



# V2X Product Life Cycle Management

Washington DC  
26 April, 2018

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# Current Deployments

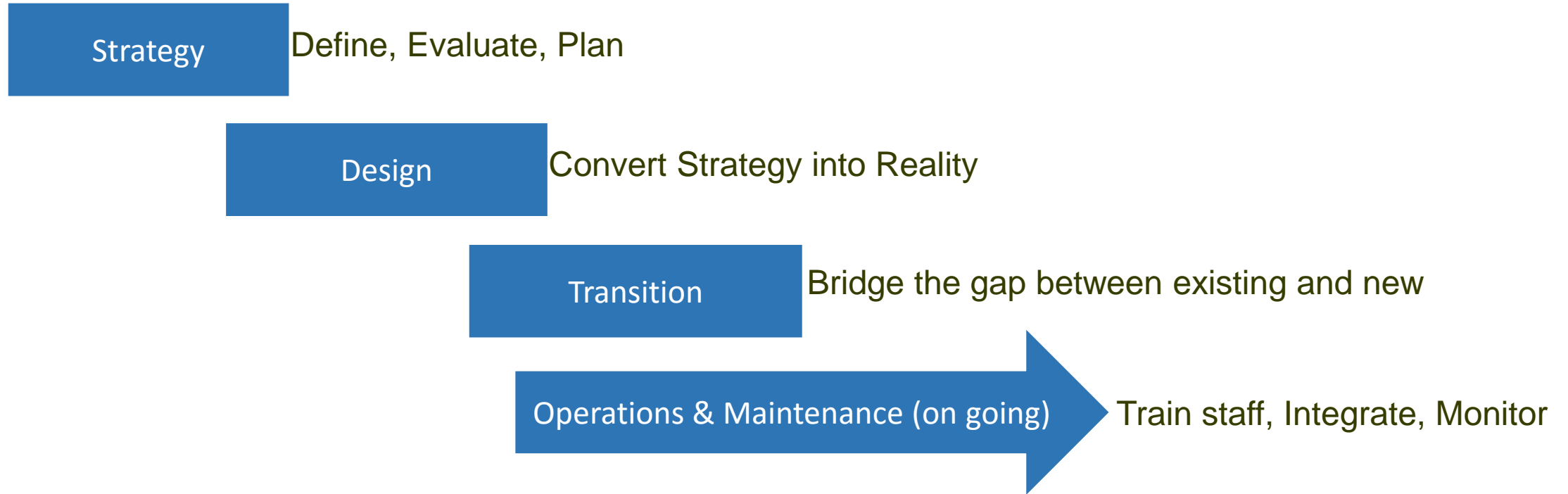
- Estimates indicate there are between 2,000 and 3,000 RSUs and between 8,000 and 10,000 OBUs in operation around the country
- Estimates indicate another 1,000 RSUs and 12,000 OBUs will be deployed within the next 18 months

**V2X is still in the early stages of Deployment**

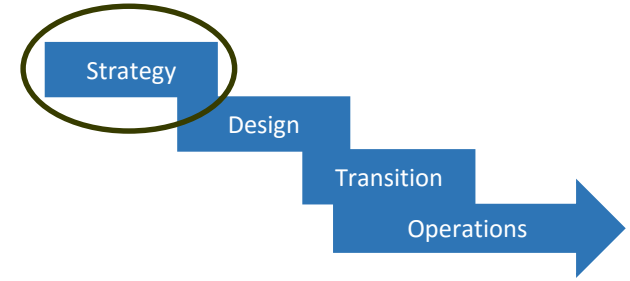
# Technology Evolution

- 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

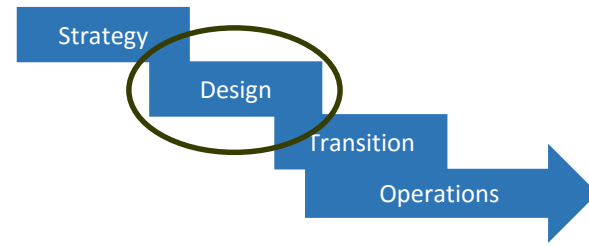


# Strategy



- 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



Standards

Design

- ConOps
- Use Cases
- Requirements

Implementation

- Hardware
- Software

Proof-of-Concept

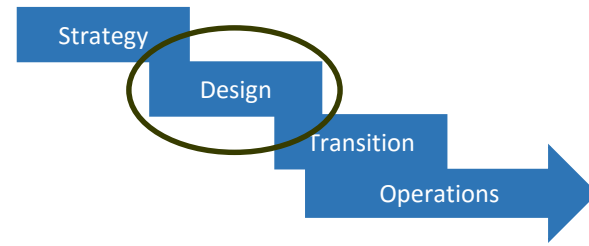
- Prove Design
- Prove Implementation

C-V2X

“Design for Deployment”

