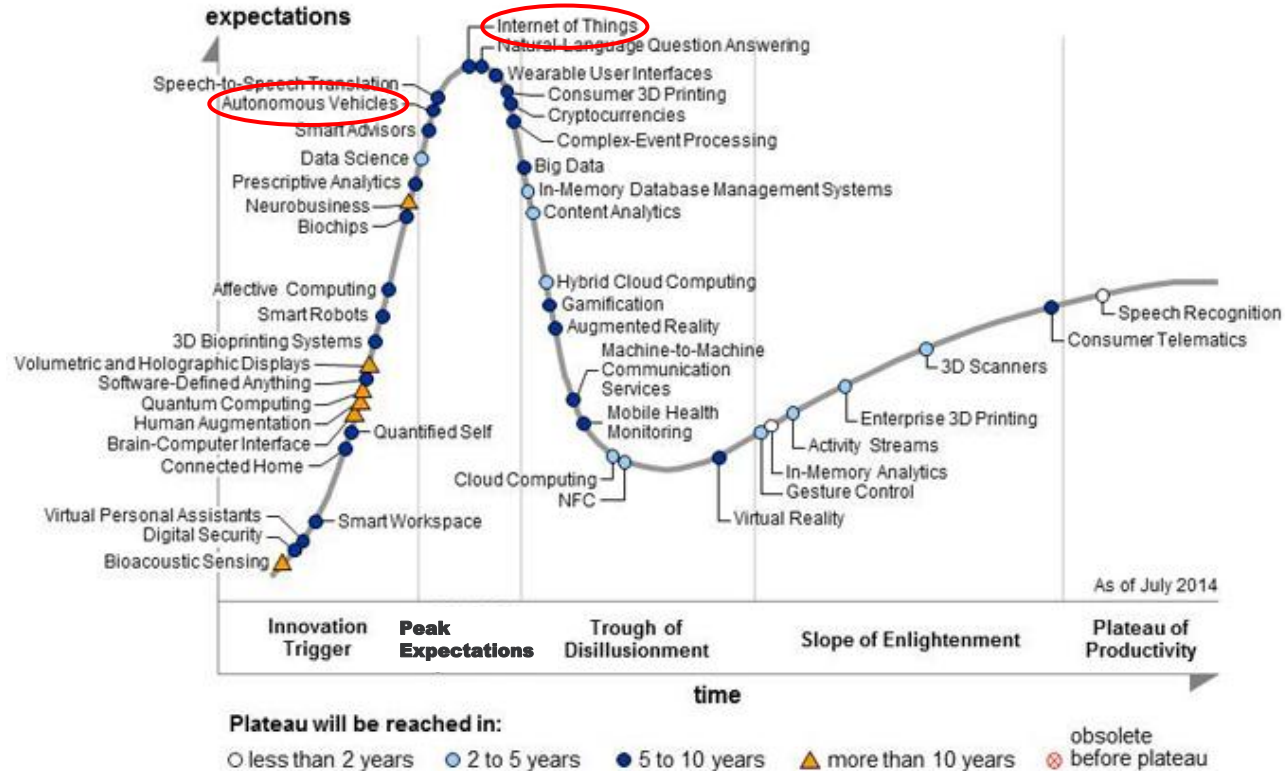
Systems & Applications

Mission

Create, architect, develop/accelerate, validate, and transfer new technology solutions for commercial product realization.

Connected Car Industry Landscape

IoT and Autonomous Vehicles are Emerging Technologies with High Expectations



Connected Car and Automated Driving Industry Timeline

Smartphone Integration and Ecosystem in Cars



Content and Apps; Car Data



V2X Safety Driver Warning
DSRC vs. 4G/LTE

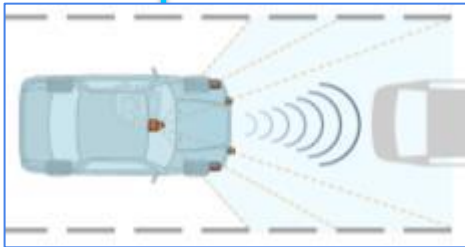


Connected and Automated Cars evolving on separate tracks. The opportunity is to bring these tracks together around broadband and cloud services, and analytics.

