How to make Connected Car Reality?

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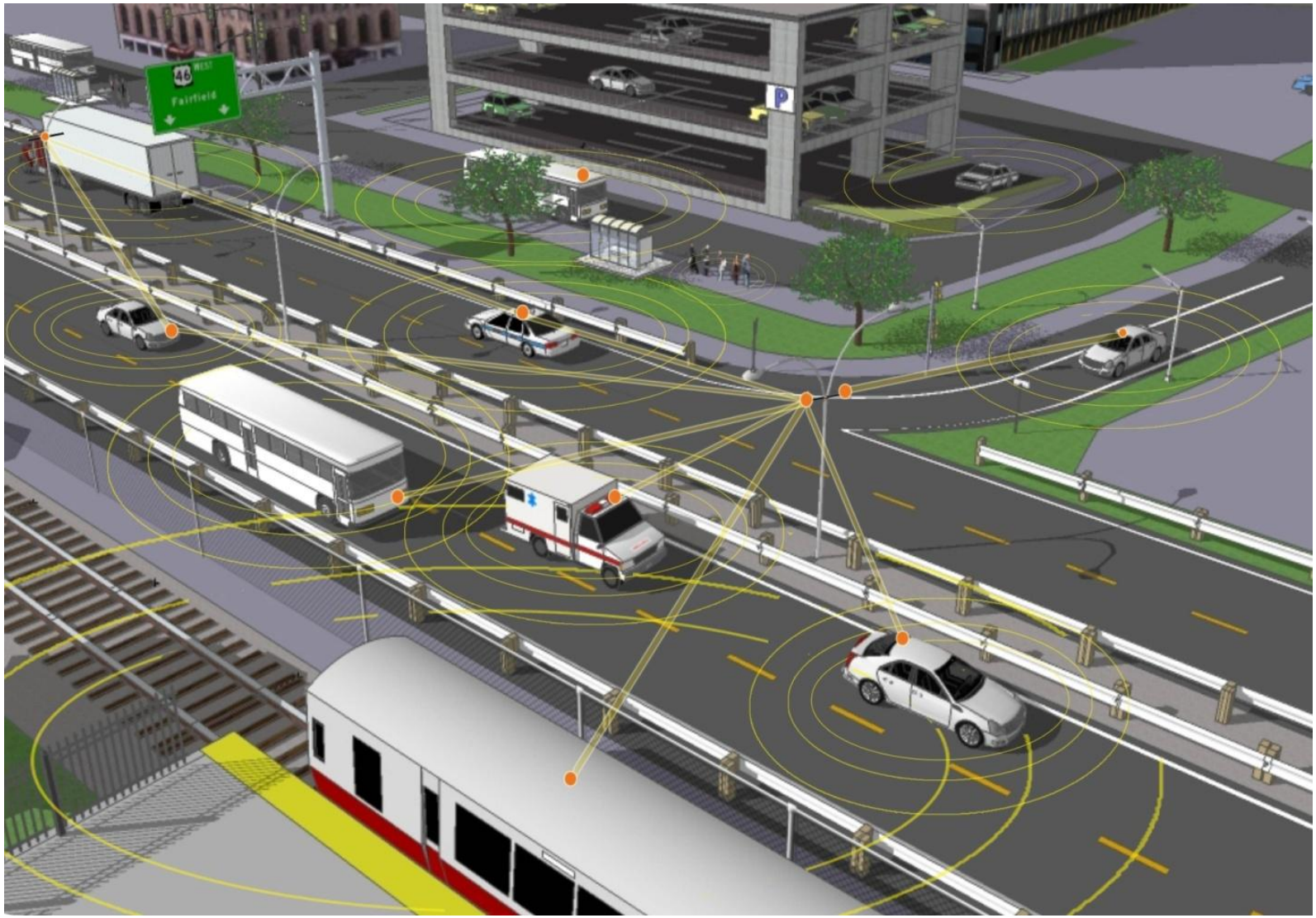
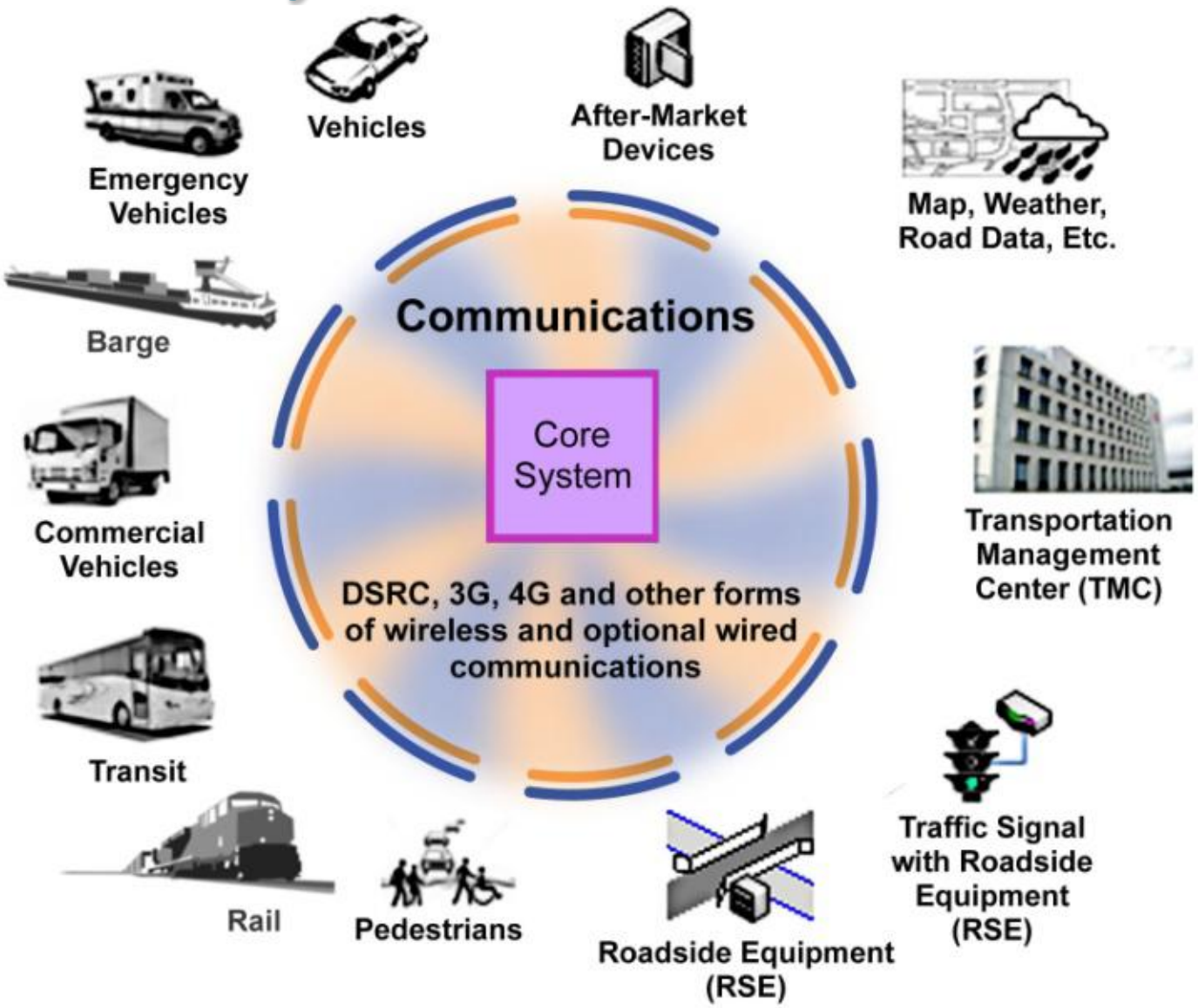
Connected Transportation