- Replace
- Upgrade

# 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

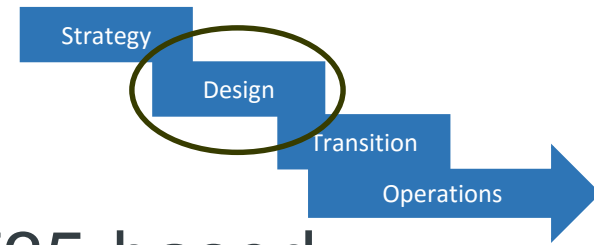
- SAE
- IEEE 1609.2
- IEEE 1609.3

| DSRC   |        |
|--------|--------|
| SAE    | 1609.2 |
| 1609.3 |        |
| 1609.4 |        |
| 802.11 |        |



| C-V2X    |        |
|----------|--------|
| SAE      | 1609.2 |
| 1609.3   |        |
| 3GPP R14 |        |

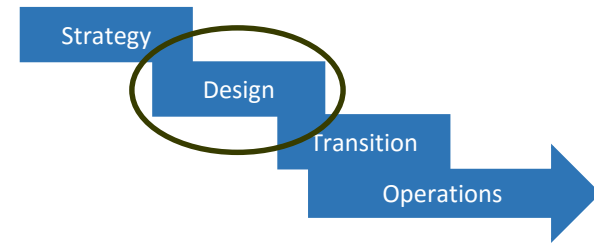
# Design (Demonstration)



- 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)

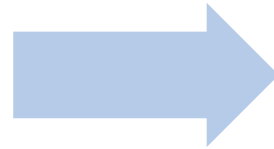


# Design



## Independent Evaluation

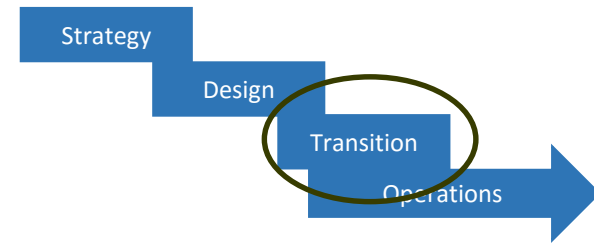
- Standards Compliance confirmation
- Interoperability



