FTF FREESCALE TECHNOLOGY FORUM 2015

Big Data Applications for the **Connected Car**

FTF-ACC-F1267

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J U N E . 2 0 1 5

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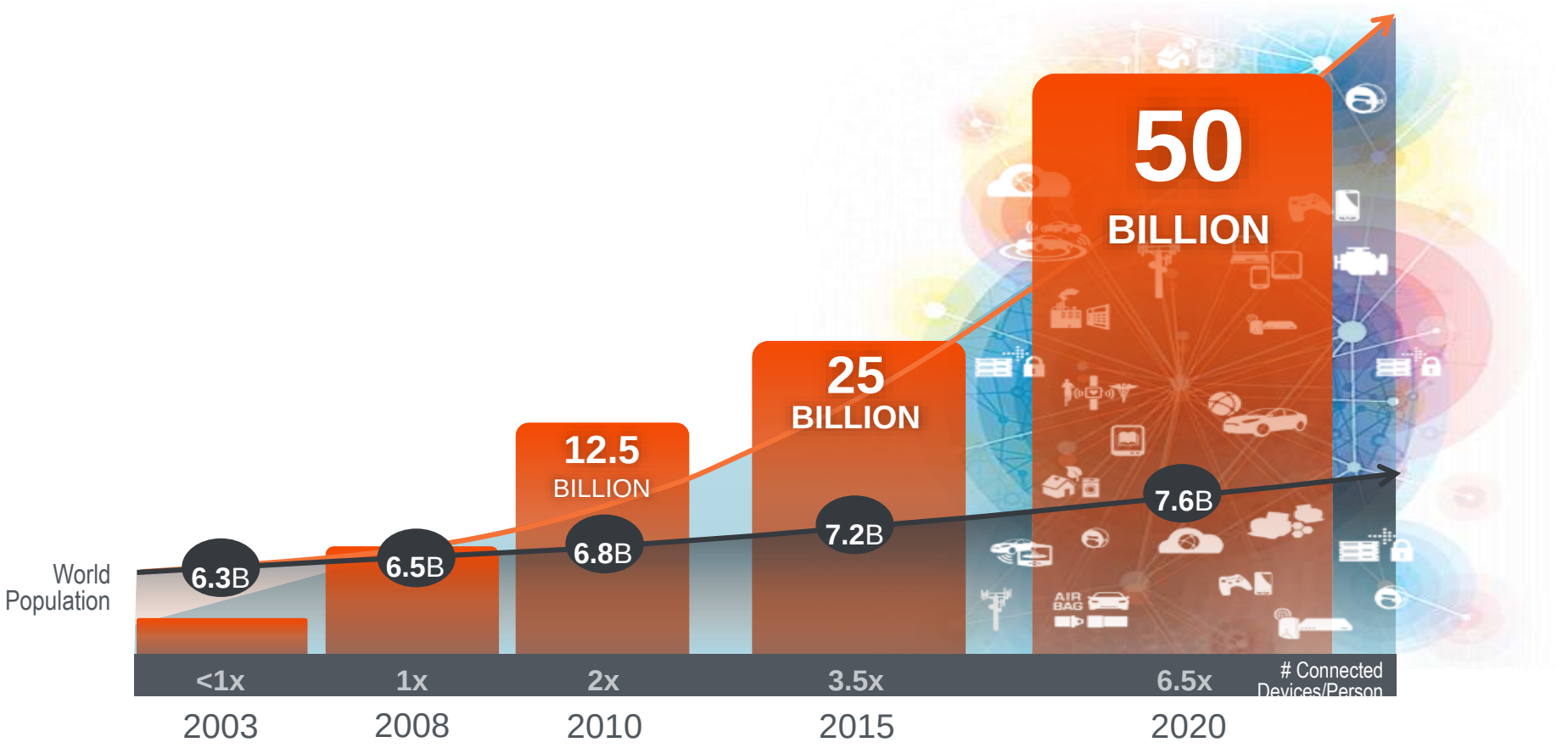
External Use

Introduction

- Freescale and IBM partnering for Automotive IoT

- A look into the key components that enable Big Data Applications for the Connected Car
  - Connecting the Vehicle
  - Moving data into the IoT
  - Big Data & Analytics
  - Security

The Internet of Things is Driving Explosive Growth in Connected Devices

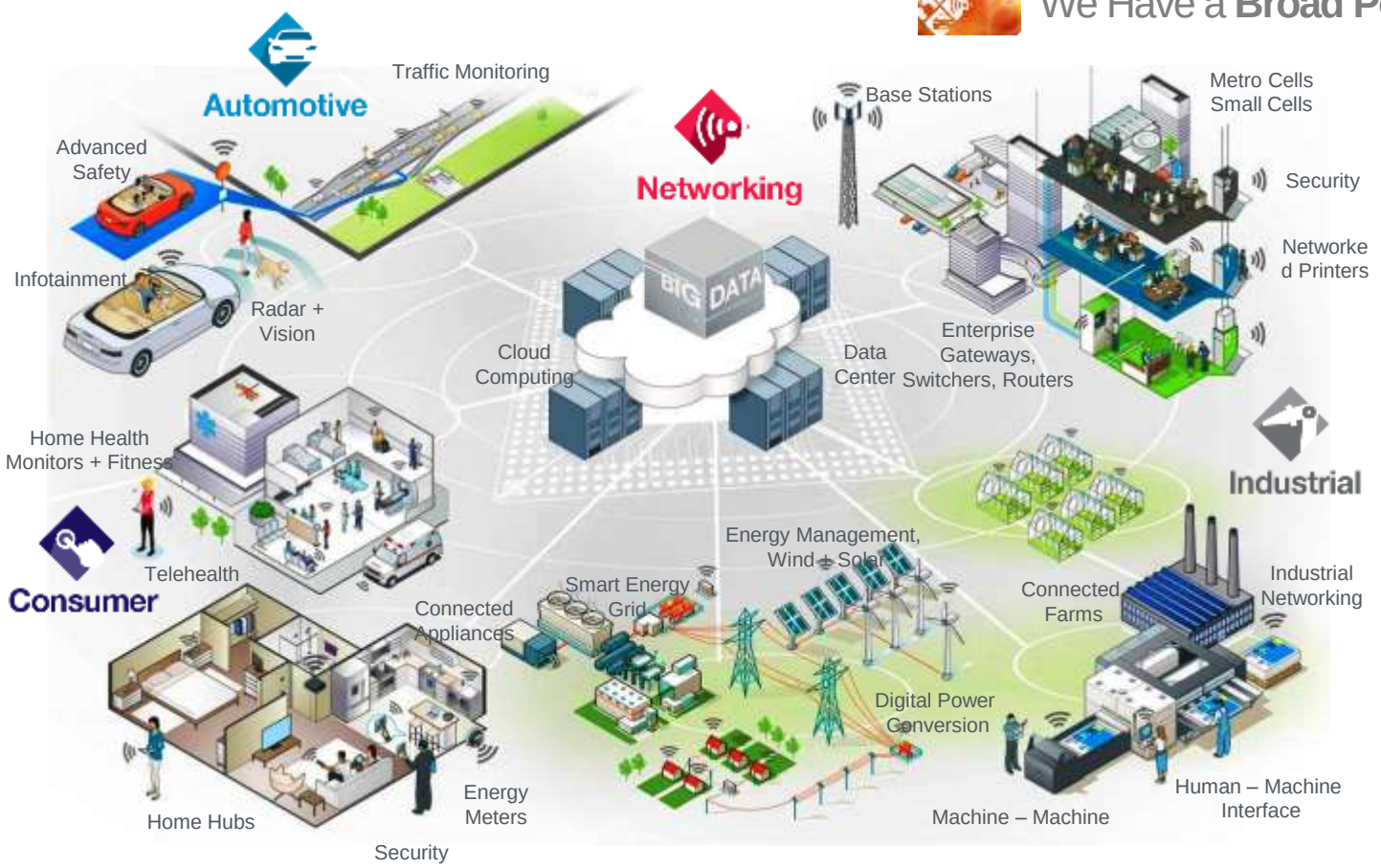


* Sources: Ericsson, February 2011; Cisco Internet Business Solutions Group (IBSG), April 2011

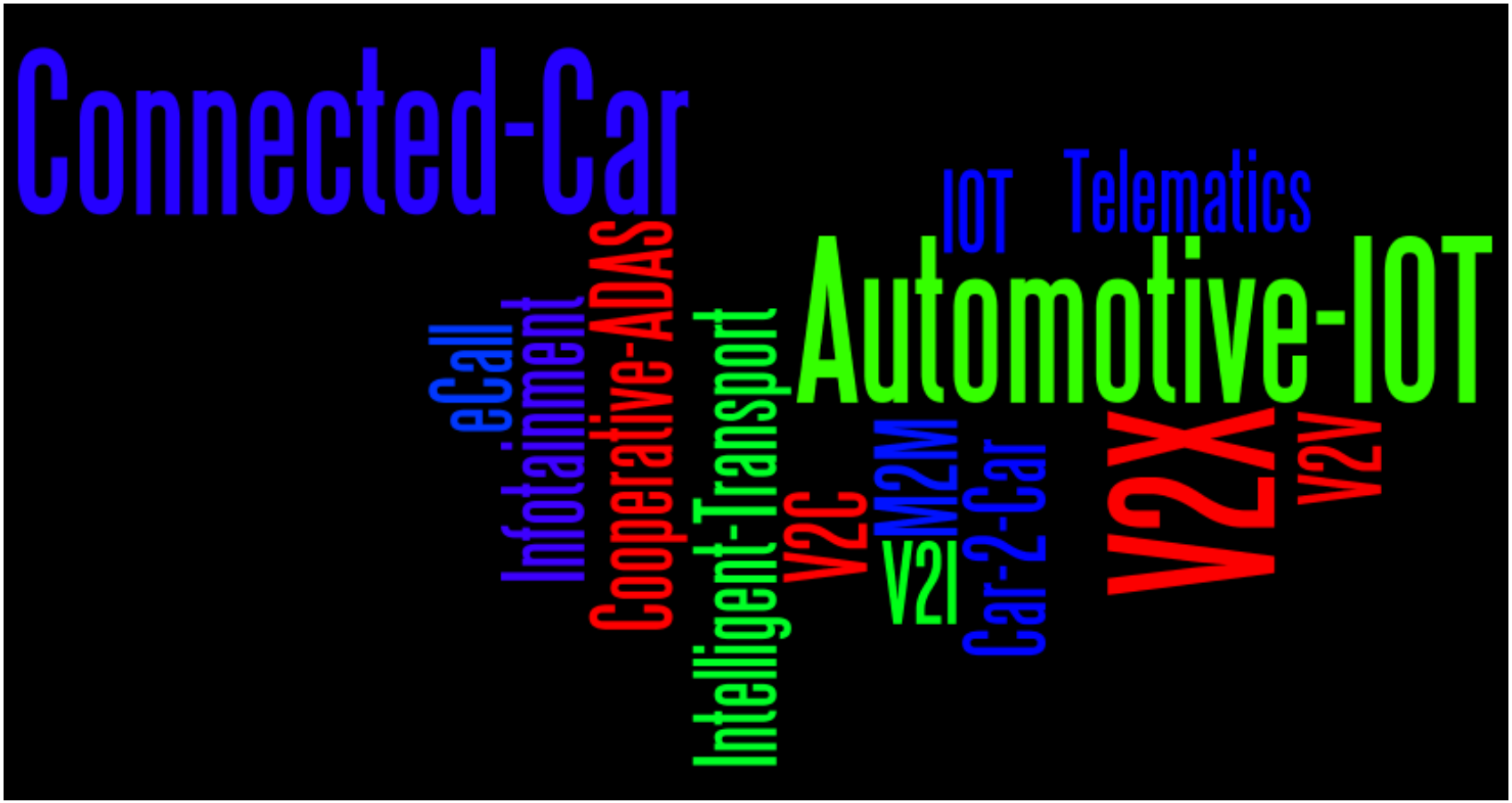
Our Products Power The Internet of Things

Microcontrollers | Digital Networking | Auto MCU | Analog and Sensors | RF

We Have a **Broad Portfolio**



Automotive IoT ??