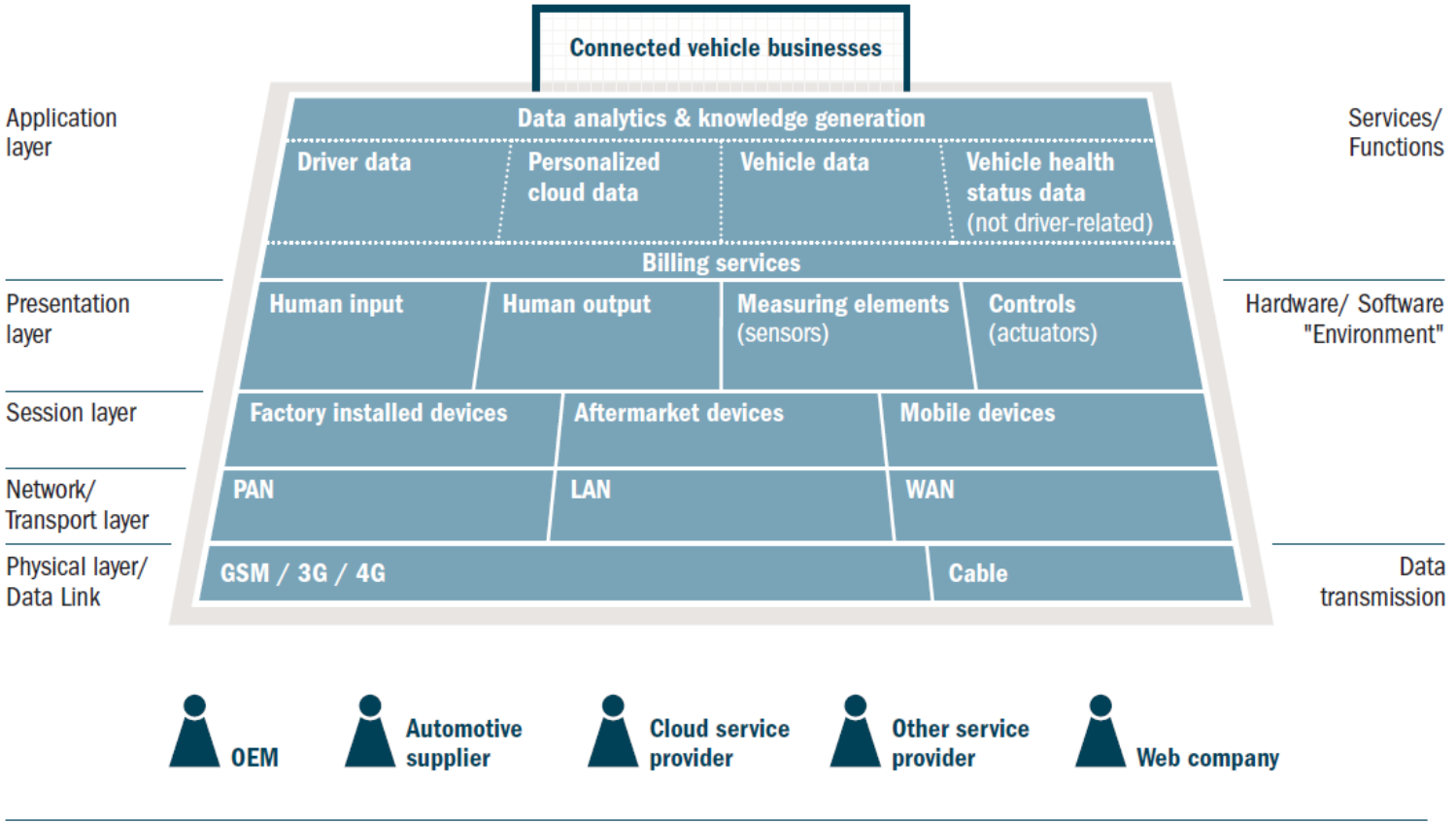


Source: US DOT, January 2012

Core System Communications



Connected Vehicle Playing Field



Source: Roland Berger

From a system perspective three layers can be identified:

- data transmission,
- software/hardware platform and
- added-value services

Some Initial Questions

- How will the connected car impact the current value chain, and what are ongoing revenue opportunities from applications and services?
- What is the role of the OEM and Tier 1 suppliers in production and support for content and app store business?
- Who will own the content, apps and software in the car?
- What role car dealers and repair shops will play?
- How to deal with diverse technology life cycles in the car
- Who will own and pay for connectivity?
- How safe, secure and reliable is over the air upgrade?

What is connected car?

- It is a mobile network node
- It is multinode distributed network
- It is actually a set of diverse and distributed networks
- It is multiprotocol network
- It is comprised of both mission critical and non-mission critical subsystems
- **It is the future… that we will discover tomorrow**

And what it is not?

- It is not a smart phone
- It is not a single device
- It is not replaceable every two years
- It is not always on
- It is not rebootable device at a user leisure
- It is not single operating system
- It is not legacy solution
- It will not have a one size fits all solution for FOTA Software/Firmware Updates
- **It is not what we understand today**

Connected Car Capabilities

- **Connectivity to the Cloud** (first step for automotive)
  - Software/firmware updates
- **Connectivity to personal devices** (ecosystem partners)
  - Use standard solutions such as BT, WiFi, etc.
- **Connectivity within the car**
  - CAN, LIN, MOST, FlexRay, etc. today
  - Wireless sensors, energy harvesting, wireless power (R&D today)
  - New in-car networks (e.g. Ethernet) – current trend
- **Connectivity car to car, and car to infrastructure** (later focus, government and regulations driven)
  - DSRC based.
  - Government regulations
  - Cost of infrastructure
  - What about intelligence in the car and in the cloud? MIA

There is a need for a platform based approach, build on fundamental, future proof and Internet friendly architecture, and phased approach to product development, to enable the four capabilities described above.