## Deployment

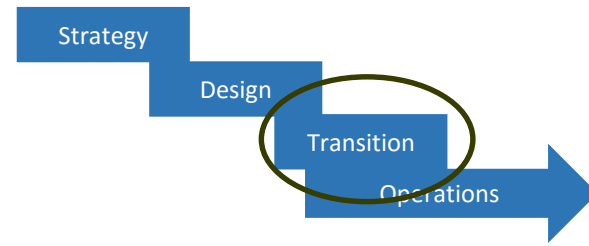
- Replace
- Upgrade

# Transition

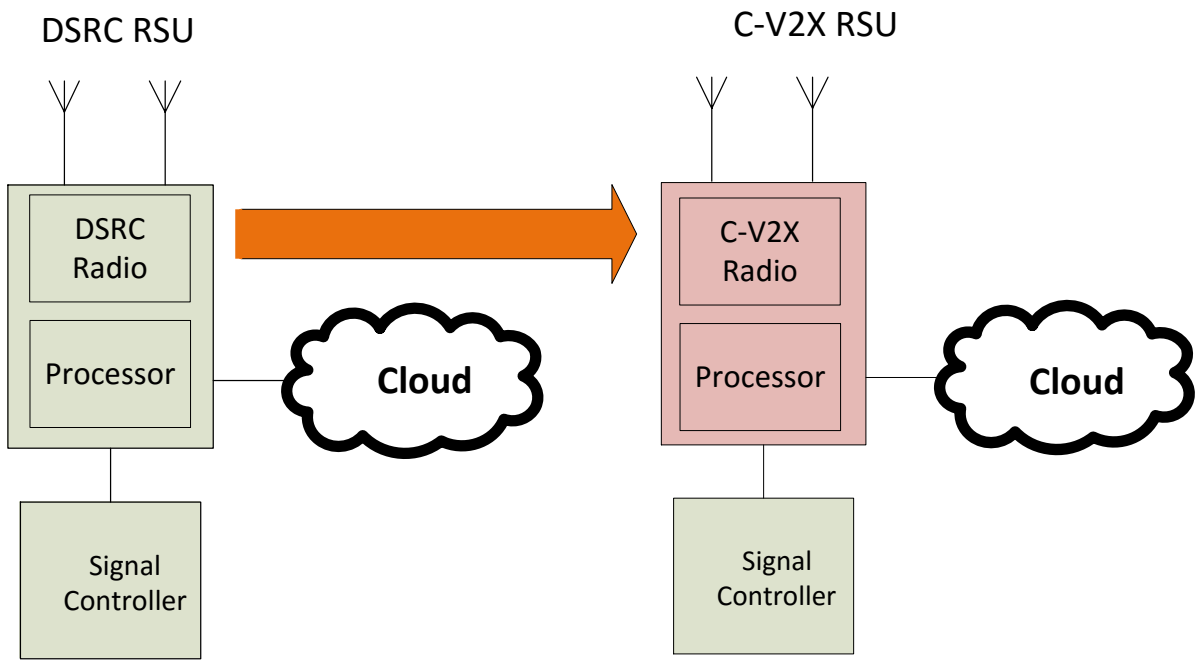


- Replace
  - Deploy new hardware
    - Reuse of Antenna's, power, etc.
    - Other external interfaces (Backhaul, Signal Controller, CAN, etc.) remain the same