Reminder – Why are we doing Automotive IoT?

85% increase in UK road traffic since 1980, further 40% growth expected by 2040

Safety

- 183,670 UK Road casualties in 2013, incl. 1,713 fatalities*
- 80% of accidents due to human error
- UK Road casualties down 50% from 2000.

Source: www.gov.uk

Congestion

- Average UK motorist spends 30 hours a year in traffic jams - 82 hours in London
- 7500km of European highways blocked by traffic jams every day

Source: INRIX

Emissions

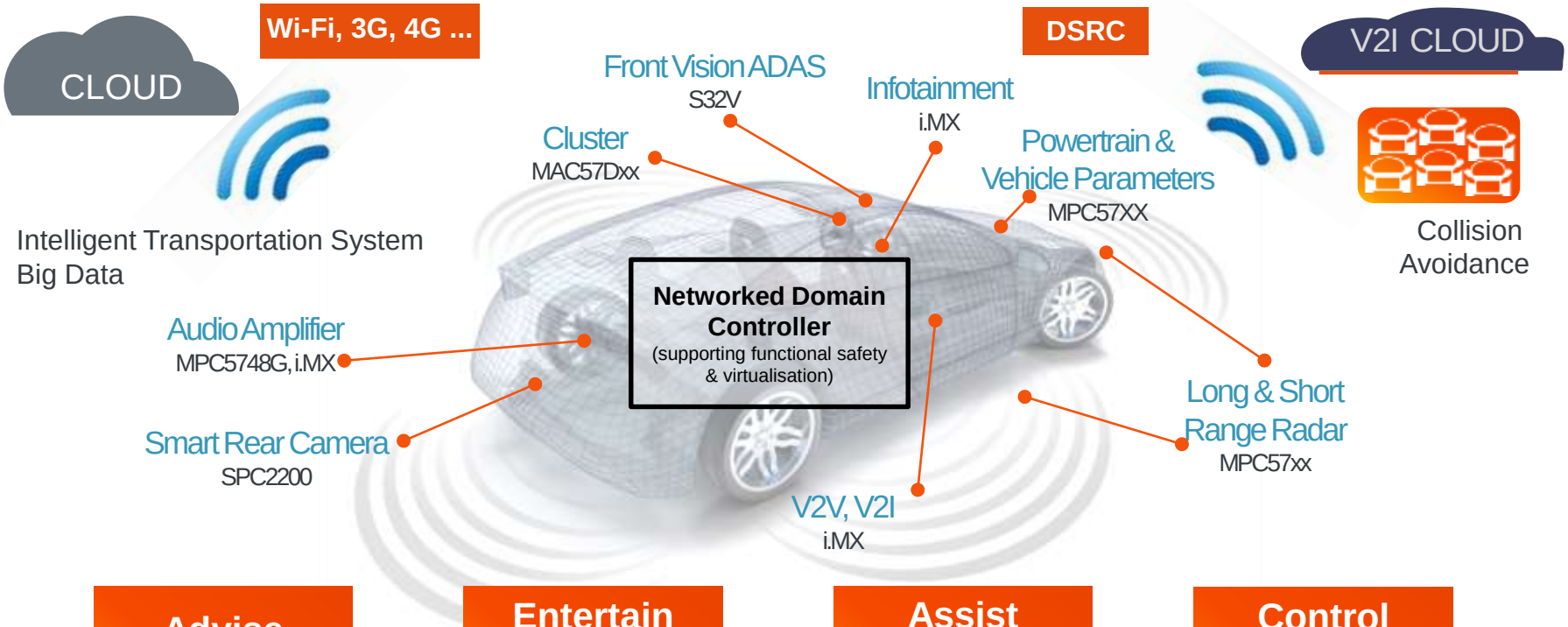
- 54% increase in CO_2 emissions from domestic transport since 1980
- Congestion on roads and at airports adds 6% to the EUs fuel bill

Source: Eurostat

Automotive MCU Product Leadership

Megatrend	Safer Travel		Electrification Going Green	Connectivity	Electrification Emerging Markets	
Application	Radar	Vision	Powertrain	Gateways	General Body and Chassis	Actuators and Sensors
				CAN lin FlexRay Wi Fi Ethernet		
Key Technology	High perf. ADC and DSP	Image processing	CPU/timer performance and instrumentation	Communication interfaces Security	ARM Cortex Software and Tools	MagniV with HV analog
Value Proposition	**Highest performance and system integration**	**Leading image processing AND functional safety**	**Leading performance architecture**	**Highest networking bandwidth AND security**	**Reduce our customers R&D and time-to-market**	**Reduce system size and manufacturing cost**

Automotive: Big Data User on the IoT



Advise
Tyre pressure
Brake wear
Service intervals
Insurance & toll services

Entertain
Dig radio
Connected games
Streaming video
Internet/phone services

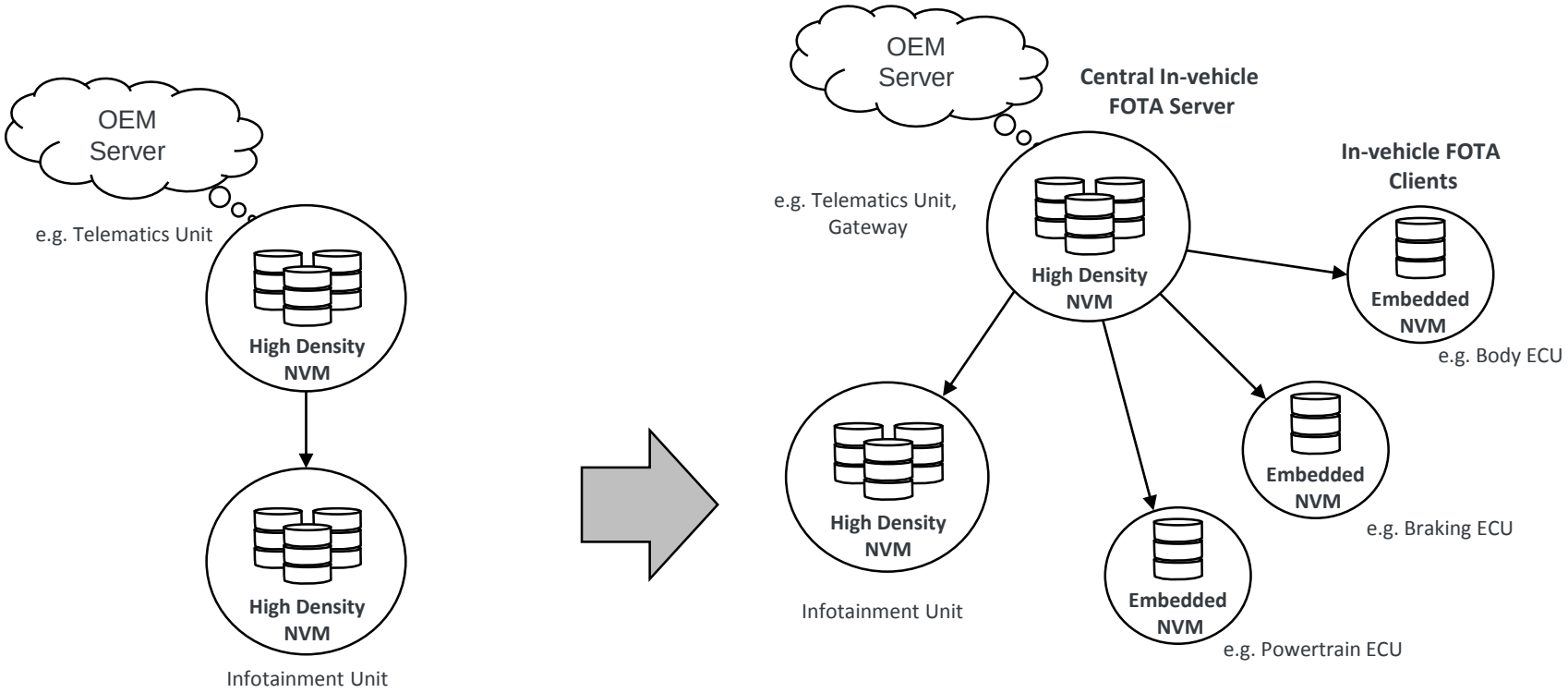
Assist
Optimised routing
Blue wave
Optimum speed
E-brake lights
OTA software updates

Control
Emergency braking
Adaptive cruise control
Road geometry tracking

A Look at the Connectivity Use Cases

Category	Example Use Case	V2?	Benefits	Connection	Latency	Bandwidth	Security level
OEM	Remote diagnostics connection	V2C	Driver, OEM	24/7 or @home	High	Med	High
	ECU SW upgrade	V2C	OEM	@home	High	Med	Highest
	Sale of vehicle SW options	V2C	OEM, driver	@home	High	Med	High
EV	Electric vehicle battery status	V2C	Driver	24/7	Med	Low	High
Regulatory	Electronic toll connection	I2V2C	Driver	24/7 or @home	Med	Low	High
	Road usage fee/insurance	I2V2C	Driver	24/7	Med	Low	High
Multimedia	Map update	V2C	Passenger	24/7	Med	High	Basic internet security
	Entertainment download	V2C	Passenger	24/7 or @home	Med	High	Basic internet security
	Traffic information	V2C/V2I	Driver	24/7	Med	Low	Basic internet security
eCall	Roadside assistance	V2C	Driver	24/7	Low	Low	Basic internet security
Safety / Cooperative ADAS	Driver assistance systems e.g. Optimal speed advice, priority traffic lights	V2I	Driver, society	24/7	Low	Low	High
	Collision avoidance systems e.g. emergency brake alert, blind spot warning, overtake warning, blind intersection	V2V	Driver, society	24/7	Low	Low	High

Firmware Over The Air (FOTA) moving deeper into the vehicle



Firmware Over-the-Air (FOTA) Update of Infotainment & Telematics Systems

Focused on updates to software on the infotainment & telematics, but not propagating further into the vehicle architecture