- **GENIVI, Linux, Android, Autosar, REST, HTML5, and others…**

Connected Car Applications

- **Safety and Security**
  - Emergency Calling (eCall), Roadside Assistance/Breakdown Call (bCall), Stolen Vehicle Tracking (SVT) and Recovery, Remote Slowdown and Immobilization, Geofencing, Remote Diagnostics and Maintenance, Driver Behavior Monitoring.
- **Connected Infotainment**
  - Multimedia Streaming (Audio, Internet Radio, and Video), Connected Navigation and Real-time Location-based Content, Social Media and Networking, In-car Wi-Fi Networks
- **Cost-Saving Applications**
  - Insurance Telematics / Usage Based Insurance (UBI), Driver Behavior Monitoring, Electric Vehicle Charging Management, Predictive Maintenance
- **Convenience Applications**
  - Remote Control, Car sharing and Rental, Electronic Toll Collection, Road Use and Congestion Charging, Concierge Services, CRM

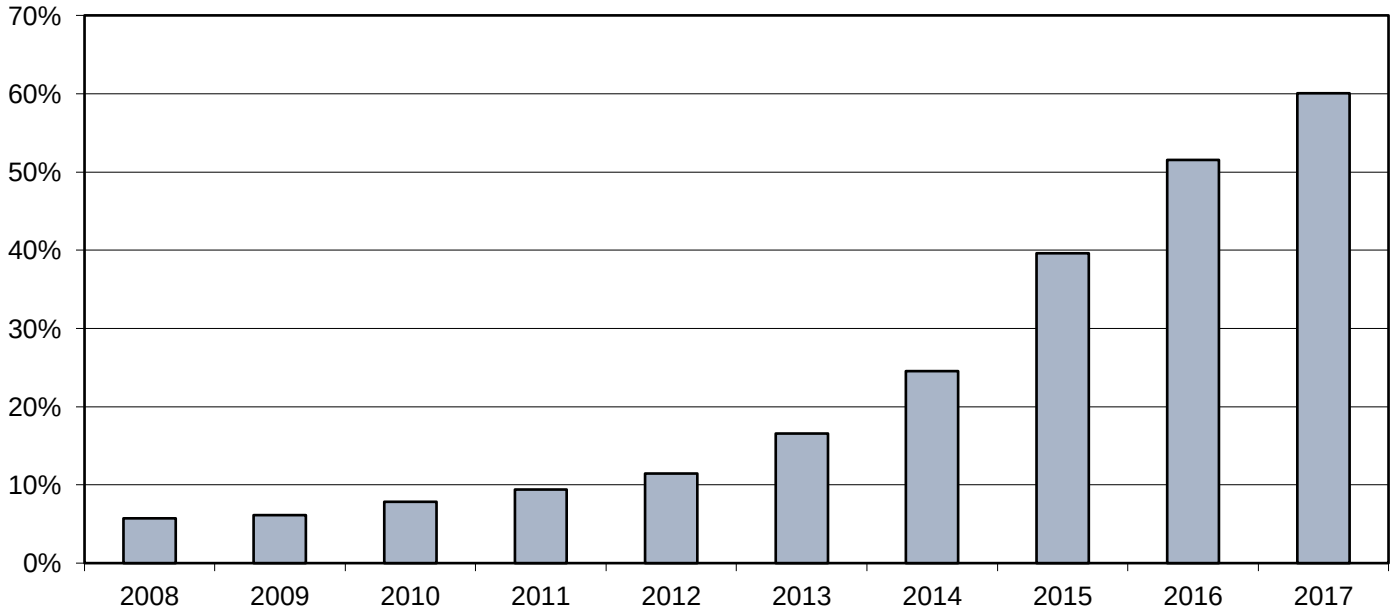
Connected Car Drivers

- New Applications:
  - Demand for new telematics features such as speed monitoring, geofencing, and driving behavior-monitoring feedback.
  - Connected infotainment services such as Internet access, real-time location-based search, and music/radio streaming
  - Stolen vehicle tracking and PAYD insurance
- Decreasing costs:
  - Decreasing cellular connectivity costs
  - Free services such as Ford's SYNC.
  - Cheaper hardware, advances in open software development platforms, such as GENIVI and Linux based.
- Cloud-based services such as:
  - navigation, diagnostics, etc.
- Government Regulation:
  - anti-theft OEM telematics in Brazil and
  - the eCall project in Europe.

Connected Car Inhibitors

- Production and technology:
  - Long automotive development cycles comparing Consumer Electronics environments.
  - The lack of upgradeability in keeping embedded systems up to date during the lifetime of vehicles.
  - Most embedded infotainment systems are not upgradeable
  - The development of easy-to-use interfaces remains a challenge
- User acceptance:
  - Privacy concerns, such as applications that track their location and behavoiur on a continuous basis.
  - the majority of drivers have little or no knowledge of the benefits of connected car solutions.
  - Car owners' reluctance to pay additional subscription fees on top of what they are already paying on their smart phones.
- Market and ecosystem:
  - Telematics ecosystem is still highly fragmented with a large number of complex solutions.
  - There is very little consensus on what technologies, business models, or service architectures are best suited for connected car
  - Up-to-date and compelling content is still not available