Connected



Automated



Combined Function Automation:
Lane Keeping + Adaptive Cruise



Partial and Highly Automated Driving

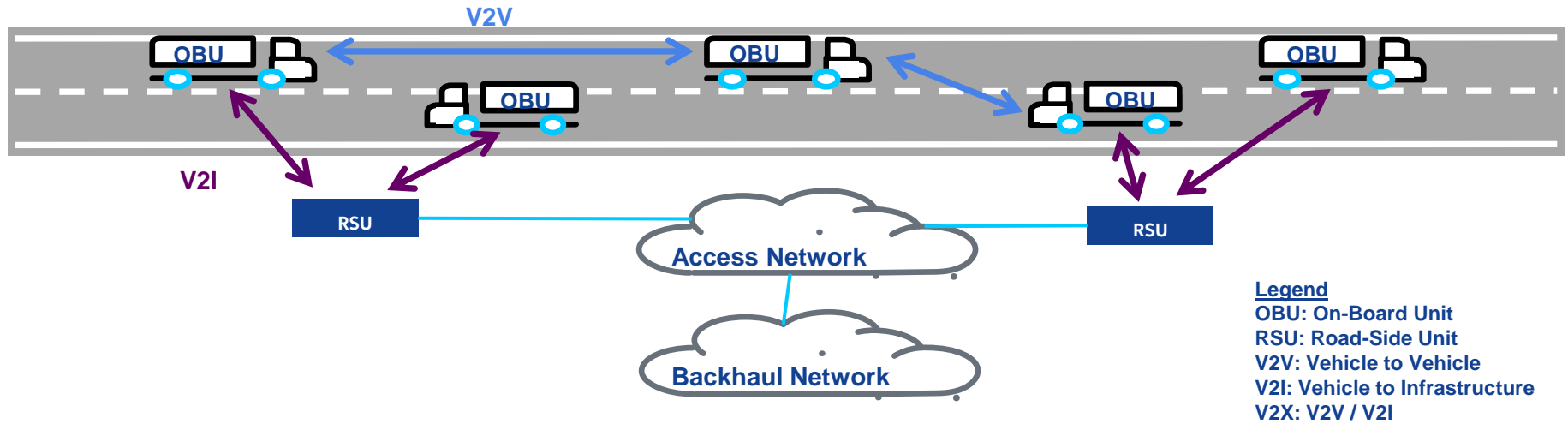


Full Self-Driving

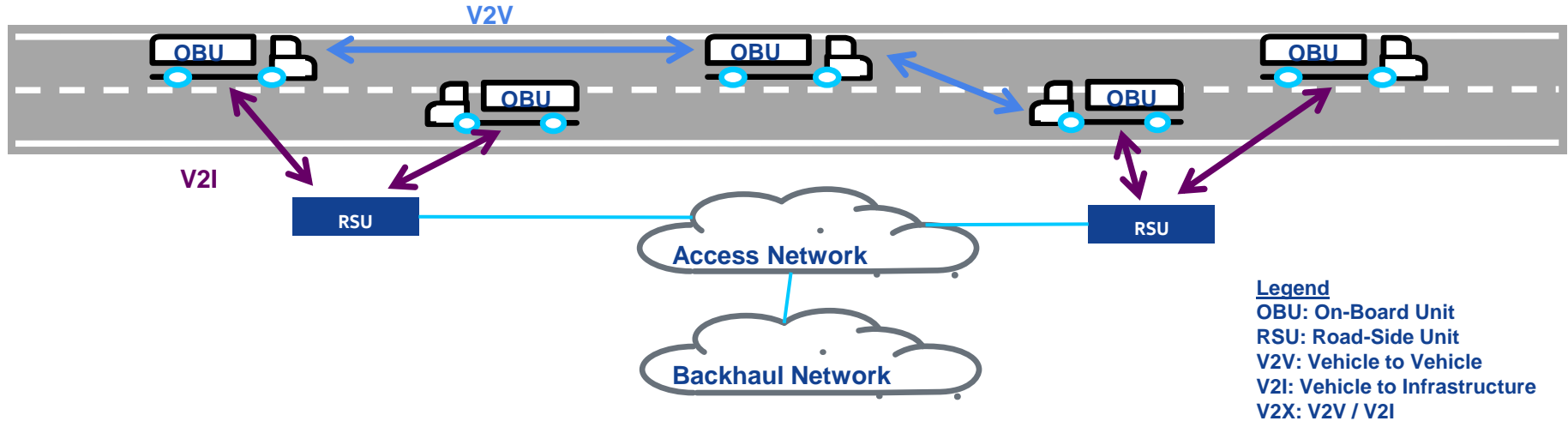
NOKIA

Connected Car Industry Architecture & Implications

Intelligent Transportation Systems (ITS)



Intelligent Transportation Systems (ITS) Terminology



- Vehicular Communication Systems

- Network in which vehicles and roadside units are the communicating nodes, providing each other with information, such as safety warnings and traffic information
- United States Department of Transportation (US DoT) affirmed its intention to explore all wireless technologies for their applicability to safety, mobility, and environmental applications
 - DSRC and non-DSRC technologies as a means of providing an open connected vehicle platform

