



FTF 2016
TECHNOLOGY FORUM

BRILLANT ROADSIDE UNITS (RSUS) FOR INTELLIGENT TRANSPORTATION SYSTEMS

GEOFF WATERS
SENIOR PRINCIPLE ENGINEER
FTF-CIT-N1862
MAY 18, 2016

PUBLIC USE



AGENDA

- Intelligent Transportation Systems
 - Smart Parking
 - Simple Roadside Units
 - Brilliant Roadside Units
- Direct Short Range Communications and 5G
- Summary



ABSTRACT

Roadside Units (RSUs) will play a critical role in helping connected and automated vehicles meet their potential for increased safety, decreased commute times, and energy savings. Learn how smart RSUs could become, how secure they must be, and their relationship to the vehicles, broadband connectivity, and the cloud.



INTELLIGENT TRANSPORTATION SYSTEMS



We Know a Little About Automotive...



#1
AUTO SEMI
SUPPLIER
GLOBALLY

2400+
AUTO
ENGINEERS

>30
AUTO SITES
IN ALL
REGIONS

>\$3B
ANNUAL
AUTO
REVENUE

~40%
OF NXP'S
REVENUE IS
FROM AUTO

+60
YEARS OF
AUTOMOTIVE
EXPERIENCE

Automotive Product Families (need to add S32V Fusion, i.MX Infotainment)

Radar

Products

SPIRIT

Scalable 77GHz SiGe Chipset

EAGLE

SiGe Transceiver

DOLPHIN

RFCMOS Transceiver for 76-81GHz

ORCA

RFCMOS One-chip Radar SoC



- ✓ 77 GHz proven in production
- ✓ Programmable chirps to 4 GHz
- ✓ MIPI interface 4x 20 Mbps
- ✓ Industry's first RFCMOS Radar SoC in the making (Orca)

Market News



Google is testing DOLPHIN as part of their self-driving cars project

V2X

GEN1

Multi Standard 2-chip Solution

GEN2

Optimized Single-Antenna one-chip



- ✓ Unique WW RFCMOS Solution 
- ✓ Best-in-class Security
- ✓ >1 Million Days Field-Tested
- ✓ First Global OEM Design Award
- ✓ Next Gen: System optimized Single Antenna 1-chip



DELPHI

GM/Delphi Design-Win in 2014:
NXP World's First Supplier to Deliver V2X Chipset for Mass Production



NXP is a Leader in Secure V2X

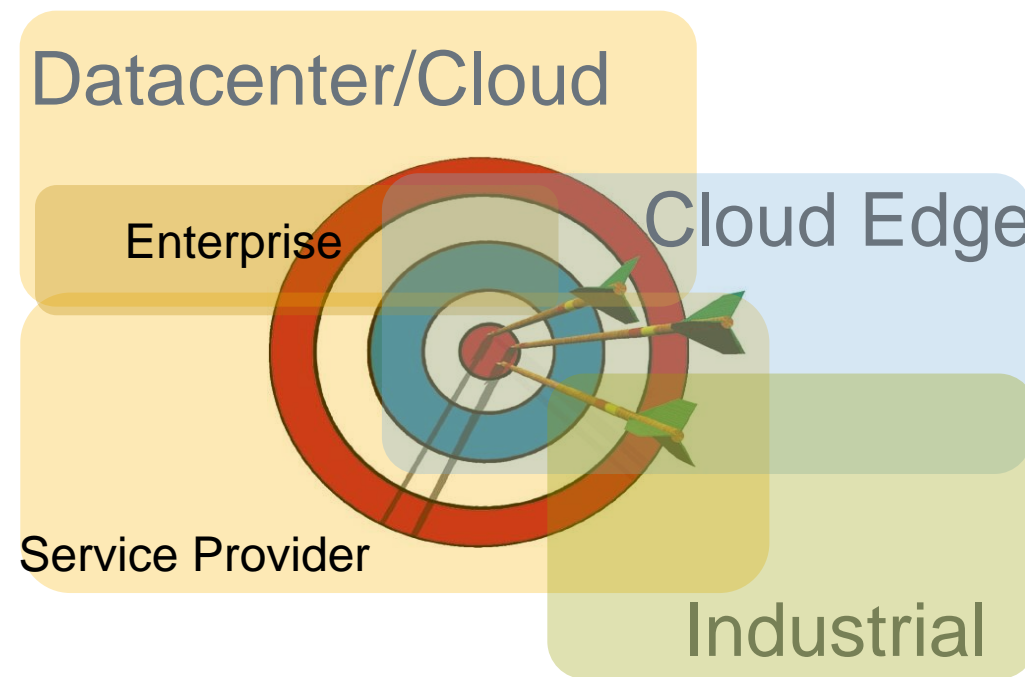
Leveraging NXP's Software Defined Radio and Security Leadership