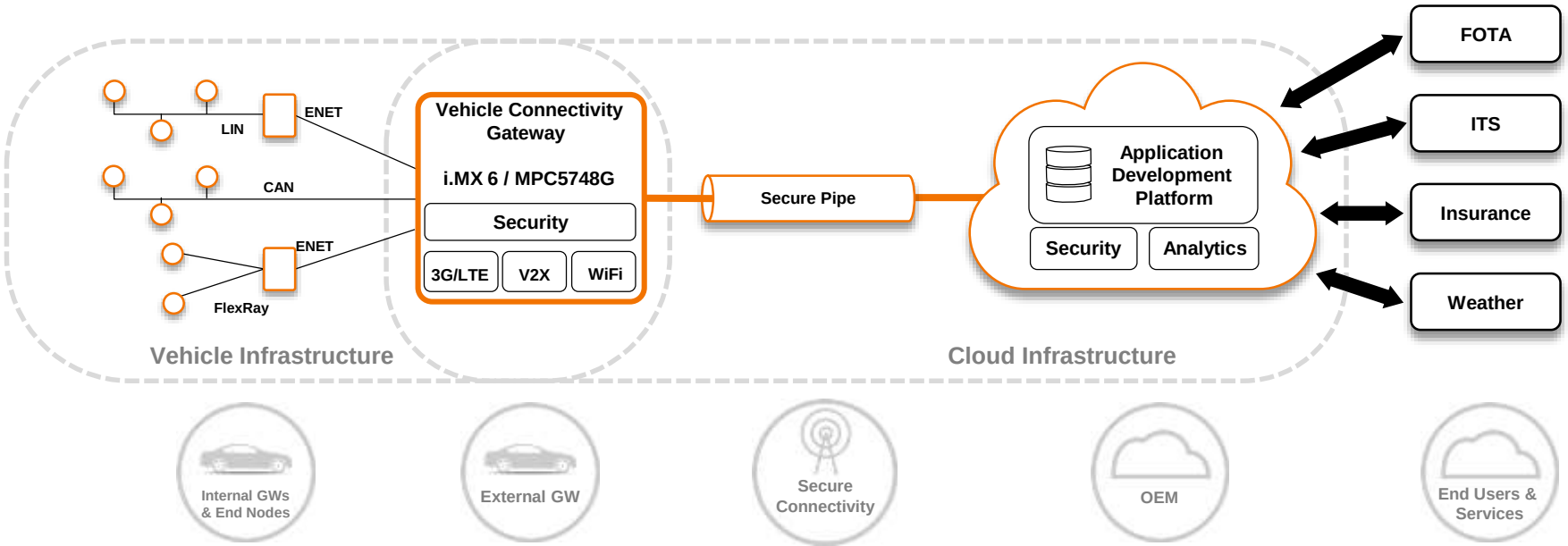
Firmware Over-the-Air (FOTA) Update of Major ECUs within the vehicle

New Challenges with this architecture:

- Security throughout
- Cost sensitivity of embedded ECUs
- Embedded NVM vs High Density NVM
- Strategy of when & what to update

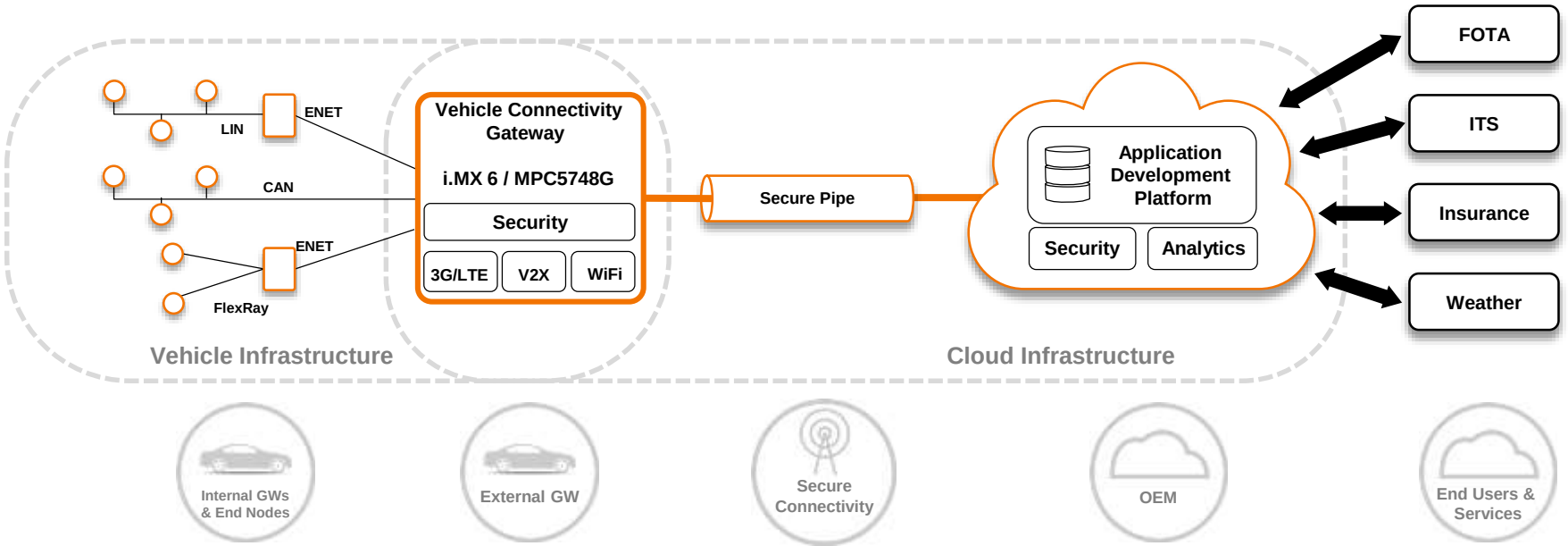
Freescale Enable the Automotive IoT

- With our partners, providing complete solutions that enable Auto IoT and Connected Car applications



Implementing the Automotive IoT

- Many elements coming together



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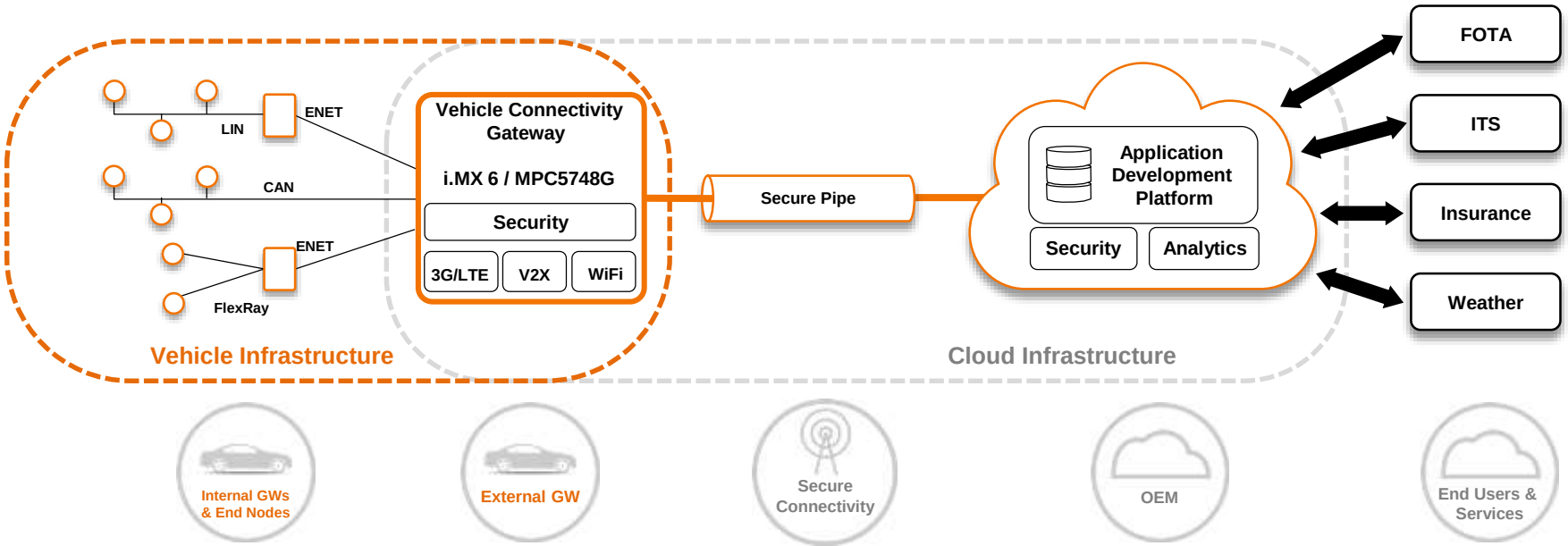

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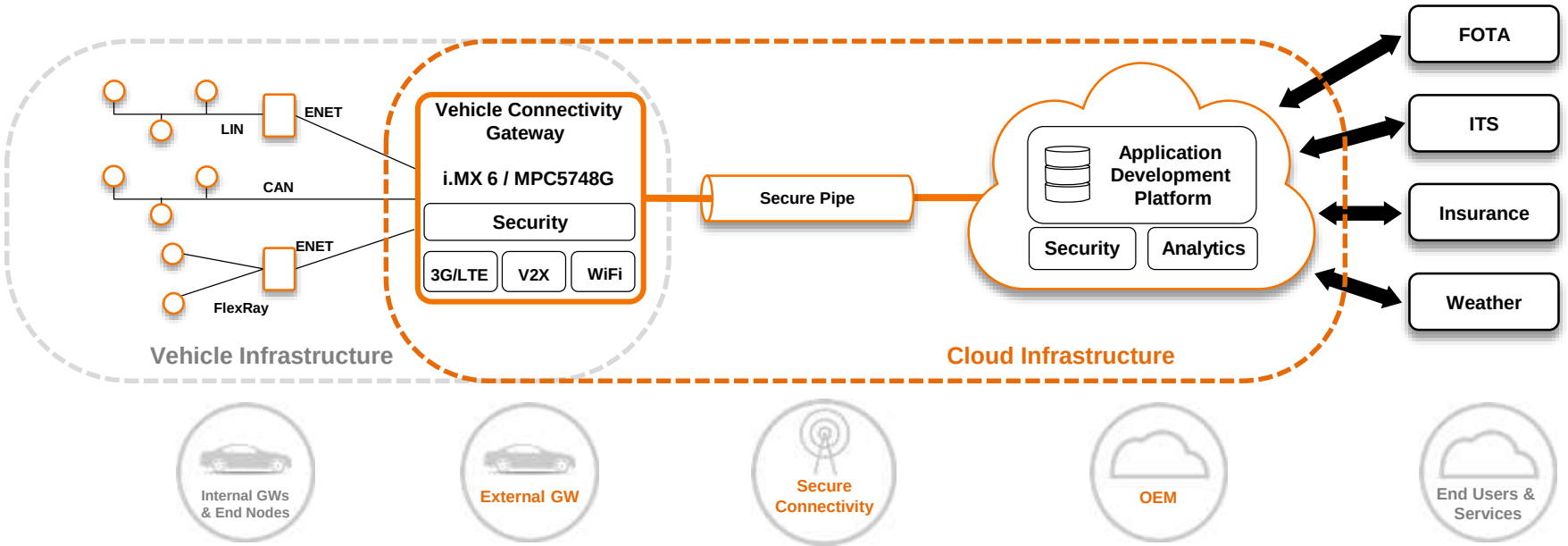