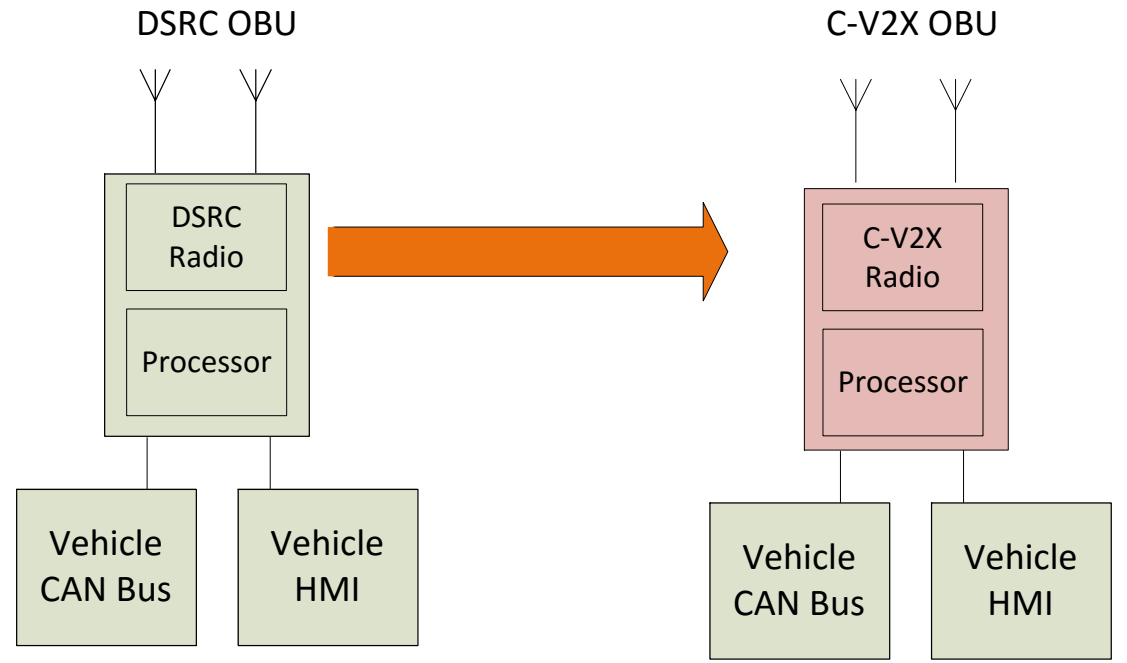
# Transition-Replace



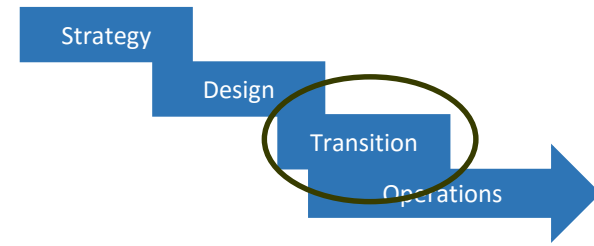
## RSU



## OBU



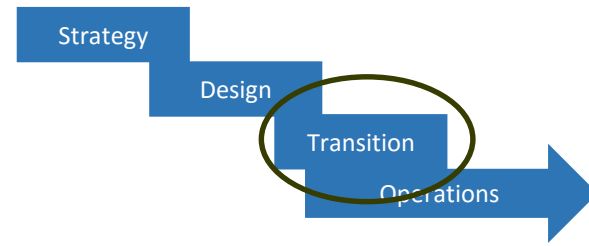
# Transition



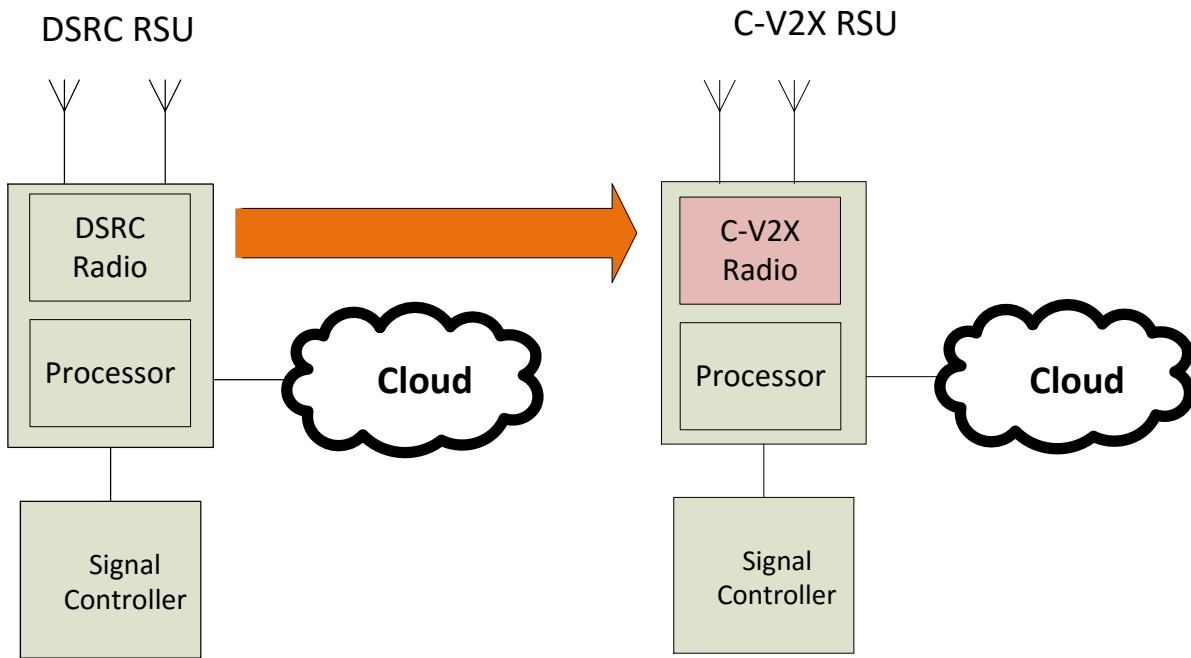
- Upgrade-Retrofit
  - Owner removes hardware
  - Owner return hardware to manufacturer
  - Manufacturer adds new technology
  - Manufacturer returns hardware to owner
  - Owner re-installs