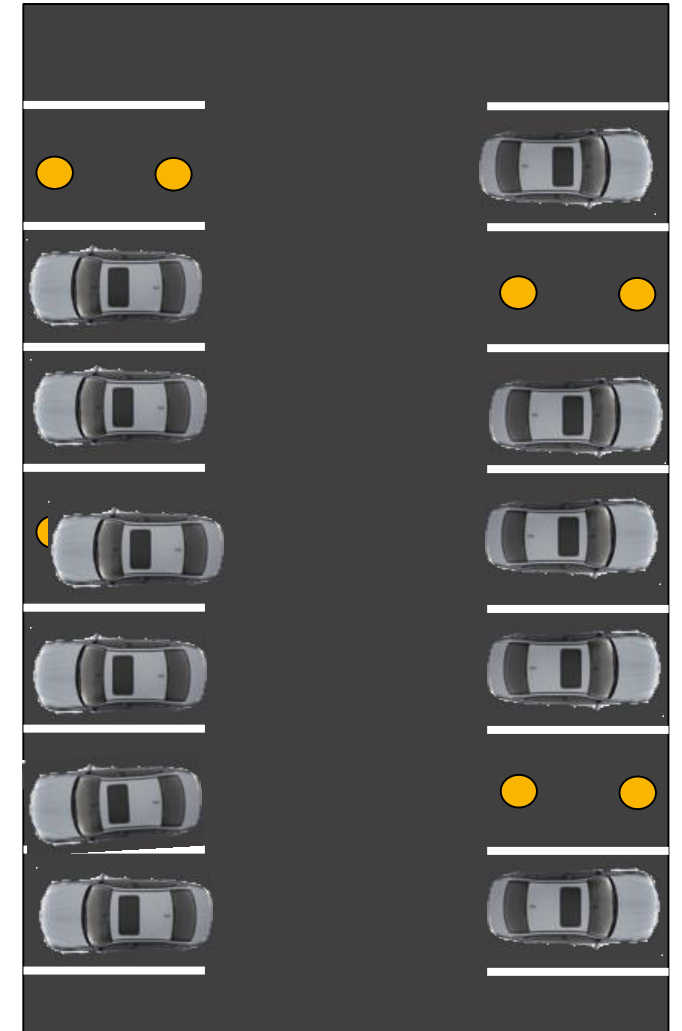
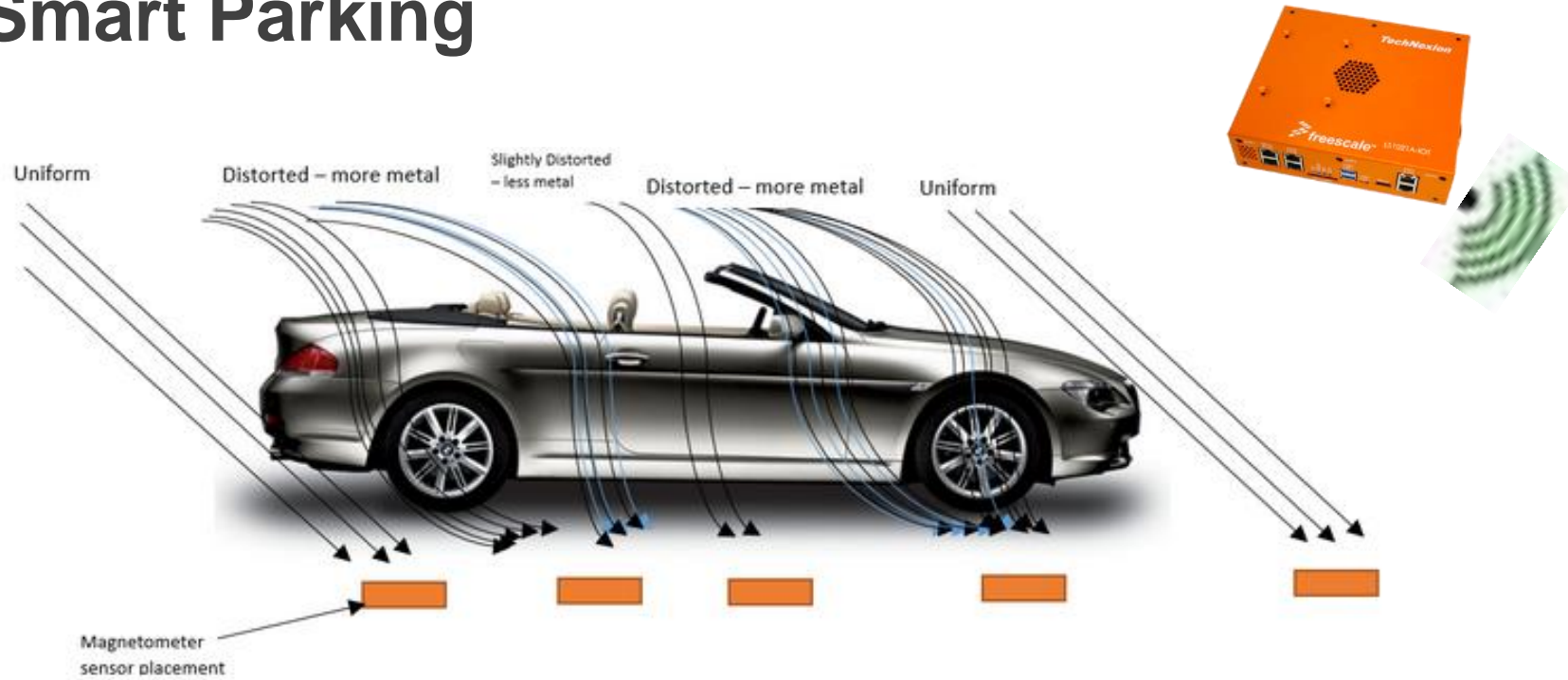
We Know a Little About Wireless Networking Too...