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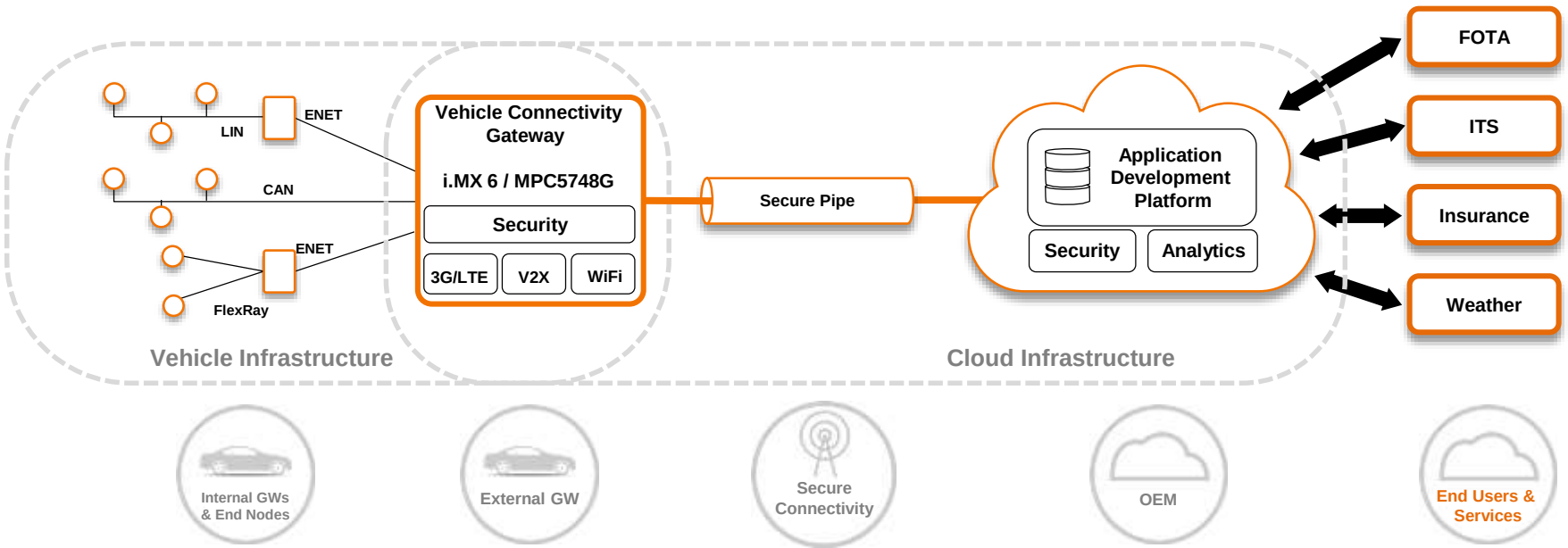
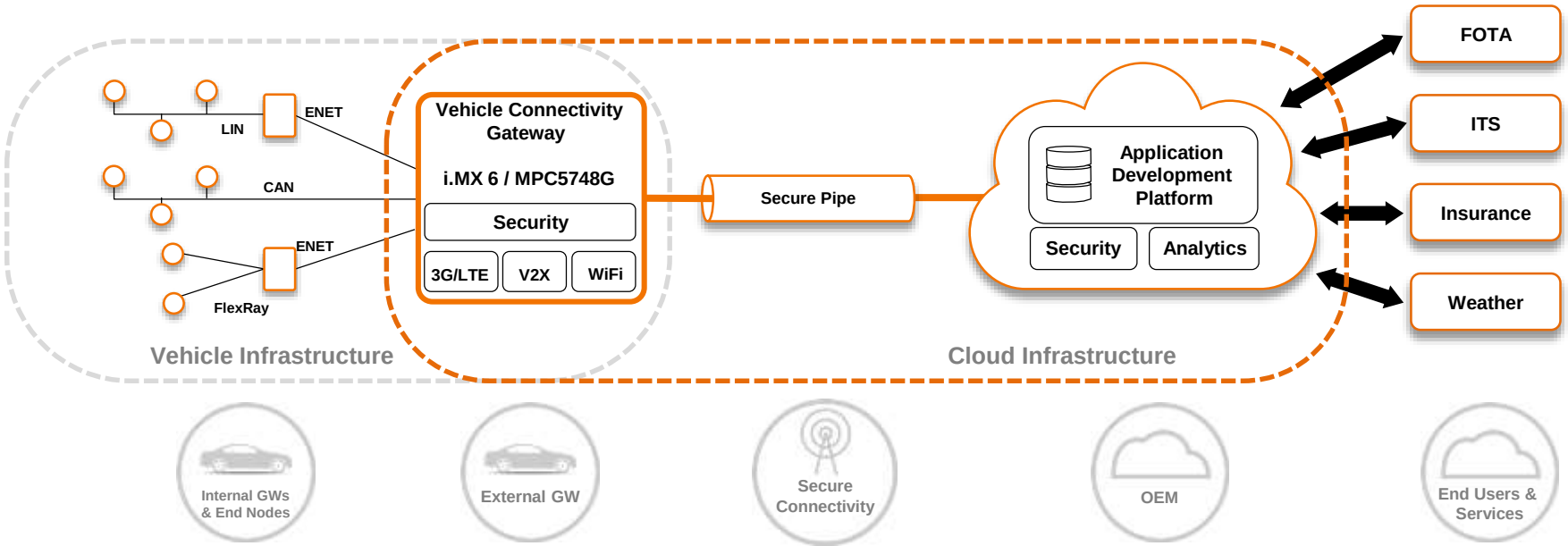


Partnering for Cloud & Services

- Working closely with partners to enable a complete Connected Platform
  - Cloud infrastructure, security & services



Freescale & IBM Partnering for Automotive IoT

IoT Can drive dramatic business value

Reduce Costs

- ✓ Increase asset usage, uptime, reliability and sustainability
- ✓ Reduced product development and maintenance costs
- ✓ Reduce operational asset costs

Drive New Revenues

- ✓ Generate new revenue streams
- ✓ Improve revenue via customer insights
- ✓ Product innovation / differentiation

Manage Risk

- ✓ Security
- ✓ Regulator Compliance
- ✓ Product Safety

Reduce time to market

- ✓ Horizontal M2M Platform
- ✓ Ease of integration to existing architectures
- ✓ Cloud based deployment model

In 2008, IBM anticipated the emergence of a Smarter Planet introducing the idea that the world was becoming more *instrumented*, *interconnected* and *intelligent*

Instrumented

billions of smart sensors and mobile devices

Interconnected

Through countless networks, applications and data centers

Intelligent

as data is transformed into real-time actionable insights at massive scale

Today 3 technology forces are converging driving the IoT Agenda.

DATA
The basis for competitive advantage

CLOUD
The growth engine for business

ENGAGEMENT
Changing expectations, fueled by mobile and social

Over the next 4 years IBM is investing $3 billion to establish a new IoT business unit.

On top of existing Strategic investments:

$1.2 Bn to increase Cloud datacenters to 40, $1 Bn in Bluemix PAAS

$24 Bn in Big Data and Analytics acquisitions and R&D

IBM IoT Cloud Open Platform for Industries

New analytics services that clients, partners and IBM will use to design and deliver vertical industry IoT solutions.

New IoT services within IBM's Bluemix

Enabling developers to easily integrate IoT data into cloud-based development and deployment of IoT apps.

Expansion of its ecosystem of IoT partners

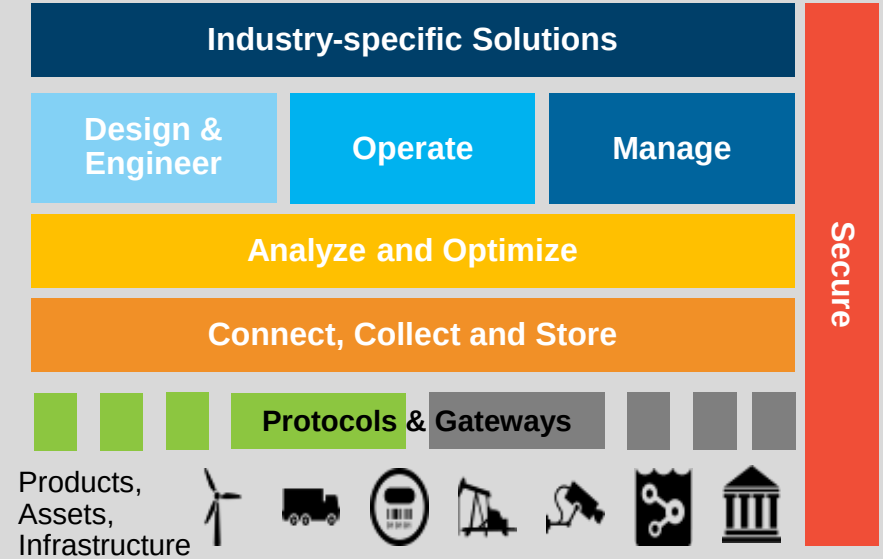
From silicon and device manufacturers to industry-oriented solution providers

IBM IoT Strategy
Deliver value through industry specific solutions & analytics *built on foundational capabilities*

Operate
infrastructure safely and securely from rollout to production

Manage
the lifecycle of things ensuring safe, reliable and predictive operations

Design and Engineer
things and applications addressing requirements management and complex system design processes

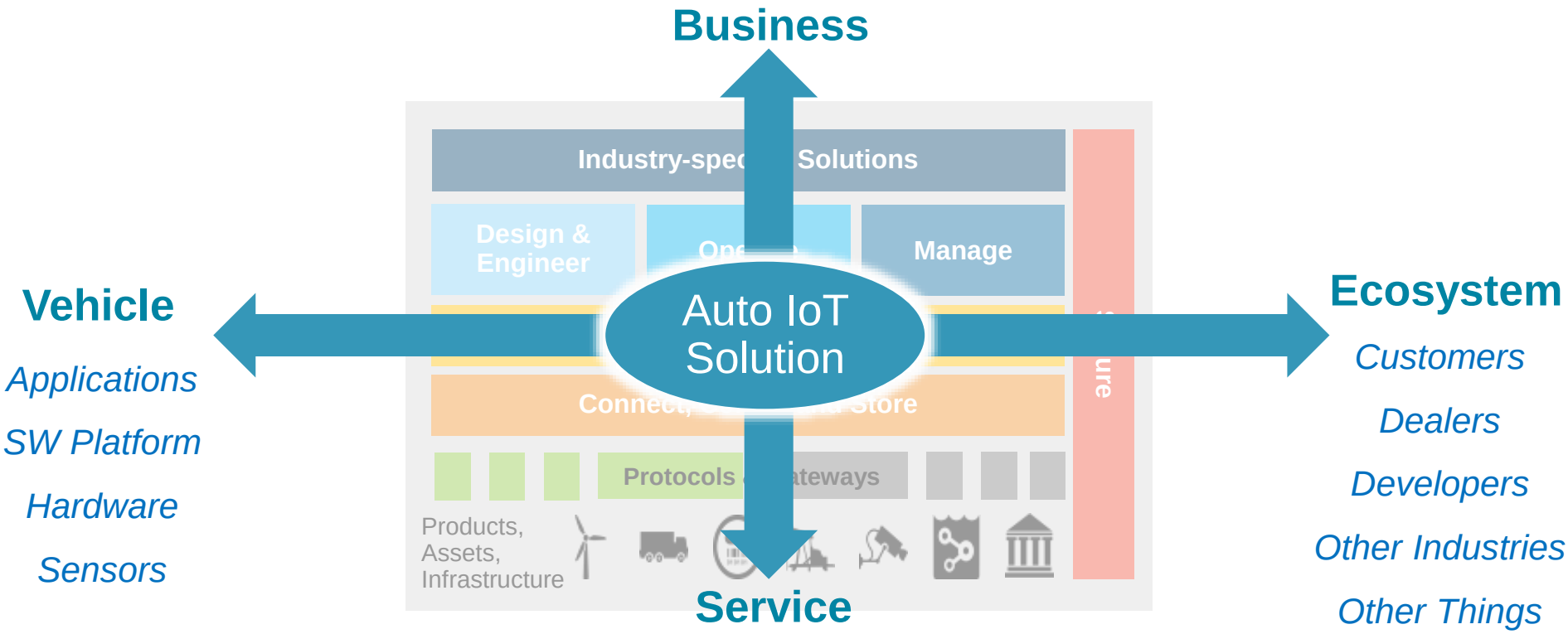


Secure
intelligence and action is critical from the thing up through industry solutions

Connect, Collect and Store
information from a range of things with range of volume, variety and velocity

Analyze & Optimize
information from across the lifecycle leveraging insight for action

No company provides all the pieces, IoT involves an ecosystem. IBM is a leader in IoT Technology and building practical IoT applications for the enterprise.