Costly and Time Consuming

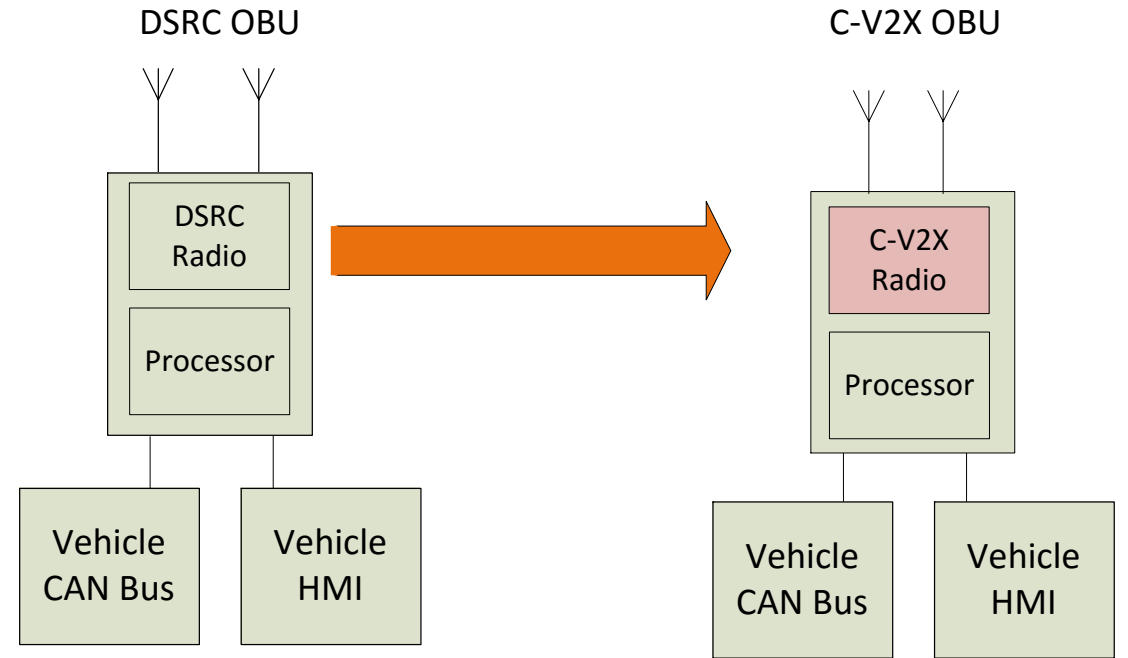
# Transition: retrofit



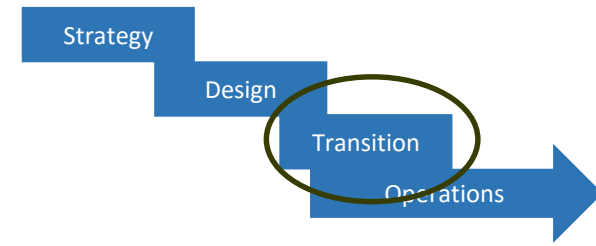
## RSU



## OBU



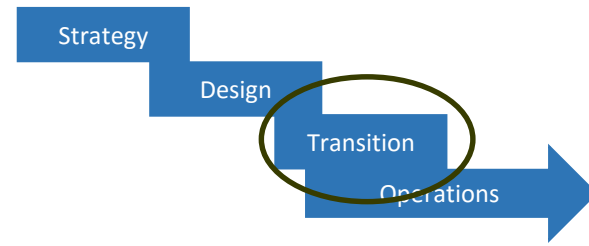
# Transition



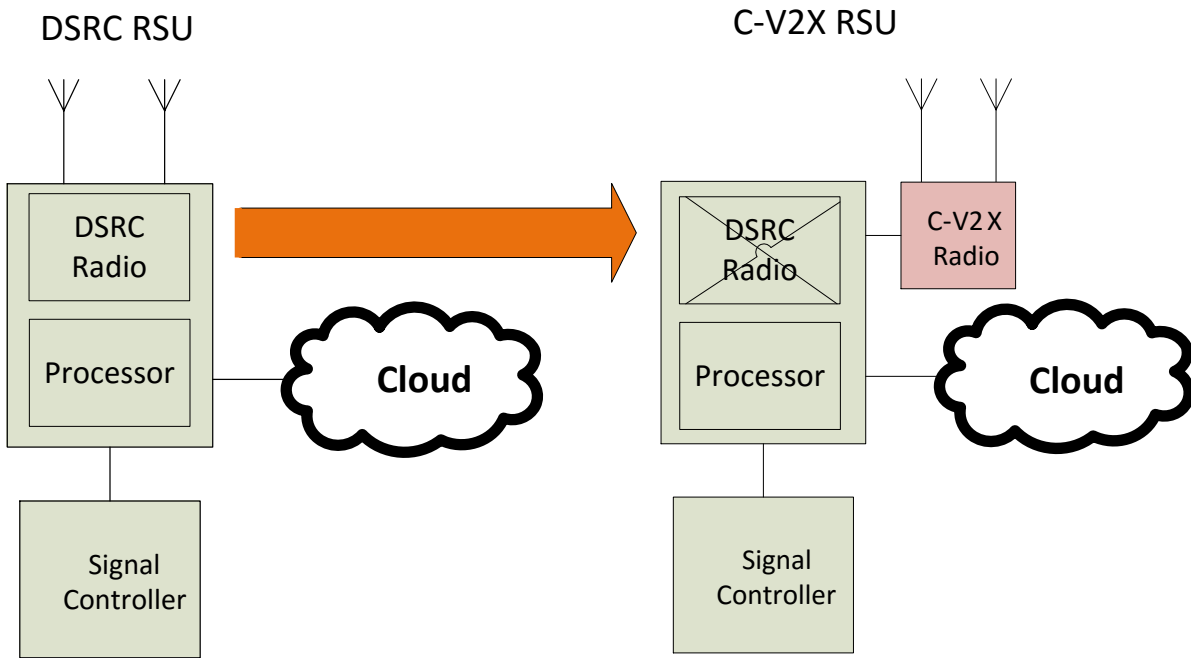
- Upgrade-Add on
  - Install additional hardware
    - Reuse Antenna's
    - Other external interfaces (Backhaul, Signal Controller, CAN, etc.) remain the same
  - Firmware upgrade