NXP QorIQ processors offer **server class performance** for real time control and high touch data services in wireless & wireline infrastructure.



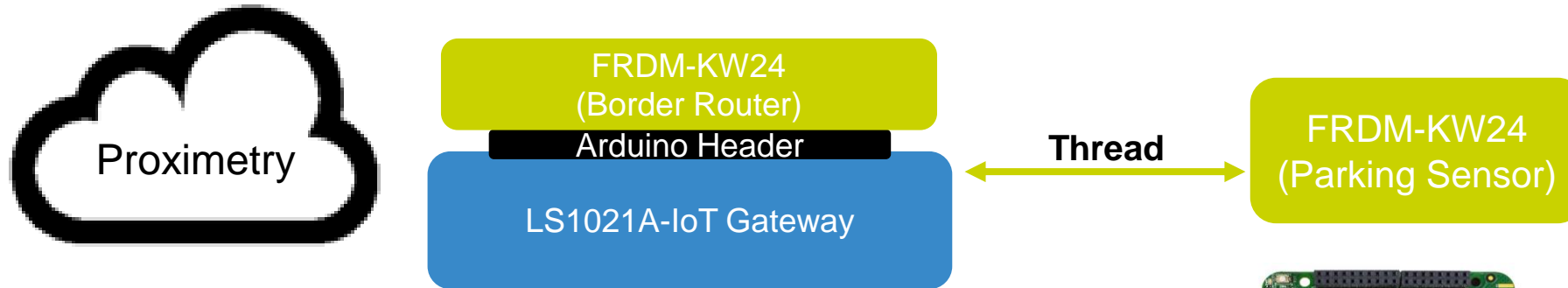
Smart Parking



Example

- Microcontroller (Kinetis KW24D512) + Magnetometer (FXOS8700CQ) embedded in parking lot
- Sensors use ZigBee to report status to QorIQ IoT Gateway
- QorIQ Gateway publishes parking space availability and location to Proximity cloud service