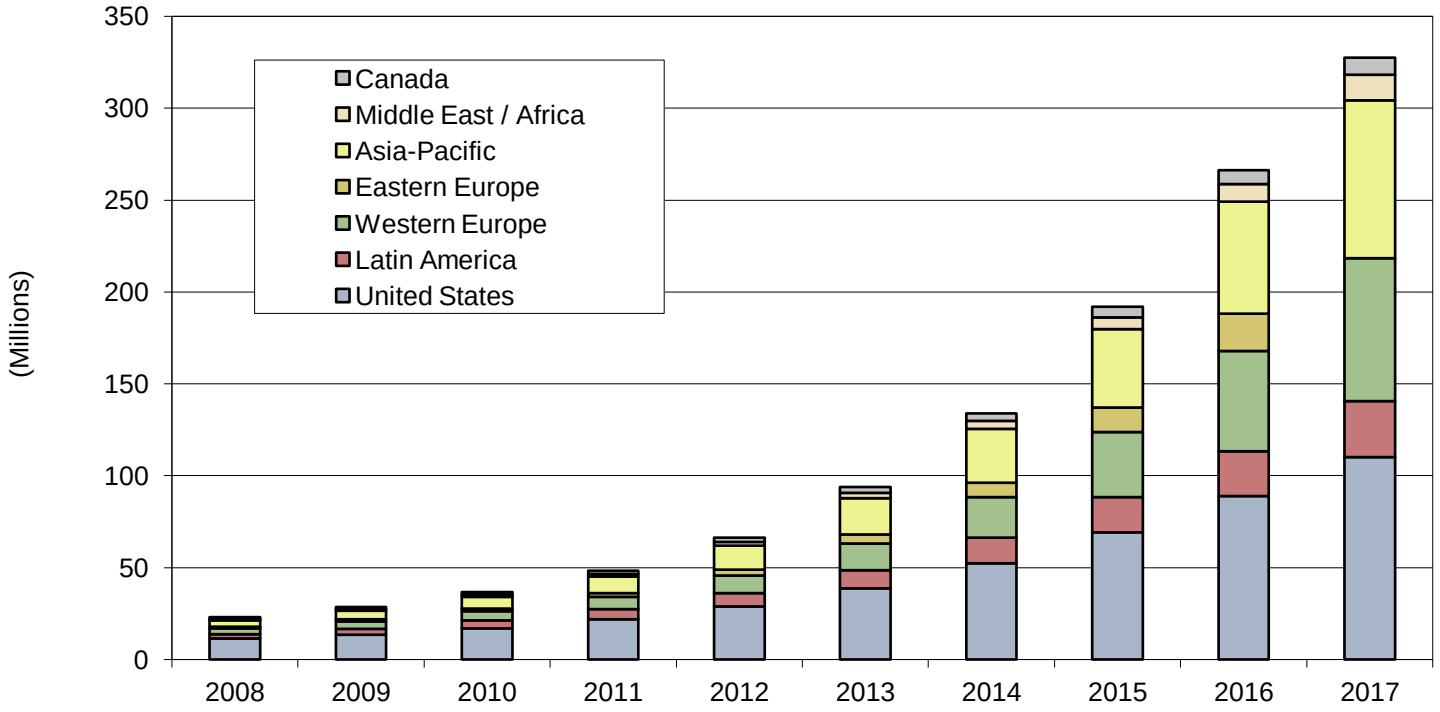
Connected Car Penetration into New Vehicles World Market, Forecast: 2008 to 2017



New vehicle factory-installed connected car penetration will reach 60% by 2017. However, despite all media coverage, penetration currently is still very low (just above 10%). This is due to many OEMs offering systems on a limited number of models and many regions still lacking a large number of available solutions. However, with many launches planned in Europe and China in the next 12 to 18 months, uptake is set to soar. Additionally, mandates will come into force in Europe, Russia, and Brazil during the forecast horizon providing a major boost for the connected car sector.