IBM

Technologies	Services	Experiences
Technologies embedded in this architecture will be shown in a following section.	IBM provides services to innovate, build and operate.	Our experiences cover all domain of the architecture.

Goals for an IoT Automotive Platform

Scalability

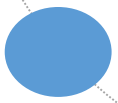
- huge increase in number of connected cars
- Increase of data volume
- near real time services
- drastically reduce running costs, and deployment costs at scale
- Ready for Big Data & Analytics

Security

- Ensure end to end security and privacy for vehicle and back end services

Global Reach

- regional coverage needs
- quick and cheap market coverage when requested
- setup an optimized operation organization



Flexibility

- **support changing business model**
- **capable of advanced analytics**
- high level of modularity and upgradability
- built on « de facto » standards
- standard interfaces and tools

Over the next 10 years the Auto industry will face a major transformation.

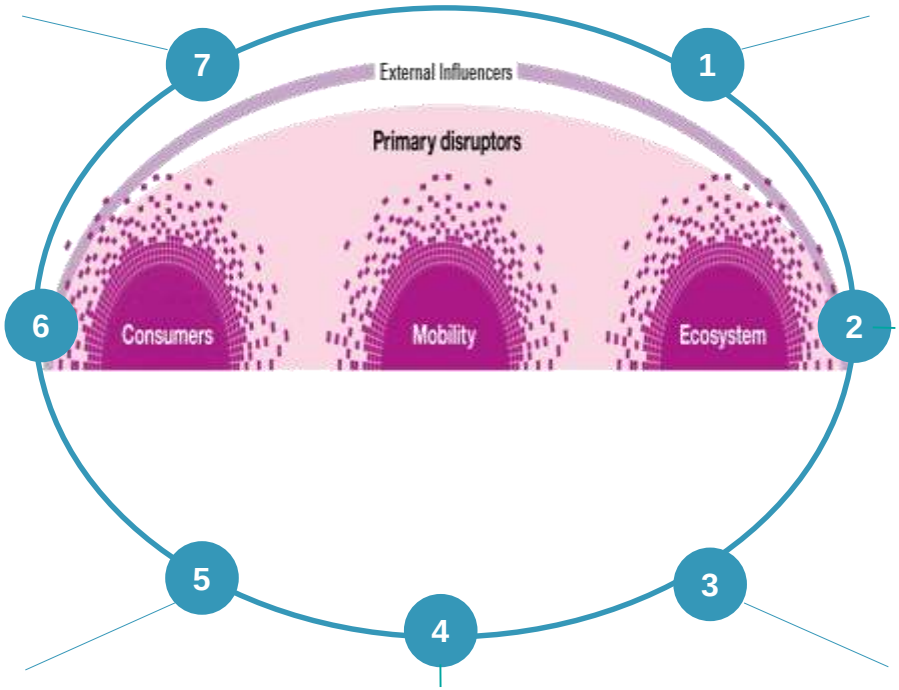
IBM‘s recent Auto 2025 study describes those future trends

Ecosystem disruption

New, non-industry players entering the ecosystem

Industry growth new value

- Collaboration with other industries
- Creating new services offerings
- Leveraging disruptive technology outside the vehicle
- Entering new markets
- Creating new product categories
- Creating new customer segments



External influencers

External forces impacting consumers will significantly increase, while those more focused on the business will decline over the next 10 years

Digital experience

Consumers expect auto companies to deliver a digital experience equal or better then what they’re already getting from other industries

Consumer-driven mobility

The mobility ecosystem offers opportunities for automotive companies to extend beyond more limited vehicle centric services ,but it also brings competition from non-traditional industry participants

Self-enabling vehicles

Intelligent, intuitive, self-enabling vehicles provide greater personalized experiences through their ability to “take care” of their occupants, themselves and work with others

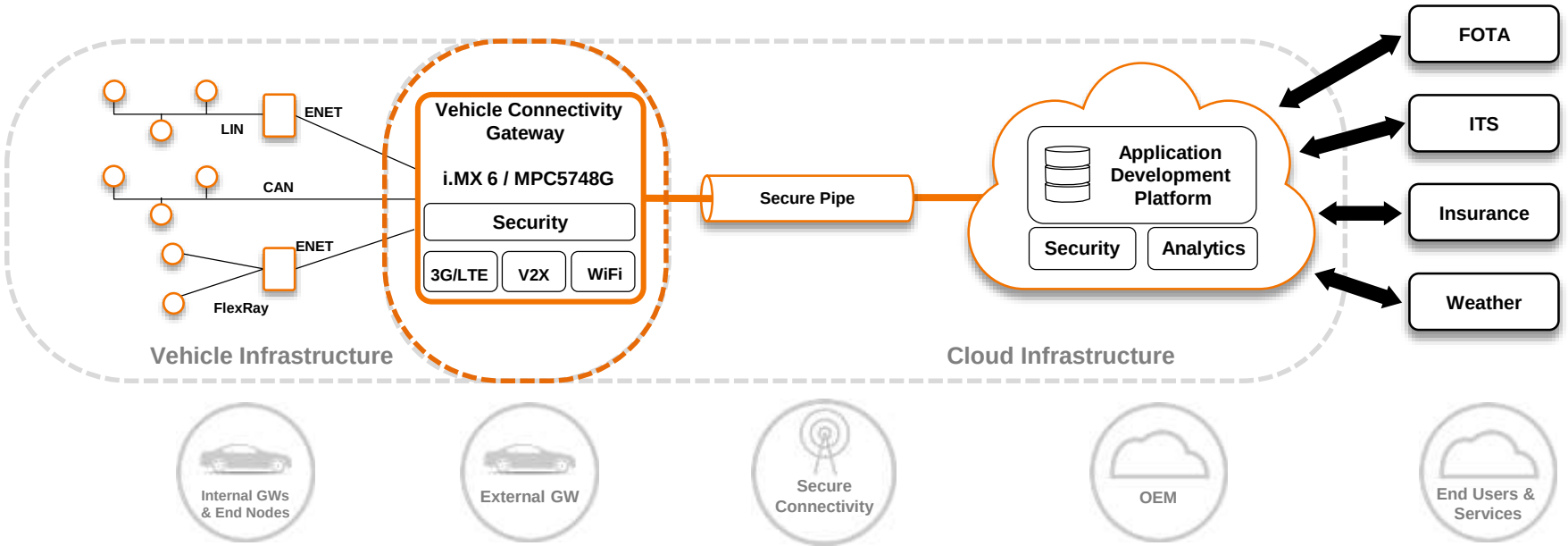
Co-creation with consumers

Digital and social technologies compel the consumers to participate more directly in all aspects of the enterprise’ business and offerings

Connecting the Vehicle

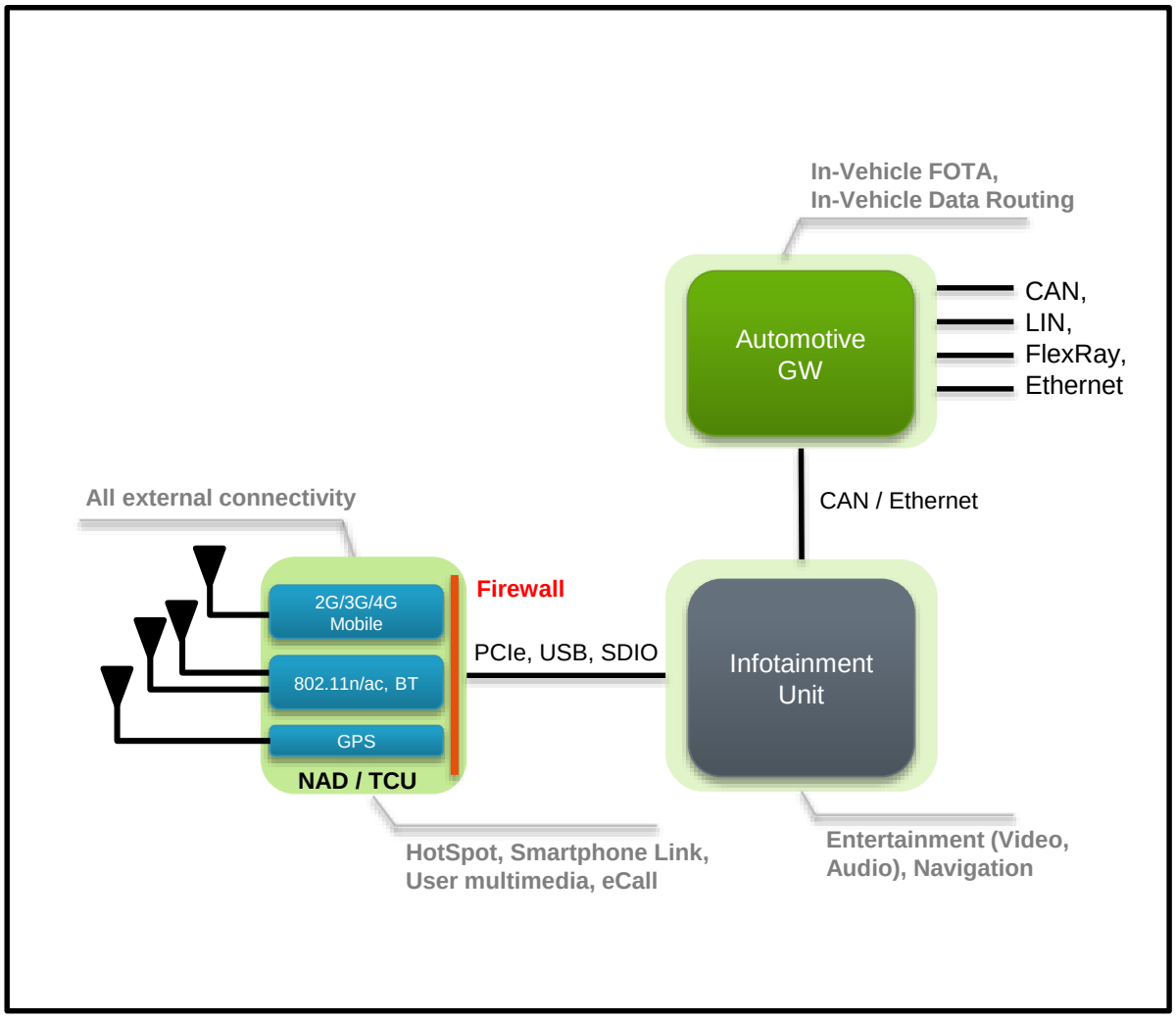
Vehicle Architecture - Connectivity

- How to connect the vehicle to the cloud infrastructure
  - Being done for many years, but variation in approaches