Cloud-Connected Parking Sensor Demo

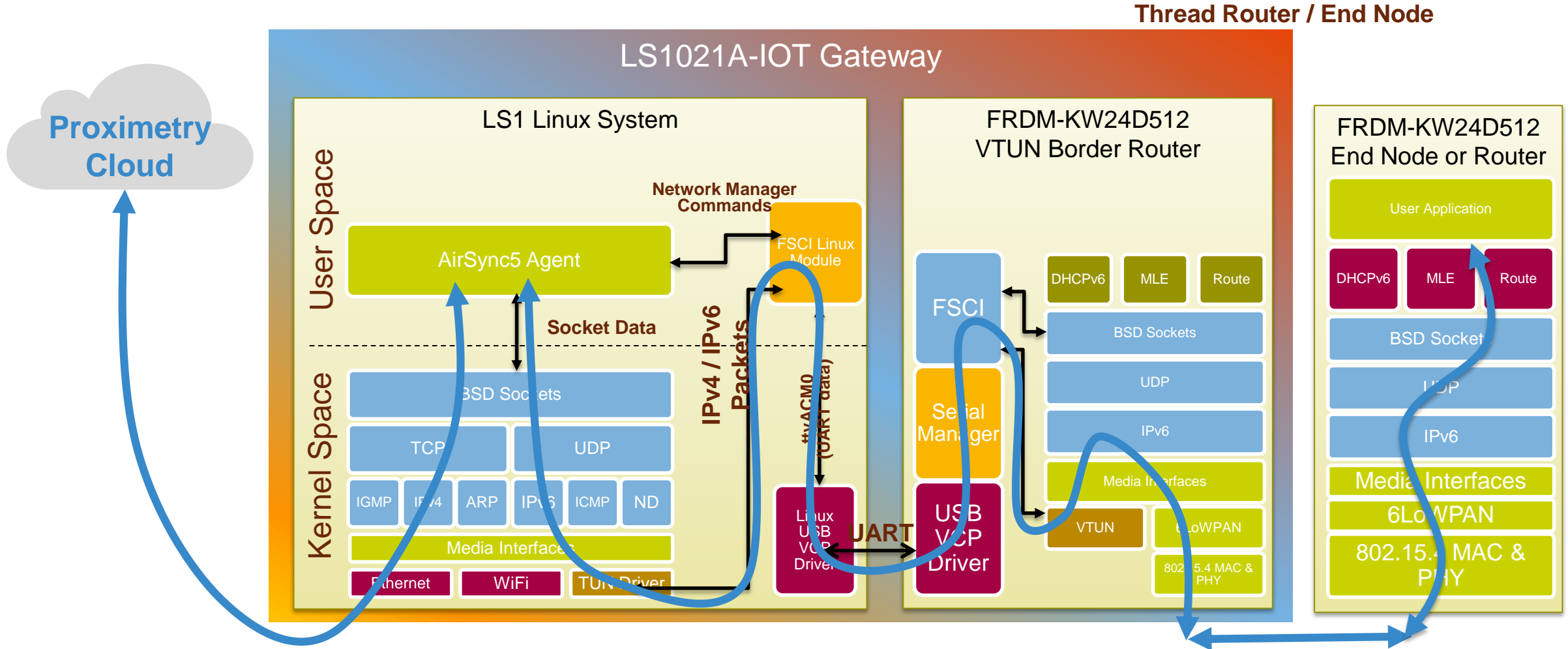


1. Detection of car triggers magnetometer interrupt
2. JSON formatted event is sent via Thread to IoT Gateway to update status
3. Proximity Agent on gateway posts information to cloud server

DIRECT SHORT RANGE COMMUNICATIONS AND 5G



PoC: Thread with FSCI and TUN Driver in a Linux QorIQ LS1021A-IoT System Paired with Kinetis KW2x



Proximetry Interface

PROXIMETRY | Portal ALL ▾

DASHBOARD **DEVICES** ▾ **LOGS** ▾ **ACTIONS** ▾

00049F07E9010012 [Tools] [Download] [Share] [Info]

Summary Alerts Provisioning

Device Data **Health Status**

UUID	6D5B0C6639FB	Status	Active