More cost effective but requires additional effort/development by manufacturer

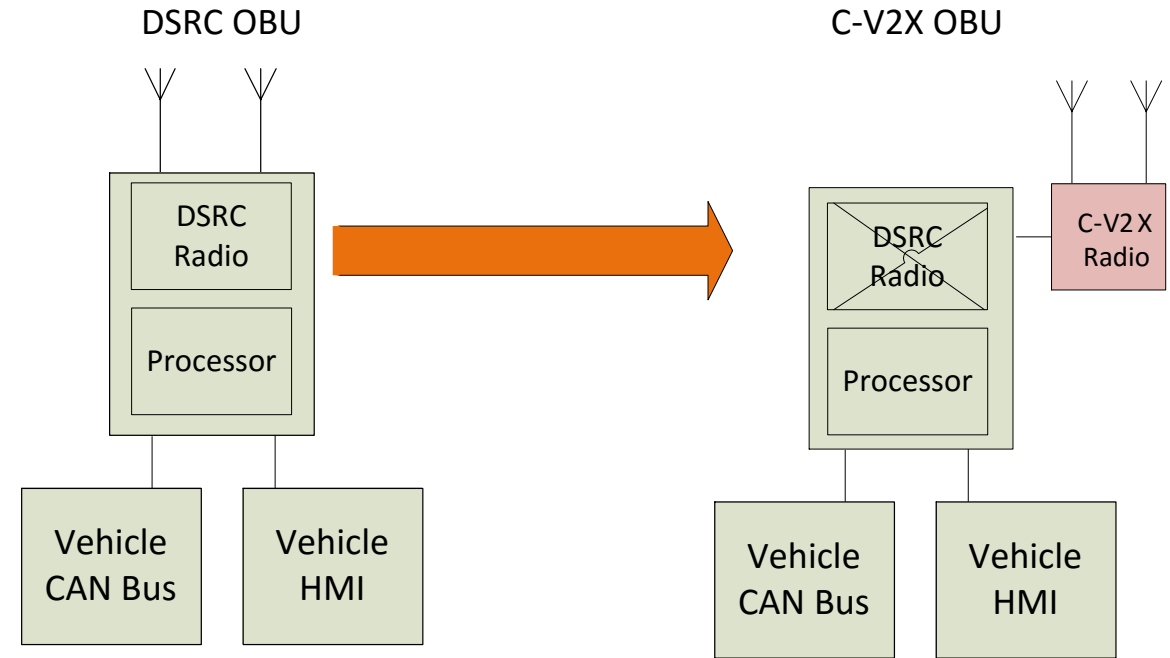
# Transition: add-on



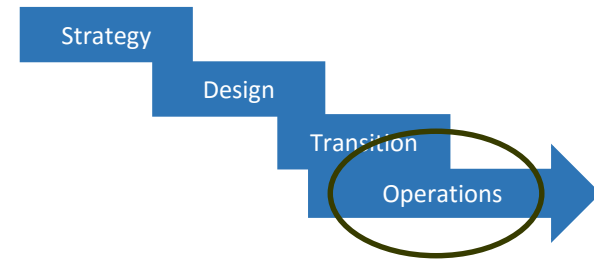
## RSU



## OBU



# 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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