Intelligent Transportation Systems (ITS) Capabilities

- Vehicle to Vehicle (V2V)
 - Vehicles (OBU) sharing location, vector, and intentions with other vehicles
 - Wireless communication via DSRC
- Vehicle to Infrastructure (V2I)
 - Vehicles (OBU) sharing road conditions with infrastructure (RSU)
 - Infrastructure sharing road and weather conditions with vehicles
 - Wireless communication via DSRC or Cellular
- Autonomous Vehicle (AV)
 - Self Driving Cars
 - Leverages technologies such as the following
 - Vision - Radar, Stereo Camera (3D Vision),
 - LiDAR (Light Detection And Ranging)
 - Object Recognition, Sign Recognition
 - Telematics (Location, GPS Mapping, Connected Car)
 - Leverages V2V and V2I DSRC and Cellular



Mercedes-Benz 300 measurement car (~1960)



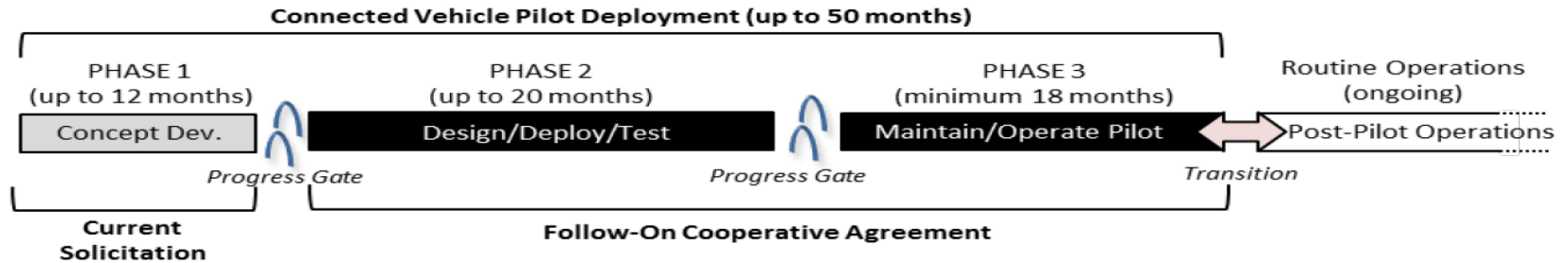
Power Company ad (~1956)



USDOT Michigan Test Bed RSU (2010)

Government Initiatives

- US Department of Transportation (DoT), Connected Vehicle Pilot Deployment Program
 - Identify, develop, and deploy applications that leverage the transformative capabilities of wireless technology between vehicles, infrastructure, and travelers' personal communication devices to enable safer, smarter, and greener surface transportation solutions
 - Request For Proposal (RFP) released January 30, 2015