Name	00049F07E9010012		38 m 53 s
Model	Thread Parking Spo...		

Provisioning **Alerts**

Configuration Status In Sync

Device Attributes

00049F07E9010012 [Tools] [Download] [Share] [Info]

Summary Alerts Provisioning

Device Data **Health Status**

UUID	6D5B0C6639FB	Status	Active
Name	00049F07E9010012		40 m 27 s
Model	Thread Parking Spo...		

Provisioning **Alerts**

Configuration Status In Sync

Device Attributes

TOPOLOGY | ST

thread.node.parking_spot [-]

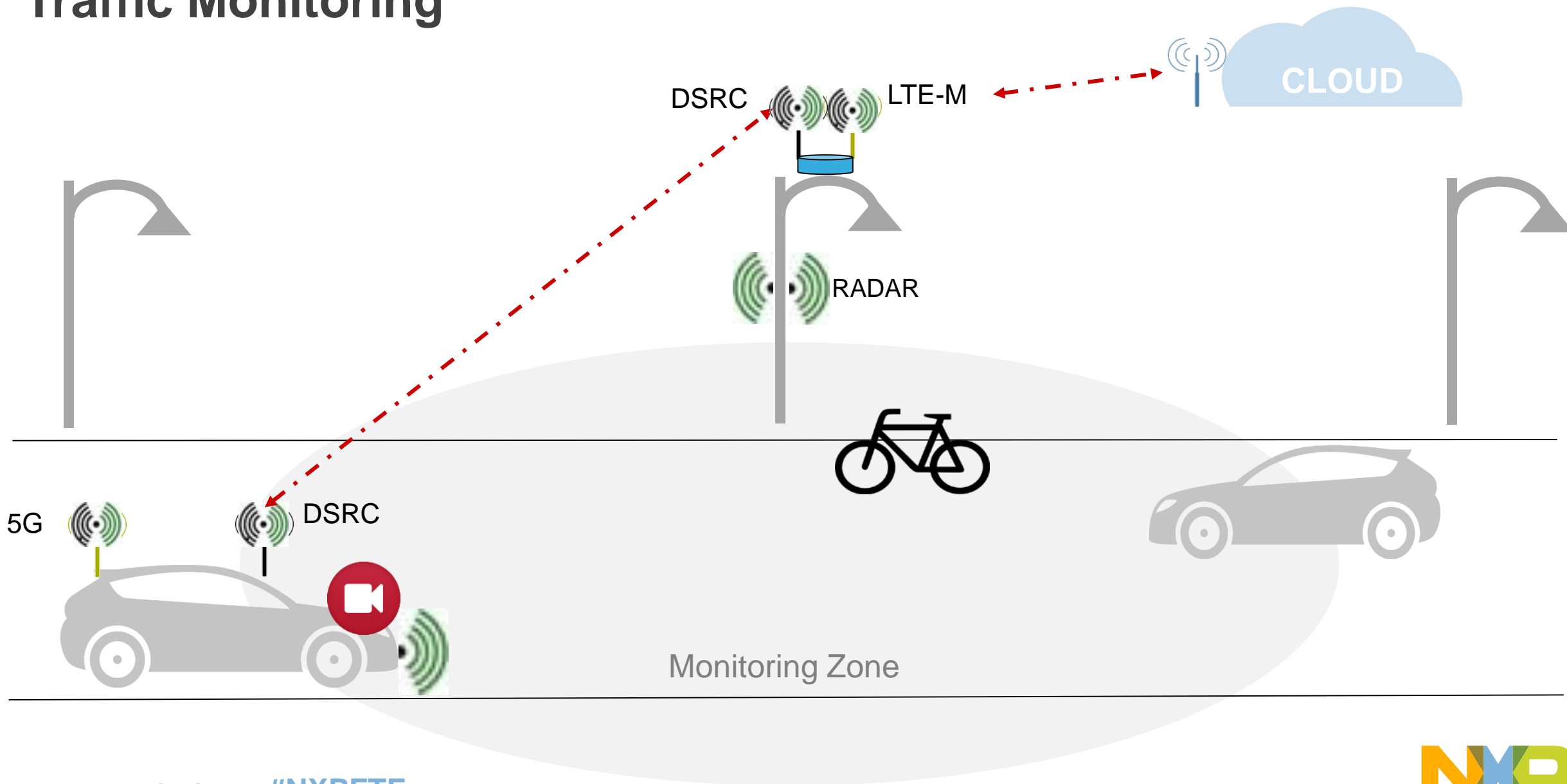
Time	Value
10:37:00 am	0.0
10:37:30 am	0.0
10:38:00 am	0.0
10:38:30 am	0.0
10:39:00 am	0.0
10:39:30 am	0.0
10:40:00 am	0.0
10:40:30 am	0.0
10:41:00 am	0.0
10:41:30 am	0.0