- Diagram above is representative: look at 3 connectivity architectures…

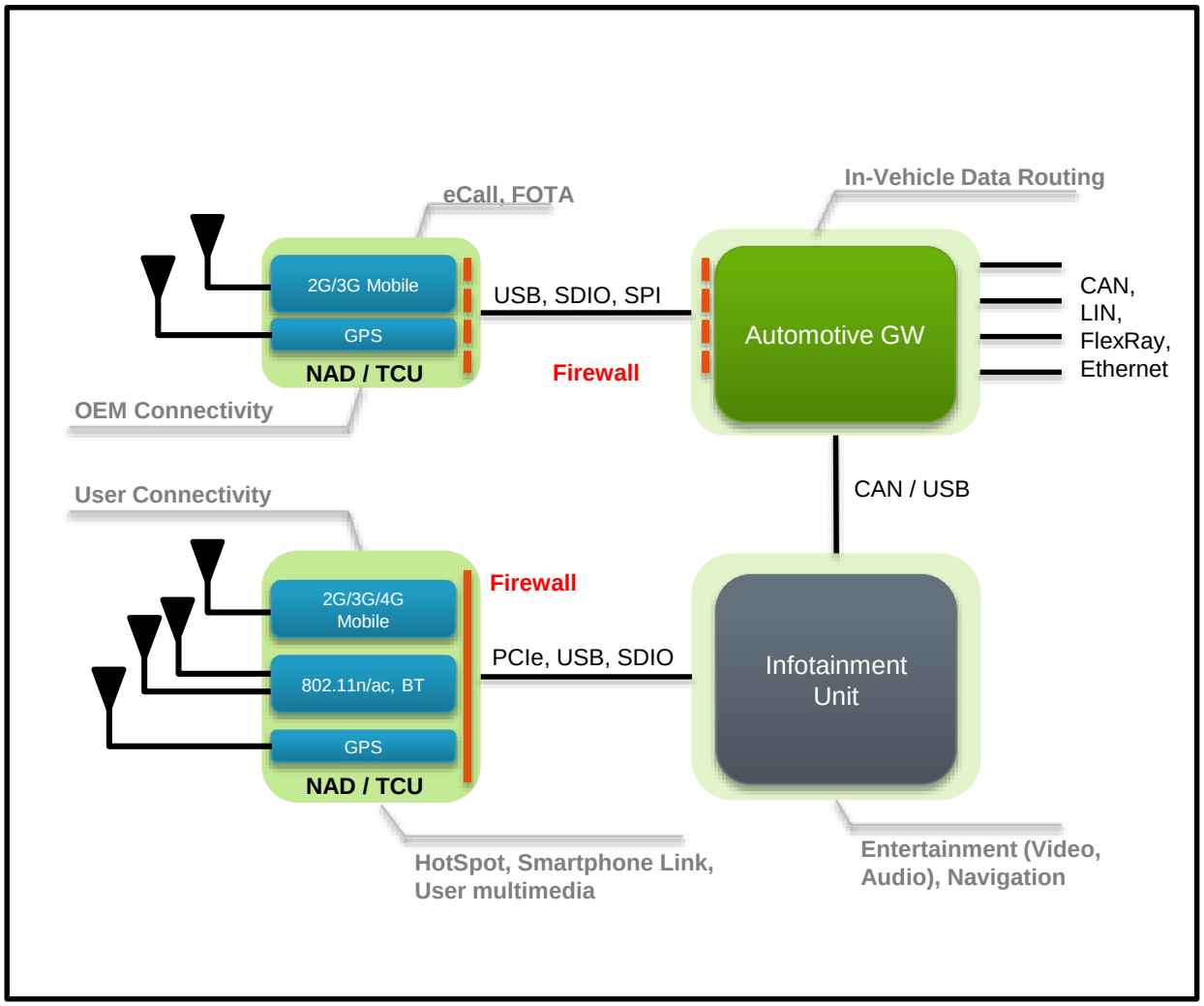
Infotainment Connectivity Architecture



- Strengths
  - **Aligned to legacy vehicle architectures**
  - High bandwidth wireless data interfaces
  - Centralized connectivity allows one node to manage which network is currently active (e.g. Roaming scenarios)

- Potential Weaknesses
  - Infotainment Unit potentially a weak point for security, due to 3rd party 'user' software being present (e.g. via app stores)
  - Automotive GW relies upon a wireless connection being available for the Infotainment Unit. This may not be the case for entry level vehicles with basic radio units

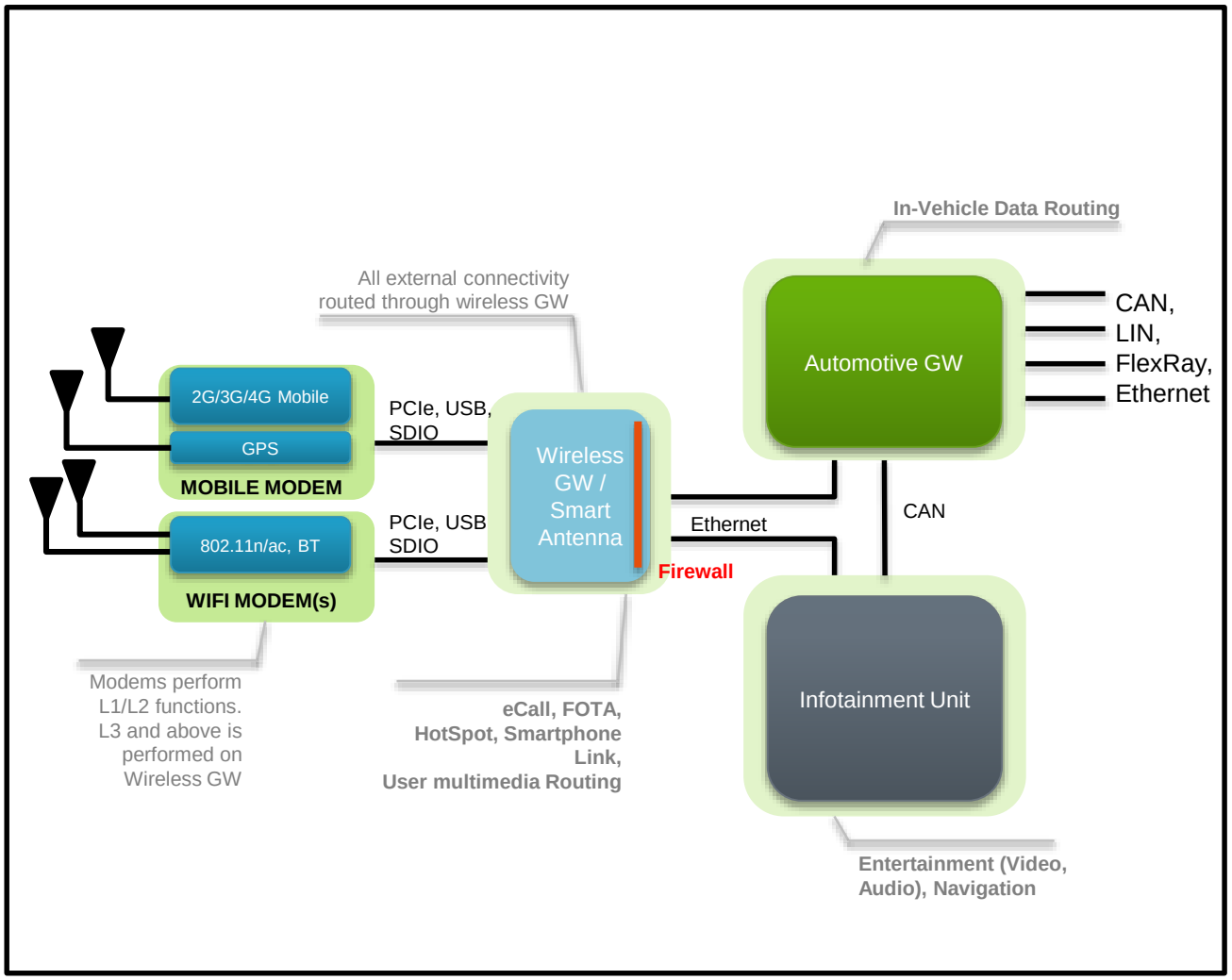
Separate OEM & User Connectivity Architecture



- Strengths
  - **Physical separation** of 'user' data from 'OEM' data (i.e. physical firewall)
  - **Detachment of Automotive GW & Infotainment Unit Connectivity**
    - Focus on Longevity for Automotive GW connectivity (e.g. UTMS)
    - Focus on scalability for Infotainment Unit connectivity (latest wireless std)

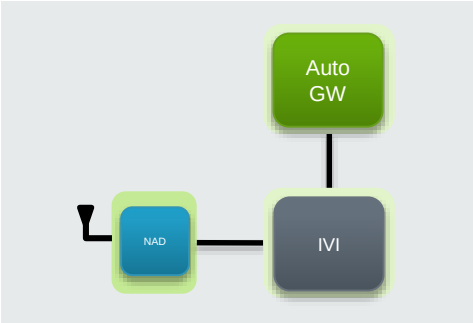
- Potential Weaknesses
  - Duplication of some connectivity components (i.e. BOM cost)
    - May be masked by reduced development costs across many vehicle modes with this approach

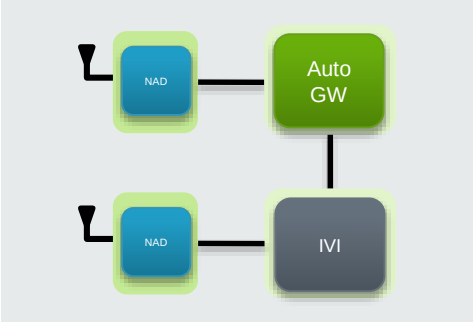
Wireless Gateway / Smart Antenna Architecture

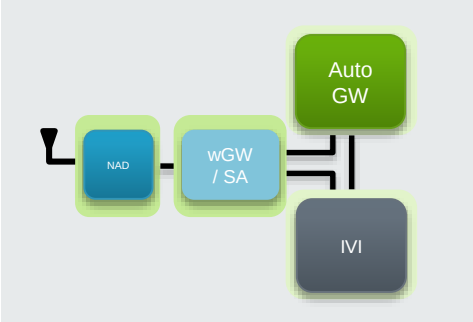


- Strengths
  - **Central Firewall** running OEM certified software
  - **Physical Automotive GW isolation** adds another level of security
  - Centralized connectivity allows one node to manage which network is currently active (e.g. Roaming scenarios)
- Potential Weaknesses
  - **Scalability is restricted**

