V2X Product Life Cycle Management

Washington DC
26 April, 2018

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Current Deployments

• Estimates indicate there are between 2,000 and 3,000 RSUs and between 8,000 and 10,000 OBUs in operation around the country

• Estimates indicate another 1,000 RSUs and 12,000 OBUs will be deployed within the next 18 months

V2X is still in the early stages of Deployment
Technology Evolution

• Past Examples:
  • SAE J2735-2009-to-J2735-2016 **Firmware upgrade**
  • RSU Spec v3.0-to-4.0 **Hardware upgrade**

• We need to continually be thinking about ways to future proof deployments as technology evolves.

• Road Operators need convenient, low cost, methods to **upgrade existing deployments**.
Product Life Cycle Stages

- **Strategy**: Define, Evaluate, Plan
- **Design**: Convert Strategy into Reality
- **Transition**: Bridge the gap between existing and new
- **Operations & Maintenance (ongoing)**: Train staff, Integrate, Monitor
Strategy

• Technology Transitions need to be carefully planned and executed by the hardware manufacturer, software developer, and the hardware owner.

• Transitioning to a new technology involves either:
  a. Replace
  b. Upgrade
Design

- ConOps
- Use Cases
- Requirements

Implementation
- Hardware
- Software

Proof-of-Concept
- Prove Design
- Prove Implementation

"Design for Deployment"
- Replace
- Upgrade

Standards

C-V2X

Strategy
Design
Transition
Operations
Design (PoC)

• Several 5GAA members partnered to develop C-V2X Proof-of-Concept devices

• We ported our communication stack to the C-V2X reference platform, which included
  • SAE
  • IEEE 1609.2
  • IEEE 1609.3
Design (Demonstration)

- The C-V2X Solution supports the following SAE J2735-based messages:
  - Basic Safety Message (BSM)
  - Signal Phase and Timing (SPaT)
  - Map (MAP)

- Demonstrating the following applications:
  - Forward Collision Warning (FCW)
  - Electronic Emergency Brake light (EEBL)
  - Left Turn Assist (LTA)
  - Intersection Movement Assist (IMA)
  - SPaT Visualization (Status with Time Remaining)
Design

Independent Evaluation
- Standards Compliance confirmation
- Interoperability

Deployment
- Replace
- Upgrade
Transition

• Replace
  • Deploy new hardware
    • Reuse of Antenna’s, power, etc.
    • Other external interfaces (Backhaul, Signal Controller, CAN, etc.) remain the same
Transition-Replace

RSU

C-V2X RSU

DSRC RSU

DSRC Radio

Processor

Signal Controller

Cloud

C-V2X Radio

Processor

Signal Controller

Cloud

OBU

DSRC OBU

C-V2X OBU

DSRC Radio

Processor

Vehicle CAN Bus

Vehicle HMI

Vehicle CAN Bus

Vehicle HMI
Transition

• Upgrade-Retrofit
  • Owner removes hardware
  • Owner returns hardware to manufacturer
  • Manufacturer adds new technology
  • Manufacturer returns hardware to owner
  • Owner re-installs

Costly and Time Consuming
Transition: retrofit

RSU

DSRC RSU
DSRC Radio
Processor
Signal Controller

C-V2X RSU
C-V2X Radio
Processor
Signal Controller

Cloud

OBU

DSRC OBU
DSRC Radio
Processor
Vehicle CAN Bus
Vehicle HMI

C-V2X OBU
C-V2X Radio
Processor
Vehicle CAN Bus
Vehicle HMI

Cloud
Transition

• Upgrade-Add on
  • Install additional hardware
    • Reuse Antenna’s
    • Other external interfaces (Backhaul, Signal Controller, CAN, etc.) remain the same
  • Firmware upgrade

More cost effective but requires additional effort/development by manufacturer
Transition: add-on

RSU

C-V2X RSU

OBU

Cloud

DSRC RSU

Processor

Signal Controller

DSRC Radio

Cloud

C-V2X OBU

Processor

Vehicle CAN Bus

Vehicle HMI

DSRC OBU

Processor

Vehicle CAN Bus

Vehicle HMI

DSRC OBU

Processor

C-V2X OBU

Signal Controller

DSRC Radio

Cloud

DSRC Radio

C-V2X Radio
Operations

- **Operations & Maintenance**: Training should be minimal for existing deployments
- **Back Office**: Integration should be minimal for existing deployments
Summary

• Technology transition must be carefully planned and executed

• C-V2X is quickly maturing

• Adding incremental hardware can be more cost effective than “rip and replace”

• Impact to O&M should be minimal
Questions

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