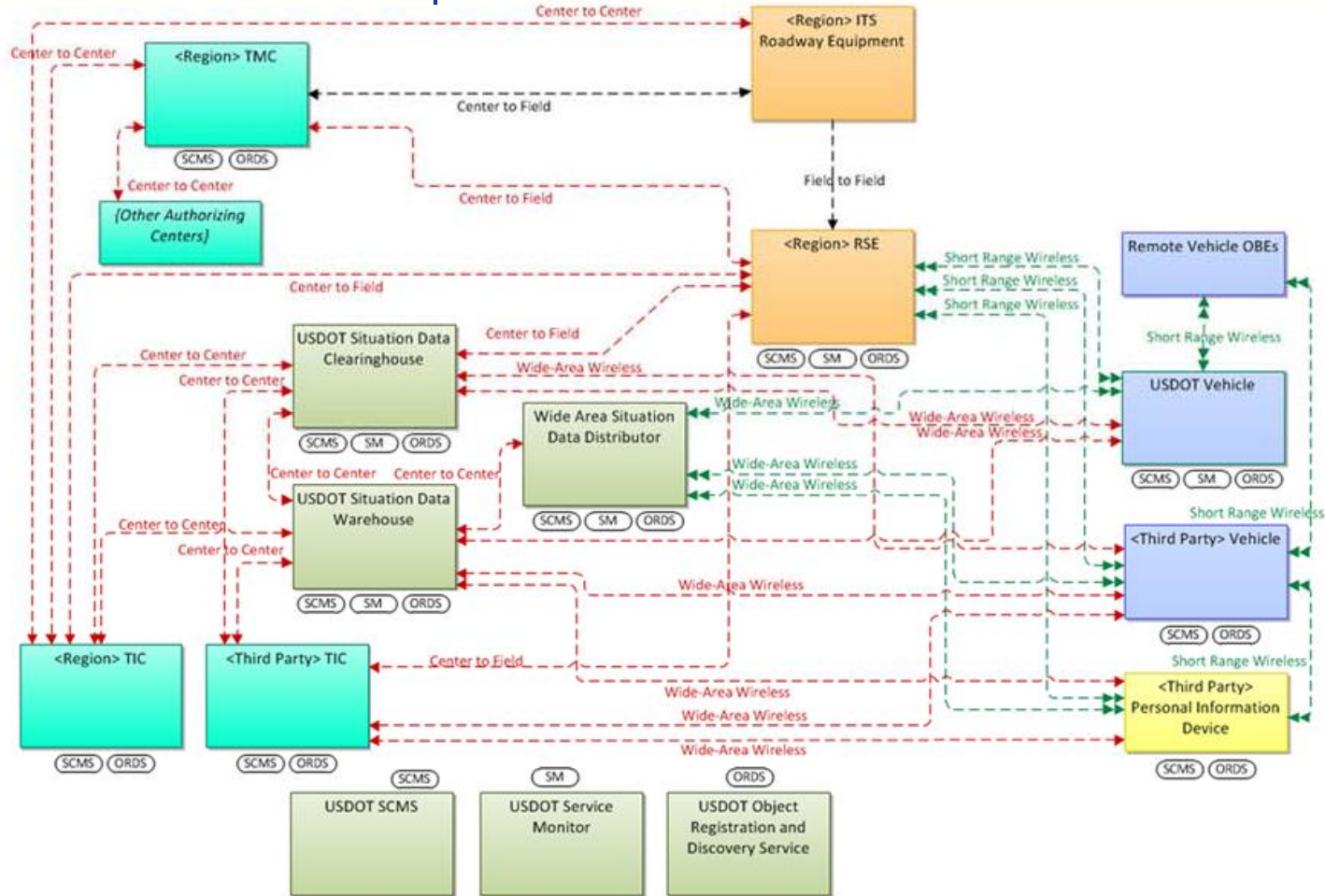


- Illinois Toll Highway Authority – Test Bed for Smart Car Technology
 - Jane Addams Memorial Tollway (I-90) - the rebuilt 16-mile 'smart corridor' will use active traffic management features to provide real-time information to drivers using a network of cameras, sensors and overhead electronic gantries
- Argonne National Laboratory - Emergency Evacuation / Transportation Planning
 - Detection, analysis and response to emergencies, and how best to evacuate the city in a major emergency

Connected Car

US DoT Reference Architecture

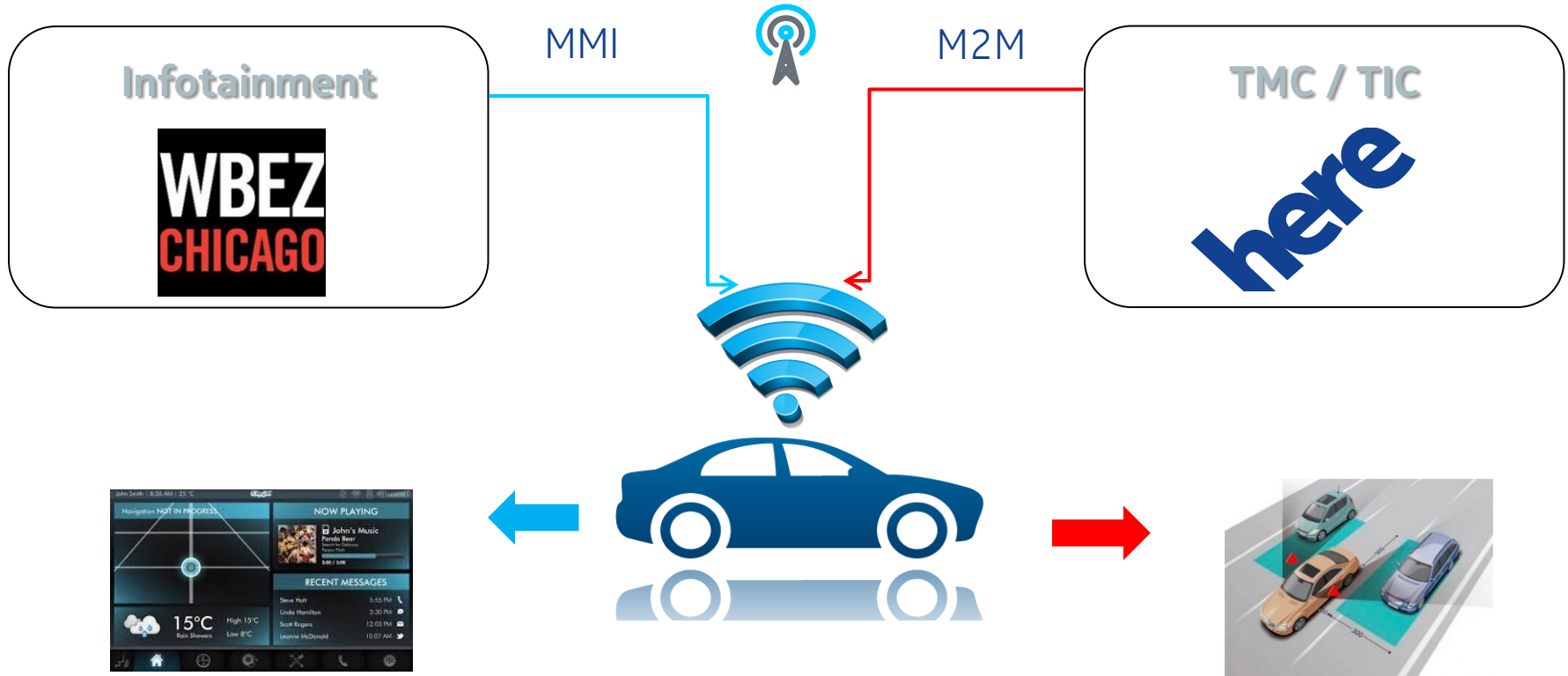
USDOT Connected Vehicle Implementation Reference Architecture