Connectivity Themes

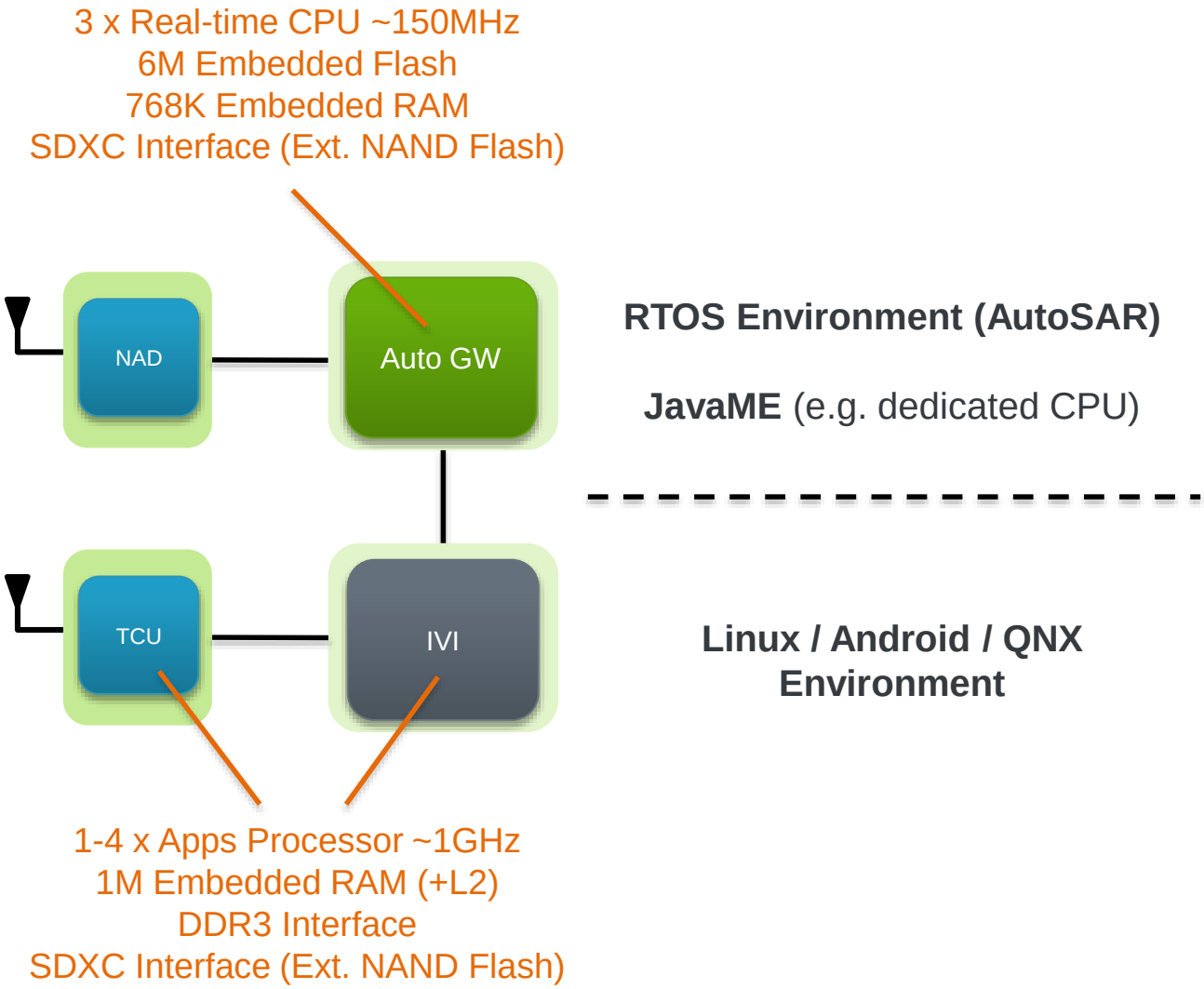






- Isolation of trusted and non-trusted resources
  - Physical separation
  - Hardware separation within SOC
- Connectivity requirements of ‘OEM’ data quite different to ‘user’
- Architecture choice not always technical
  - Legacy considerations, etc…

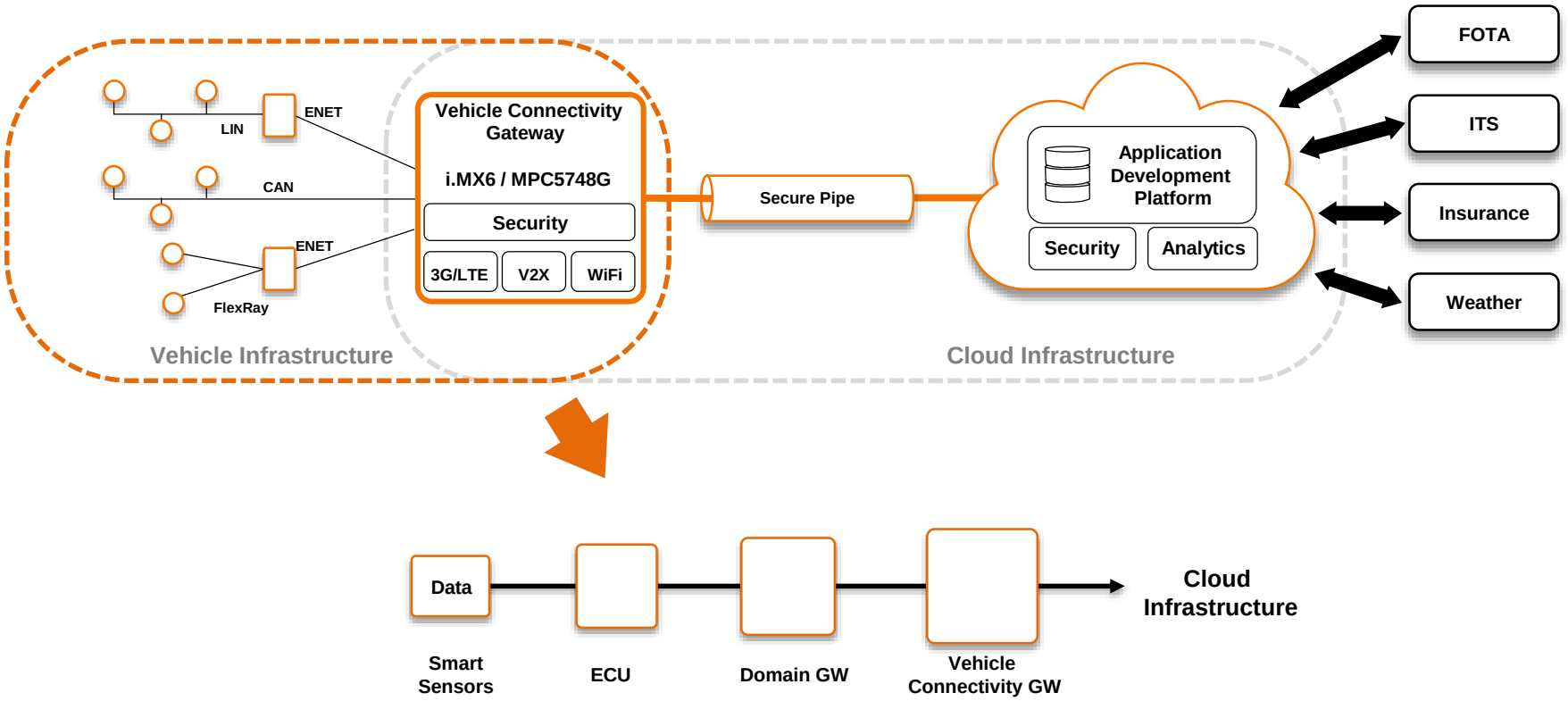
Ecosystem Considerations



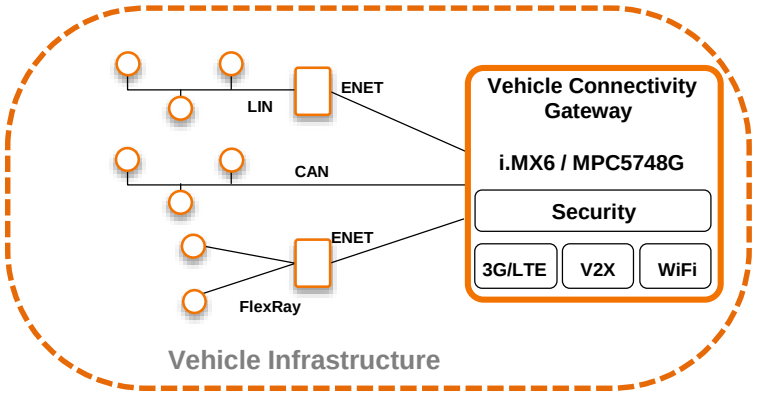
Moving data into the IoT

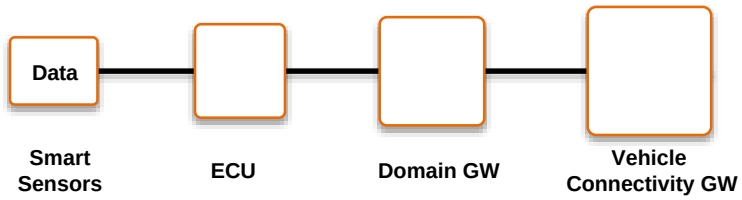
Moving data into the IoT

- Which node is responsible for managing IoT data?



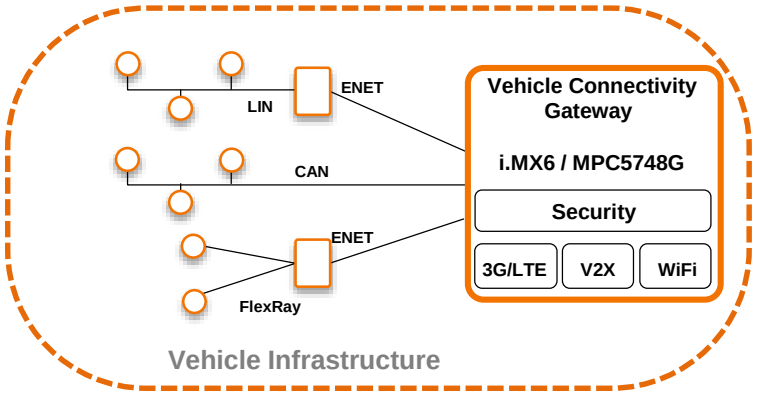
Who's responsible for IoT Data

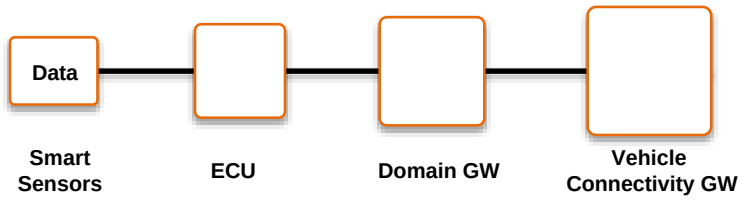




- Why is this important?
  - That node onwards has to consider the transport externally / into the cloud.
  - E.g. Web/IoT based protocols
- Security at that node
  - Decides what data is shared
  - Validates the data & commands received from external world