Source: ABI Research, Connected Car, May 21, 2012

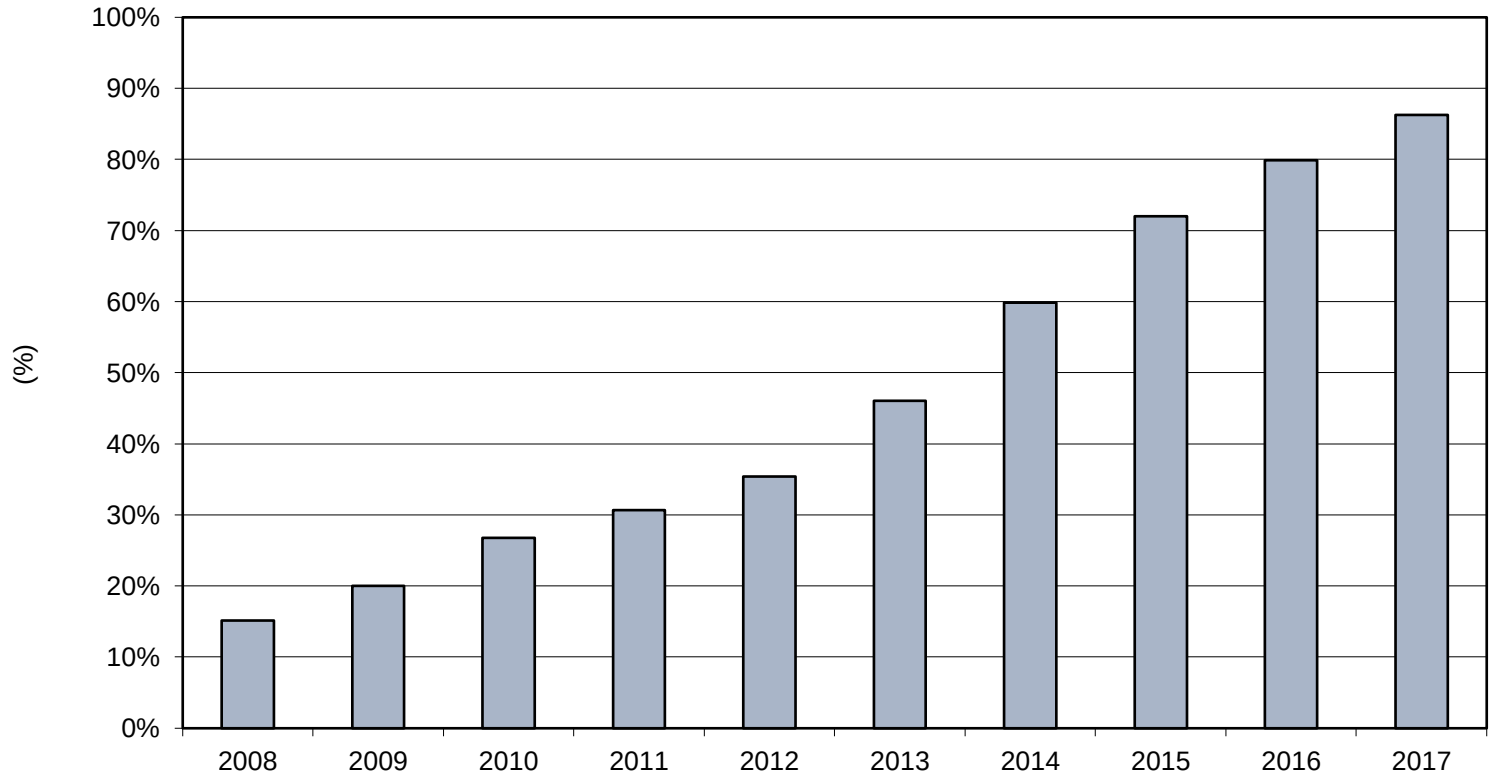
Connected Car Subscribers by Region



•The United States market remains the dominant telematics region with GM's OnStar services, which have been available since 1996 and are currently used by 6 million consumers.
•Since its launch in 2007, Ford's hybrid SYNC solution has been adding new features such as emergency calling, remote diagnostics, and off-board navigation in an attempt to challenge GM. Ford SYNC reached the 4 million customers mark recently.
• In 2009, Toyota started offering OEM telematics services on select models in partnership with ATX.
•Mercedes Benz rebranded its Tele Aid product line into the mbrace solution.
•Further launches by Hyundai, Audi, Nissan, and Chrysler have resulted in all major OEMS now having connected car solutions available in the market.