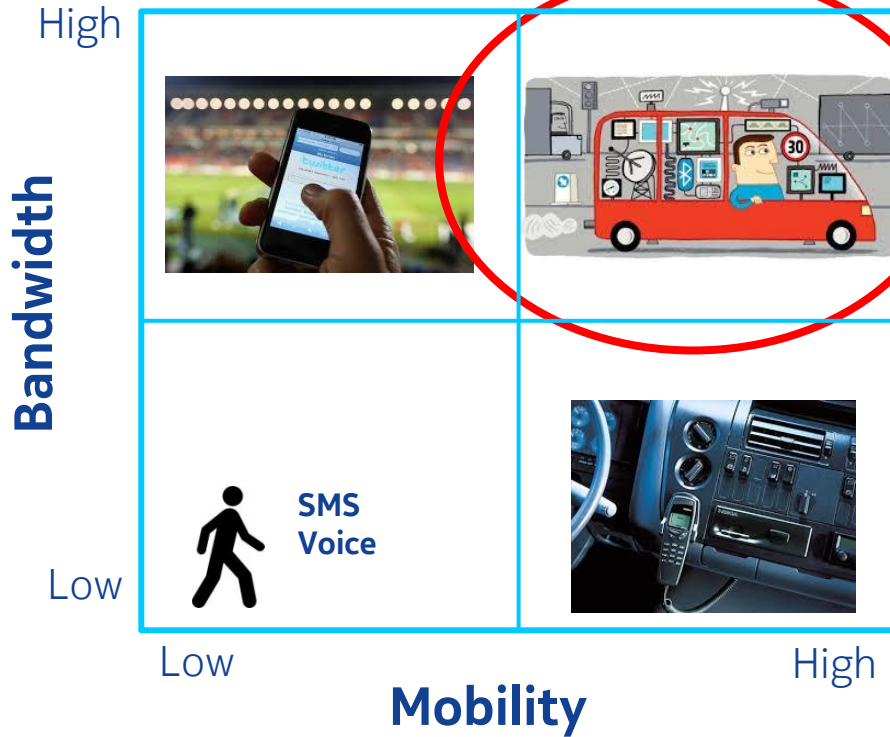
Connected Car

MMI + M2M

Connected Car combines Machine Type Communication and Broadband Requirements



Why is High Bandwidth / High Mobility a challenge?