● thread.node.parking_spot [-]

thread.node.raw_magnetometer_z [micro Tesla (uT)]

Time	Value
10:37:00 am	-14.0
10:37:30 am	-14.0
10:38:00 am	-14.0
10:38:30 am	-14.0
10:39:00 am	-14.0
10:39:30 am	-14.0
10:40:00 am	-14.0
10:40:30 am	-14.0
10:41:00 am	-14.0
10:41:30 am	-14.0

Traffic Monitoring



Traffic Monitoring and Simple Control

- Using local sensors (RADAR) and V2X (DSRC) communications, monitor traffic flow on a section of roadway, detecting both V2X equipped and legacy vehicles.
- Using wireless or wireline backhaul, share data with cloud based traffic management system.
- Perform V2V relay, transmit traffic warnings/directives from cloud (variable speed limit, wrong way driver detection)
- (Optional, not shown) Using wireless or wireline backhaul, act as broadband hotspot, providing high bandwidth connectivity to connected cars and mobile devices

Dedicated Short Range Communications (DSRC)

Operations Model

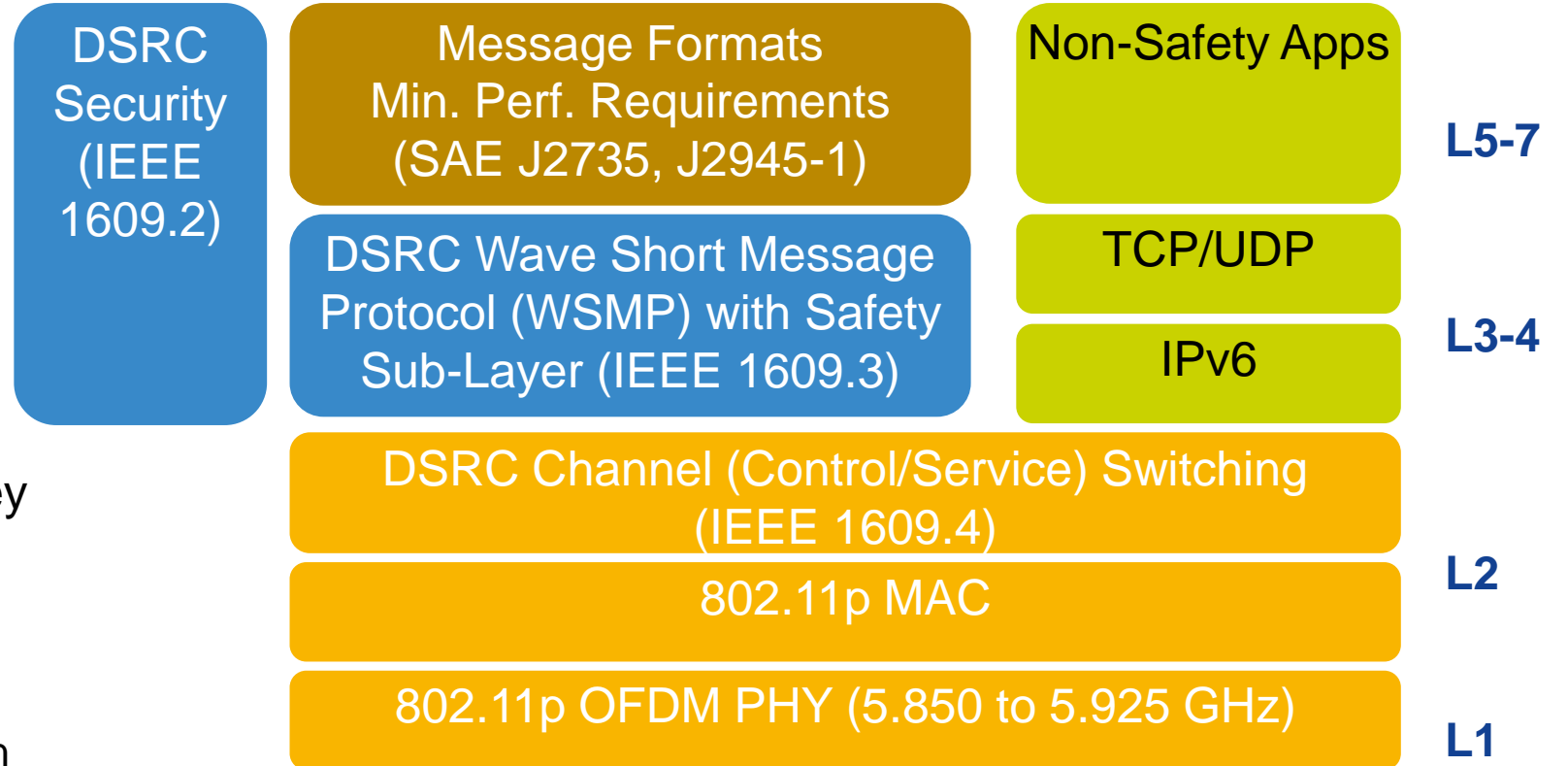
- 7 licensed channels
- Low latency (~50ms)
- Range up to 1km
- Data rates from 6-27Mbps
- Signed messages using Public Key Infrastructure

1400B limit on WSMP

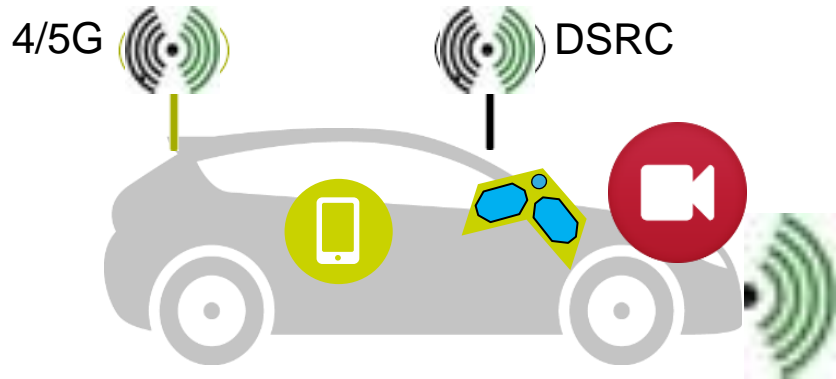
WAVE is a subset of 802.11.

L3-7 in Europe is specified by European Telecommunications Standards Institute (ETSI) TC-ITS standards

Protocol Stack (USA)



We Care About the V and the I...