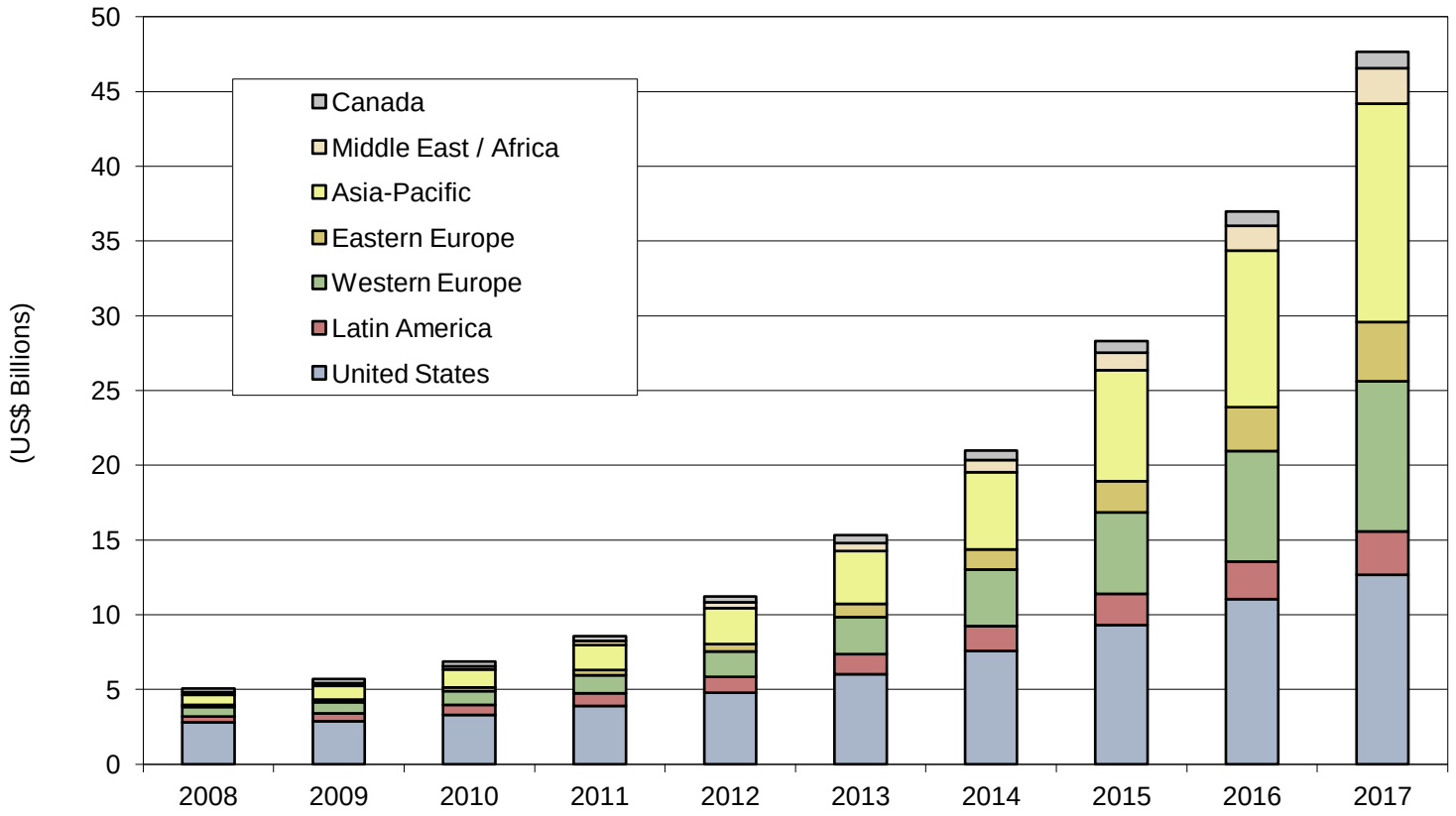
Source: ABI Research, Connected Car, May 21, 2012

Connected Car Penetration into New Vehicles United States, Forecast: 2008 to 2017



Source: ABI Research, Connected Car, May 21, 2012

Connected Car Services Revenue by Region



- Connected Car Systems services revenue—monthly or yearly subscription fees for operator-based and other connected car systems services.
- The subscription and usage fees paid for data communications are not included in connected car systems services revenue.

Source: ABI Research, Connected Car, May 21, 2012

Key Enablers and Trends

- Open, upgradeable, standards-based platforms to manage the long life cycle of automotive solutions, provided by:
  - industry consortia such as GENIVI and the Car Connectivity Consortium
  - industry-wide collaboration to reduce costs while providing sufficient scale for an OEM and aftermarket services and application ecosystem
- Next-generation automotive user interfaces such as speech technology, heads-up displays and dynamic clusters, steering wheel controls, allowing convenient, efficient, and safe access to services and applications.
- Connectivity is quickly becoming a must have in cars for a number of reasons, discussed today.
- Integrated systems combining embedded functionality, smartphone and other personal devices, and cloud based services and applications.
  - the embedded head unit role in providing reliable and secure data connection and the rich application environment, also for smart phones and other user personal devices
- Mix of business models, to support low data volume safety-centric applications, diagnostics free (under warranty) services, subsidized business model approaches, and data-intensive subscription based infotainment
- Emerging ecosystem of a large number of suppliers

Key Requirements for Software & Firmware OTA Updates in the Connected Car

- Complete Configuration Management System at the OEM Cloud Data Center of all ECU Software/Firmware Updates across all Vehicles supported by OEM.
  - Must be able to receive updates from both internal and external sources; and manage them according to release criteria and finally to subsequently distribute them accordingly (make sure specific updates go to the correct vehicles).
- Complete Configuration Management System at third party OEM Distribution Points (ex. OEM-centric dealerships, independent repair facilities, etc.) of all ECU Software/Firmware Updates across all Vehicles supported by OEM.
- Complete Configuration Management System of all ECU Software & Firmware Updates within Vehicle.
  - Must be able to receive ECU updates, from OEM Cloud or OEM Cloud Proxy; then internally manage and distribute within the vehicles specific updates to the correct ECUs.
- Must solve major pain point of OEMs today – How to update ECU core software & firmware with minimal cost and time.
- Must provide revenue generation ability to OEMs today – Installing and Updating Third Party applications within Telematics & Infotainment ECUs.
- Must be able to run in the background for all non-mission and/or safety critical applications with no customer involvement for ECU Core Software/Firmware updates.