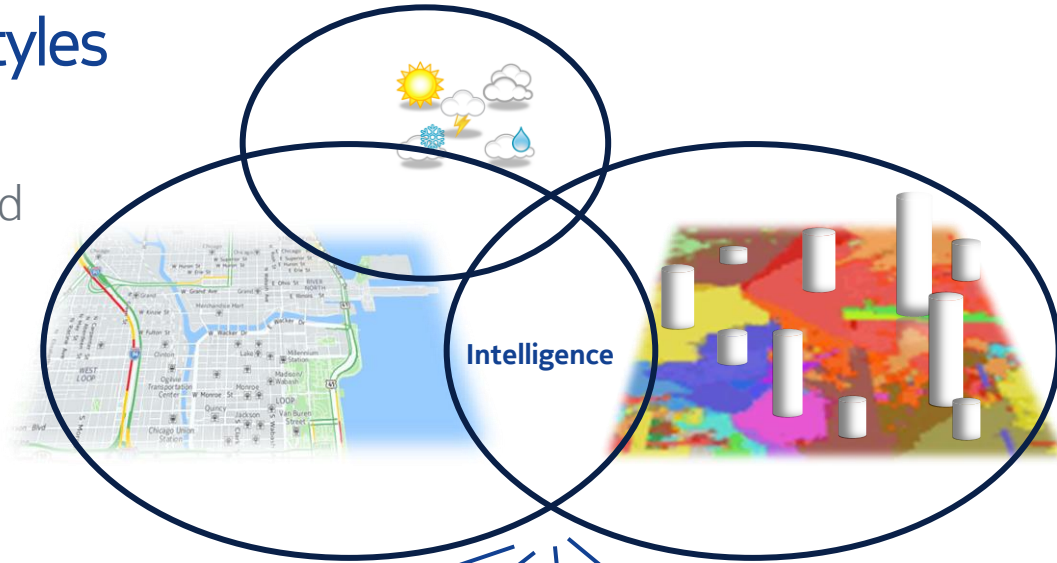


The combination of High Bandwidth with High Mobility presents a new challenge for MNOs

Connected Car Lifestyle Delivery

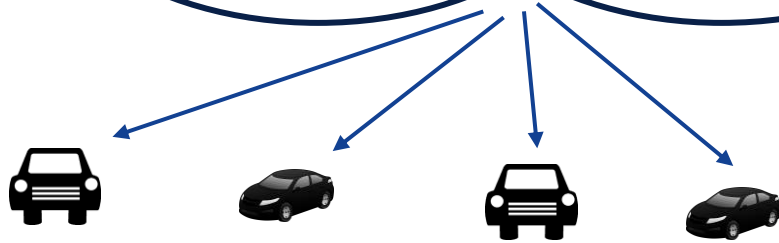
Creating New Lifestyles

Correlating networks and road information to derive *intelligence*



Delivered through intelligent Notifications

The right information to the right vehicles at the right time



Creating new lifestyles



Lifestyle Delivery

Data Collection, Fusion, Analytics, Guidance



Lifestyle Delivery

Available Parking	Curve Speed Guidance	Emergency Vehicle	Accident	Congestion	Road Crew
Fuel Prices	All-Electric Zone	Snow/Ice	Tornado	Rough Road	

New Lifestyle Delivery

Drive Intelligence, Alternate Routes

Other Feeds



- Traffic Probe
- Traffic Signals
- Emergencies
- Weather
- Driver Behavior

Downstream Vehicle

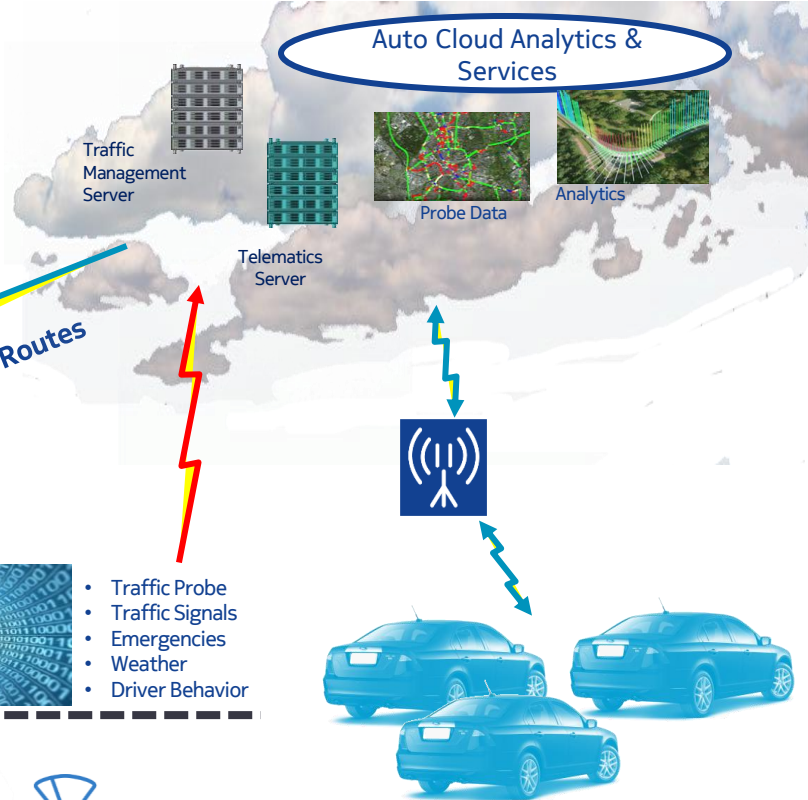
Vehicle State



Radar	Heavy Braking	Gyro - Steep Slope	Wipers - High	
Camera	Traction Control	Antilock Brakes	Headlamps	Chassis Sensor - Severe Bounce