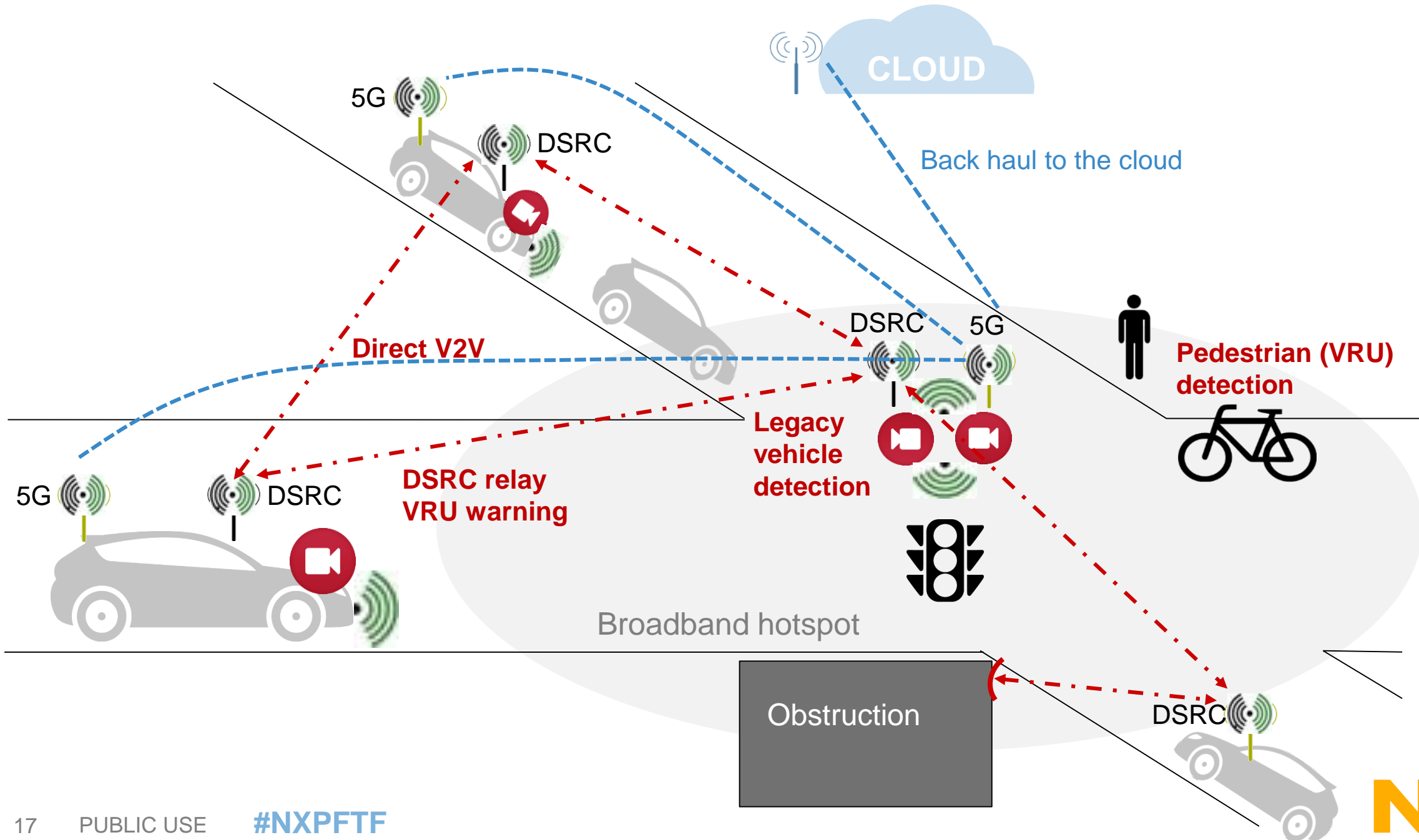
Vehicle

Sense: Vision, RADAR, DSRC Rx
Think: Sensor fusion, motion planning
Act: Motion control
Communicate: DSRC Tx, Broadband Infotainment



Intelligent Intersection

Sense: Vision, RADAR, DSRC Rx, Wide Area sensors from Cloud
Think: Sensor fusion, flow optimization
Act: Traffic light control, DSRC traffic control message
Communicate: DSRC Tx, 5G Broadband Infotainment Hotspot, Traffic Analytics to Cloud



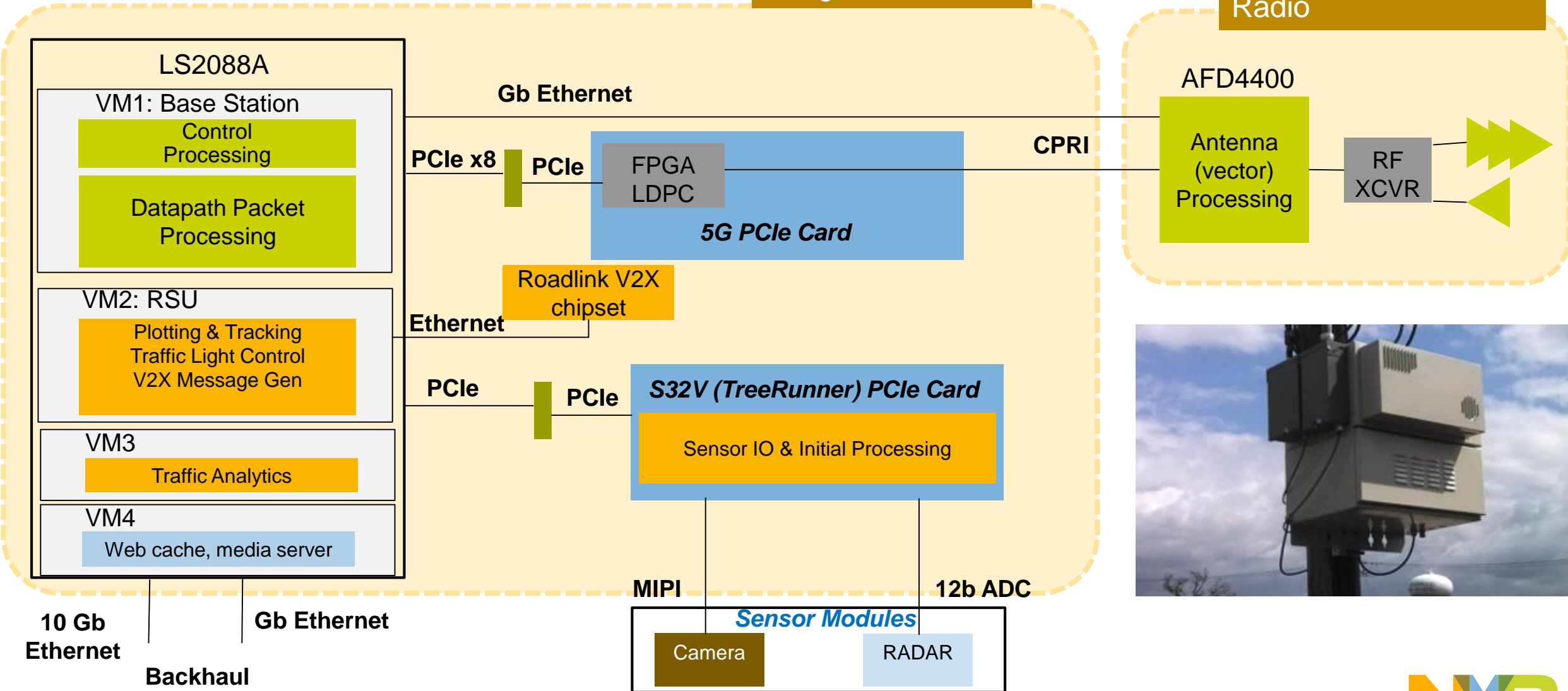
Dynamic Traffic Control: Vision for a Small Cell RSU