Key Requirements for Software & Firmware OTA Updates in the Connected Car

- Must have ability to utilize a variety of data transmission mediums (ex. satellite, cellular, Wi-Fi, USB, etc.) while remaining agnostic when possible to the overall operation of the update process
- Must be able to start/stop with no loss of data. Meaning, must be able to do pick up download where it left off.
- Must be efficient in download methodology by minimizing the amount of data downloaded (i.e. only downloading those files and potentially only portions of those files (FEC methodologies) that actually changed within a particular ECU if ECU Core Software/Firmware Release or within specific User Application if Third Party User Application).
- Must support ALL Tier 1 ECUs for a specific OEM.
- Must support ALL OEMs for a specific Tier 1 (the ECU Mfg.) does NOT want to have a completely different methodology for each specific OEM they sell into).
- Must support third-party After-Market ECUs and their associated non-OEM cloud.
- Must be minimally invasive when updating to subordinate ECUs from a Master ECU.
- Must maintain within each vehicle at least one complete version of ECU core software/firmware for each ECU at a designated location within the vehicle.
- Must be fault tolerant without affecting future operation of vehicle (must be able to lose power during update and recover automatically without user intervention).

CarSync™ Architecture & Applications

Safety & Security Services
- Collision Notification
- Emergency Call
- Roadside Assistance
- Vehicle Location
- Alarm Notification
- eCall
- DSRC

Navigation & Media Services
- Internet Apps (Yelp, FB, Google, etc.)
- Music & Info Services
- Points of Interest
- Route Assistance
- Parking Assistance
- Location-Based Traffic
- Location-Based Weather

Driver Assistance Services
- Remote Door Lock/Unlock
- Dealer/OEM Connect
- Tolls & Payments
- Car information
  - -Fuel
  - -Oil pressure
  - -Tire pressure

Diagnostics & Update Services
- Remote OBD
- FOTA
- Apps Download
- Software updates

CarSync™ Cloud Sever (Backend Infrastructure & Connectivity)

Internet

Remote Operation Center

North Bound APIs

CarSync™ Gateway (Device/sensor abstractions)

South Bound APIs

- Engine Bay
- Chassis & Drive Train
- Occupant Cabin & Safety
- Infotainment Devices

CarSync™ Architecture Driving Factors

- The CarSync™ Configuration Management and Delivery System (CMDS) for Over-The-Air Updates (OTAU) is an end-to-end solution that enables OEMs and their Tier-1s to manage and deliver Software and Firmware Electronic Image updates from their Central Data Centers into individual vehicles of consumers.
- The CarSync™ CMDS-OTAU utilizes aspects of both GENIVI and AutoSAR in its overall design approach to incorporate already well thought-out design strategies as a means of:
  - Expediting Product Delivery
  - Standardizing Overall Approach
  - Increasing the probability that the CarSync™ CMDS-OTAU Framework will gain acceptance and be subsequently adopted.
- The CarSync™ CMDS-OTAU is a Development Framework that has anticipating where the industry is and where it needs to go.

CarSync™ CMDS-OTAU Initial Implementation

- The CarSync™ CMDS-OTAU Initial Implementation is done:
  - Within a NexCom Telematics VTC 1000 embedded computer module and VMD 1000 HMI Screen.
  - GENIVI Compliant Tizen Runtime Stack
  - Utilizing the Unified Diagnostic Service (UDS) Communication running within all ECUs for delivery of Electronic Image (EI) Releases from the “master” ECU within each sub-domain down to the ECUs it oversees.

    NOTE: Because of the exponential growth of the AutoSAR Layered Software Architecture within ECUs, the Arynga approach is developing CarSync to adhere to this standard while still ensuring it interact with non-AutoSAR ECUs (most of North America) developed to run with VectorCAN’s and other proprietary implementations of UDS.
- GENIVI is important to the CarSync™ CMDS-OTAU for Application Layer continuity; as GENIVI is geared towards an open-source development platform (built on an HTML5 abstraction layer) for In-Vehicle Infotainment (IVI).
- AutoSAR is important to the CarSync™ CMDS-OTAU for standardization of ECUs, ECU Domains, and Inter-ECU Communication and Diagnostics.

Thank You