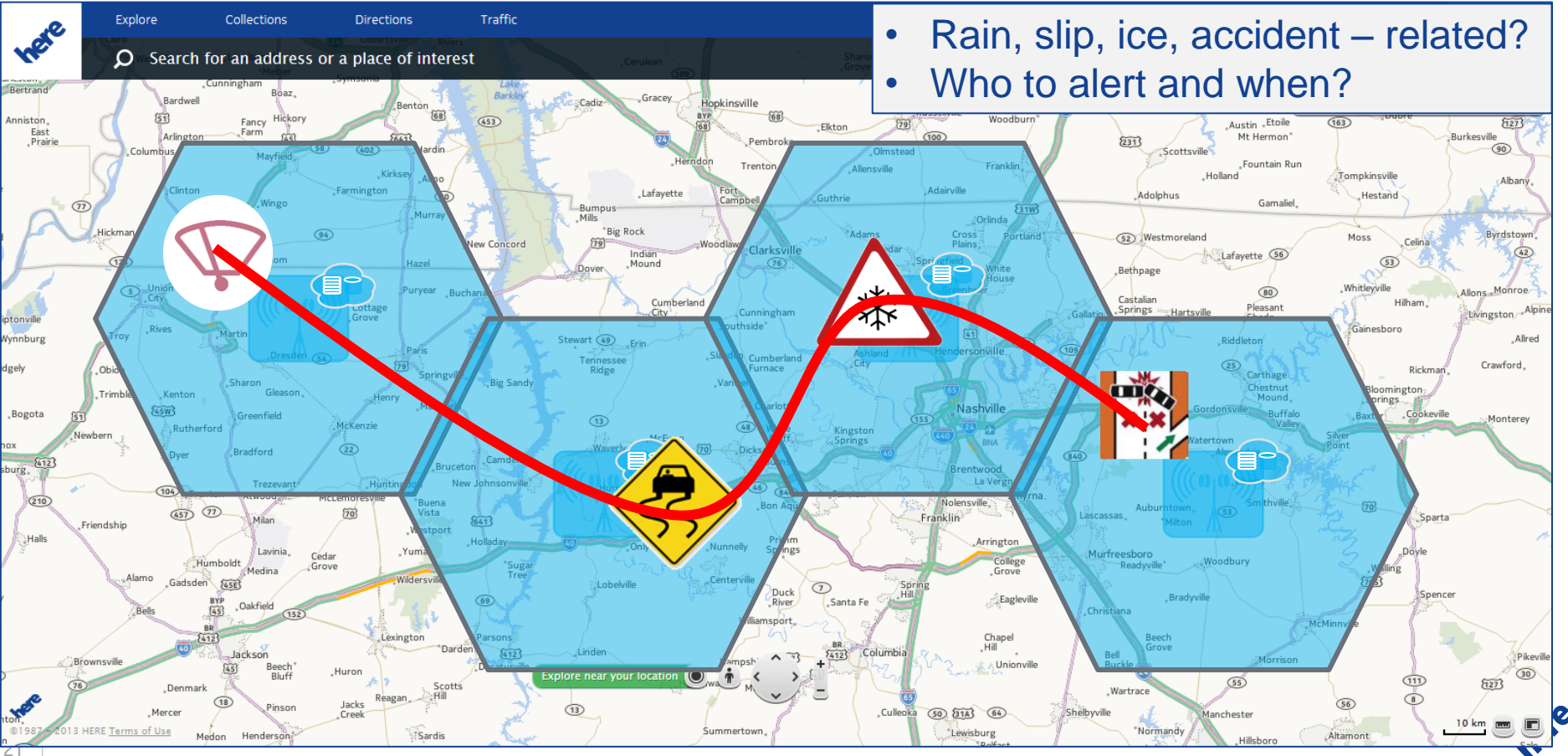
Lead Vehicle(s) Knowledge

Possible low friction, poor visibility, etc.