- Using local sensors and V2X (DSRC) communications, maximize safe throughput of vehicles through a single intersection, smoothing traffic flow for both autonomous and legacy vehicles, while also protecting vulnerable road users (pedestrians, bikes)
- Using wireless or wireline backhaul, share data with cloud based traffic management system, accept traffic flow directives from cloud to maximize safe throughput across multiple intersections
- Using wireless or wireline backhaul, act as broadband hotspot, providing high bandwidth connectivity to connected cars and mobile devices
- Using Network Function Virtualization, host multiple applications with full isolation
 - Base station control & data paths
 - Local traffic control (RSU functionality)
 - Wide area traffic analytics
 - Web cache/server

Intelligent Roadside Unit PoC

“Beige Box”

RF BL 4T4R Compact Radio



SUMMARY

SUMMARY

- NXP is the market leader in automotive semiconductors
- We have expertise in vehicle side and infrastructure side communication
- We have expertise in sensor fusion
- These capabilities can be combined for smart parking, traffic monitoring, and sophisticated traffic control.





SECURE CONNECTIONS
FOR A SMARTER WORLD

ATTRIBUTION STATEMENT

NXP, the NXP logo, NXP SECURE CONNECTIONS FOR A SMARTER WORLD, CoolFlux, EMBRACE, GREENCHIP, HITAG, I2C BUS, ICODE, JCOP, LIFE VIBES, MIFARE, MIFARE Classic, MIFARE DESFire, MIFARE Plus, MIFARE Flex, MANTIS, MIFARE ULTRALIGHT, MIFARE4MOBILE, MIGLO, NTAG, ROADLINK, SMARTLX, SMARTMX, STARPLUG, TOPFET, TrenchMOS, UCODE, Freescale, the Freescale logo, AltiVec, C 5, CodeTEST, CodeWarrior, ColdFire, ColdFire+, C Ware, the Energy Efficient Solutions logo, Kinetis, Layerscape, MagniV, mobileGT, PEG, PowerQUICC, Processor Expert, QorIQ, QorIQ Qonverge, Ready Play, SafeAssure, the SafeAssure logo, StarCore, Symphony, VortiQa, Vybrid, Airfast, BeeKit, BeeStack, CoreNet, Flexis, MXC, Platform in a Package, QUICC Engine, SMARTMOS, Tower, TurboLink, and UMEMS are trademarks of NXP B.V. All other product or service names are the property of their respective owners. ARM, AMBA, ARM Powered, Artisan, Cortex, Jazelle, Keil, SecurCore, Thumb, TrustZone, and μ Vision are registered trademarks of ARM Limited (or its subsidiaries) in the EU and/or elsewhere. ARM7, ARM9, ARM11, big.LITTLE, CoreLink, CoreSight, DesignStart, Mali, mbed, NEON, POP, Sensinode, Socrates, ULINK and Versatile are trademarks of ARM Limited (or its subsidiaries) in the EU and/or elsewhere. All rights reserved. Oracle and Java are registered trademarks of Oracle and/or its affiliates. The Power Architecture and Power.org word marks and the Power and Power.org logos and related marks are trademarks and service marks licensed by Power.org. © 2015–2016 NXP B.V.