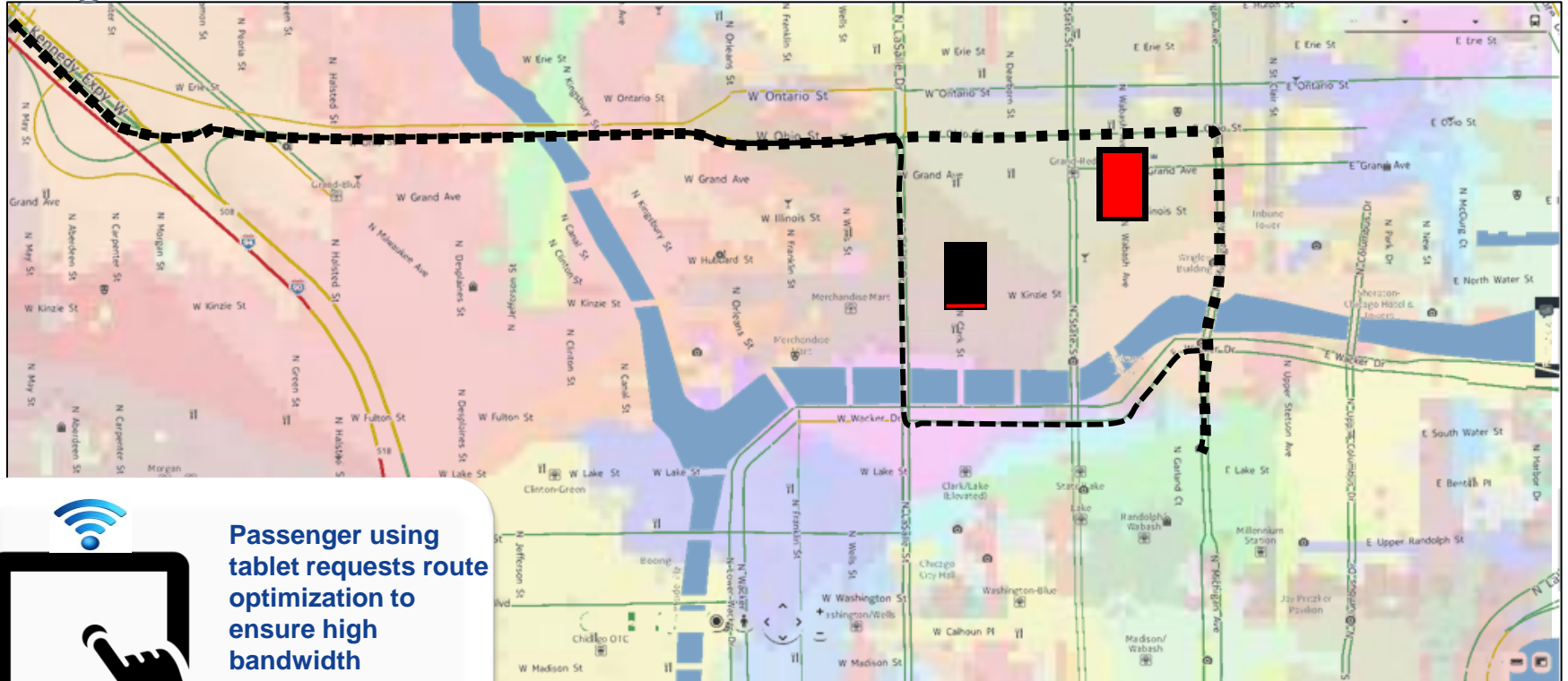
Safety Experience Delivery

- Rain, slip, ice, accident – related?
- Who to alert and when?

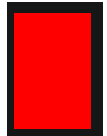


Entertainment / Application Experience Delivery

Navigation for Bandwidth



Passenger using tablet requests route optimization to ensure high bandwidth connectivity

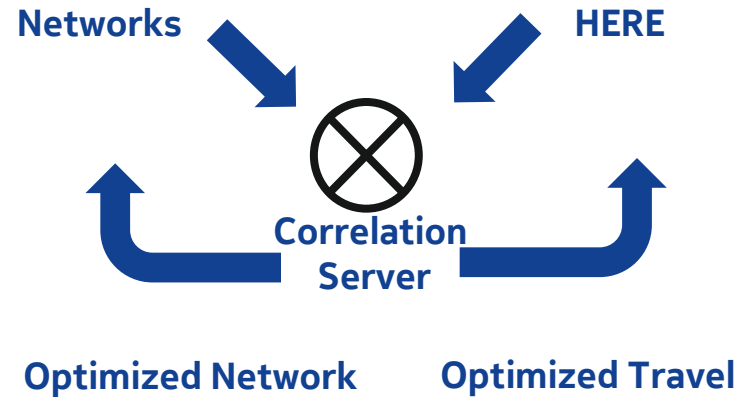
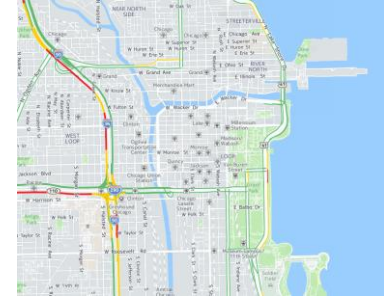


Serving Cell Available Capacity

Connected Car Solution Architecture

Correlation Server

- The correlation of physical road sectors to cellular coverage and capacity
- Correlate road + probe data with network data to predict and handle scenarios previously not feasible to address
- Get the right data to the right vehicles at the right times in a network efficient manner



Wrap-up

Summary

- Connected World Transformation
 - Challenges ↔ Opportunities
- Intelligence from Data
 - Collect → Synthesize → Analyze → Learn → Apply
- Create Unprecedented Lifestyle Experiences

Connecting Cars ...



... Creating **INTELLIGENT LIFESTYLES**

... Leveraging network and road information

Thank You!