Who's responsible for IoT Data

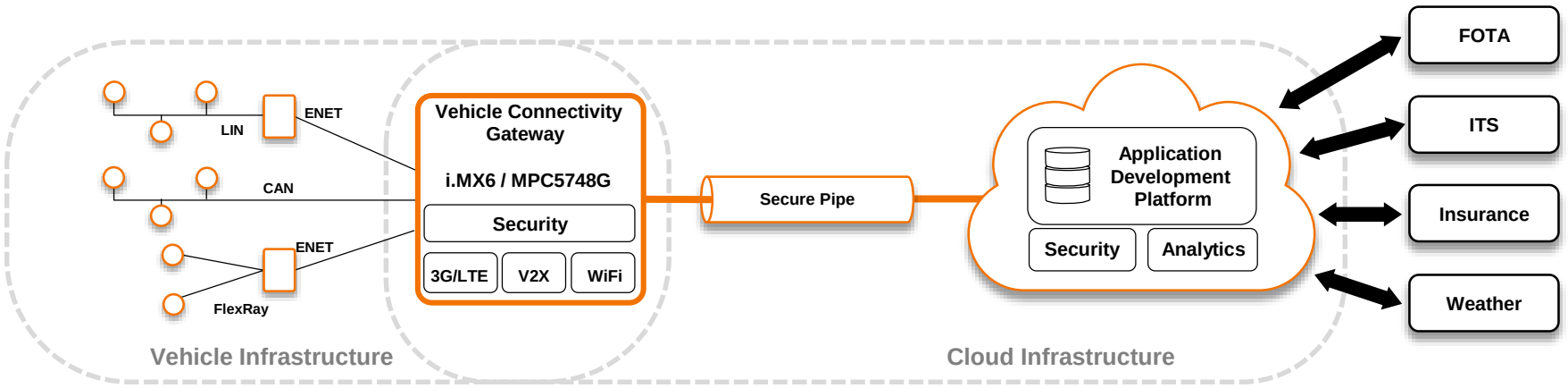




- Application specific ECU vs Gateway
  - ECU: Knowledge of data, scales poorly
  - GW: Centralised, scales well
- Change in which data has value
  - E.g. OBDII data vs IoT
  - IoT: Not just about repairing vehicles
  - Wiper speed setting → rate of rainfall

The cost of data

- Mobile data doesn't come for free…



Example:

IoT Data	Sensor Data	App Header	Security Header	TCP / IPv6 Header	LTE L2 Headers	Total Frame Size	Update Period	Data per Month (2hrs/day)
Wiper Speed Setting	1 byte	6 bytes (MQTT)	~30 bytes (TLS)	4 bytes (ROHC Compressed)	~40 bytes	**~81 bytes**	**5 sec**	**3.5 MB**
Front facing camera image	50 Kbytes	~400 bytes (HTTP)	~30 bytes (TLS)	4 bytes (ROHC Compressed)	~40 bytes	**~51 kB**	**5 sec**	**2.2 GB**
Automated Drive Packet	1 Kbytes	6 bytes (MQTT)	~30 bytes (TLS)	4 bytes (ROHC Compressed)	~40 bytes	**~1 kB**	**500ms**	**4.3 GB**

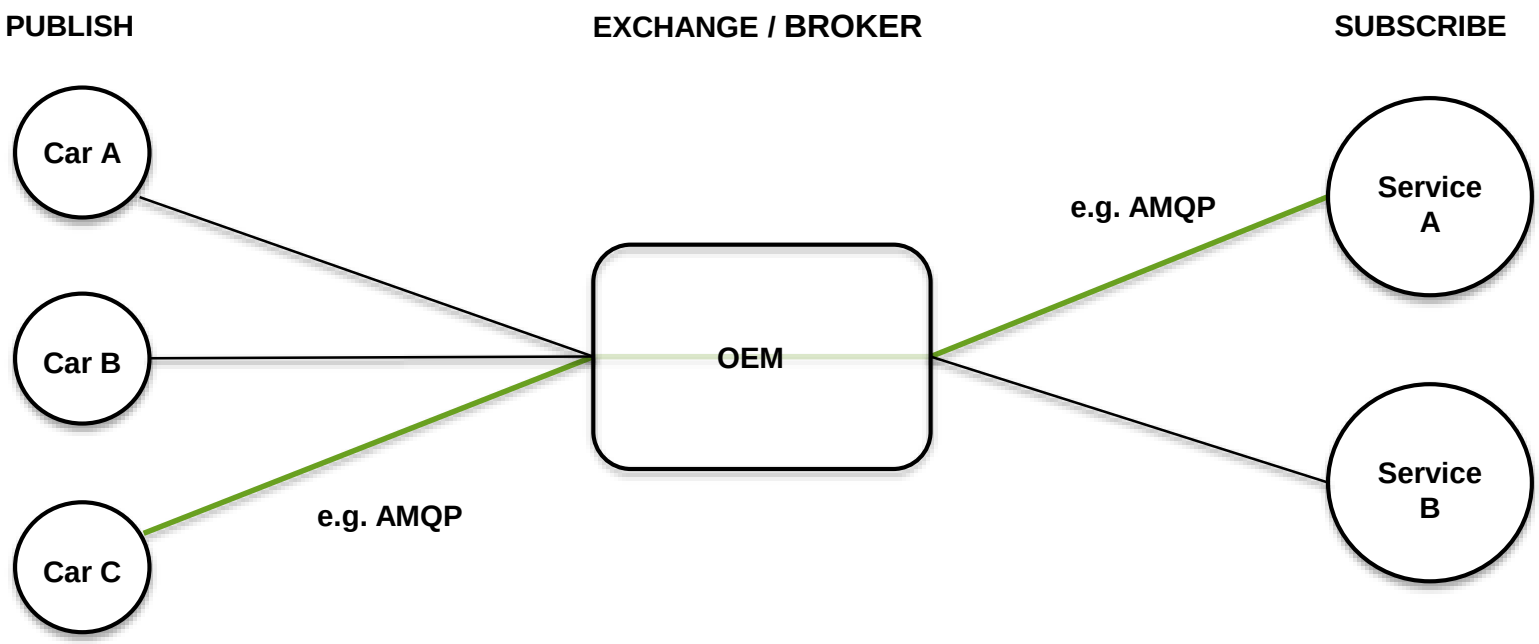
Importance of: Protocol Header, Data Aggregation & Event driven data

IoT Protocols

- Internet of Things
  - Embedded devices, not people
- Emerging IoT protocols more suited to devices
  - Small data packets

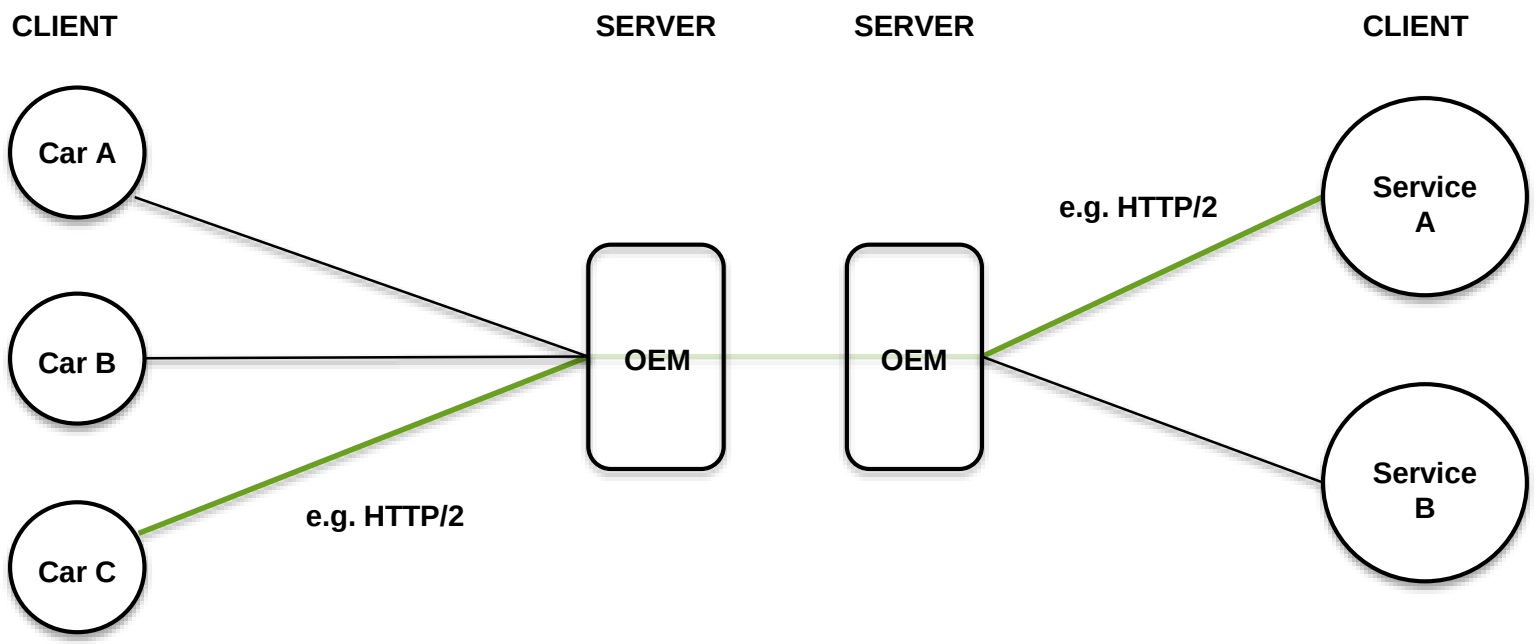
Protocol	Salient Points
HTTP/2	- Re-use existing internet infrastructure (HTTP1.1, REST) - ~10X reduction in header size vs HTTP1.1 (40 bytes vs 400 bytes)
MQTT	- Small header size (6 bytes) - Publish / Subscribe model
AMQP	- Publish / Subscribe model - More enterprise orientated than MQTT (e.g. banking sector)

Publish / Subscribe Model



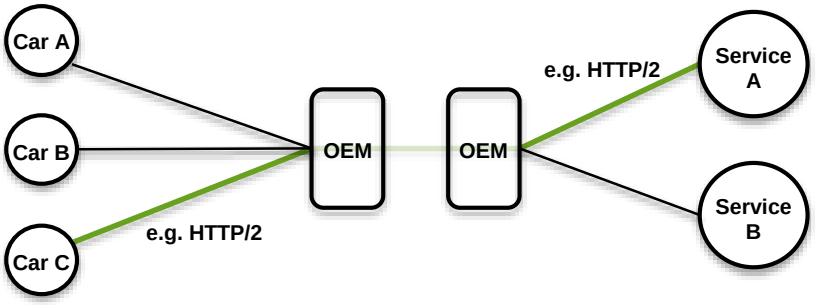
Two related exchanges, automatically connected & triggered by broker

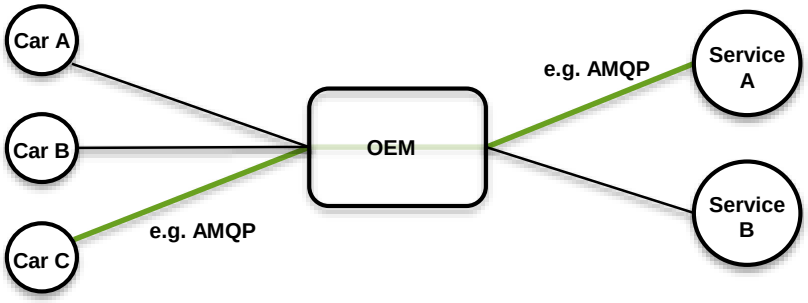
Client / Server Model



Two isolated exchanges, with separation & control between them

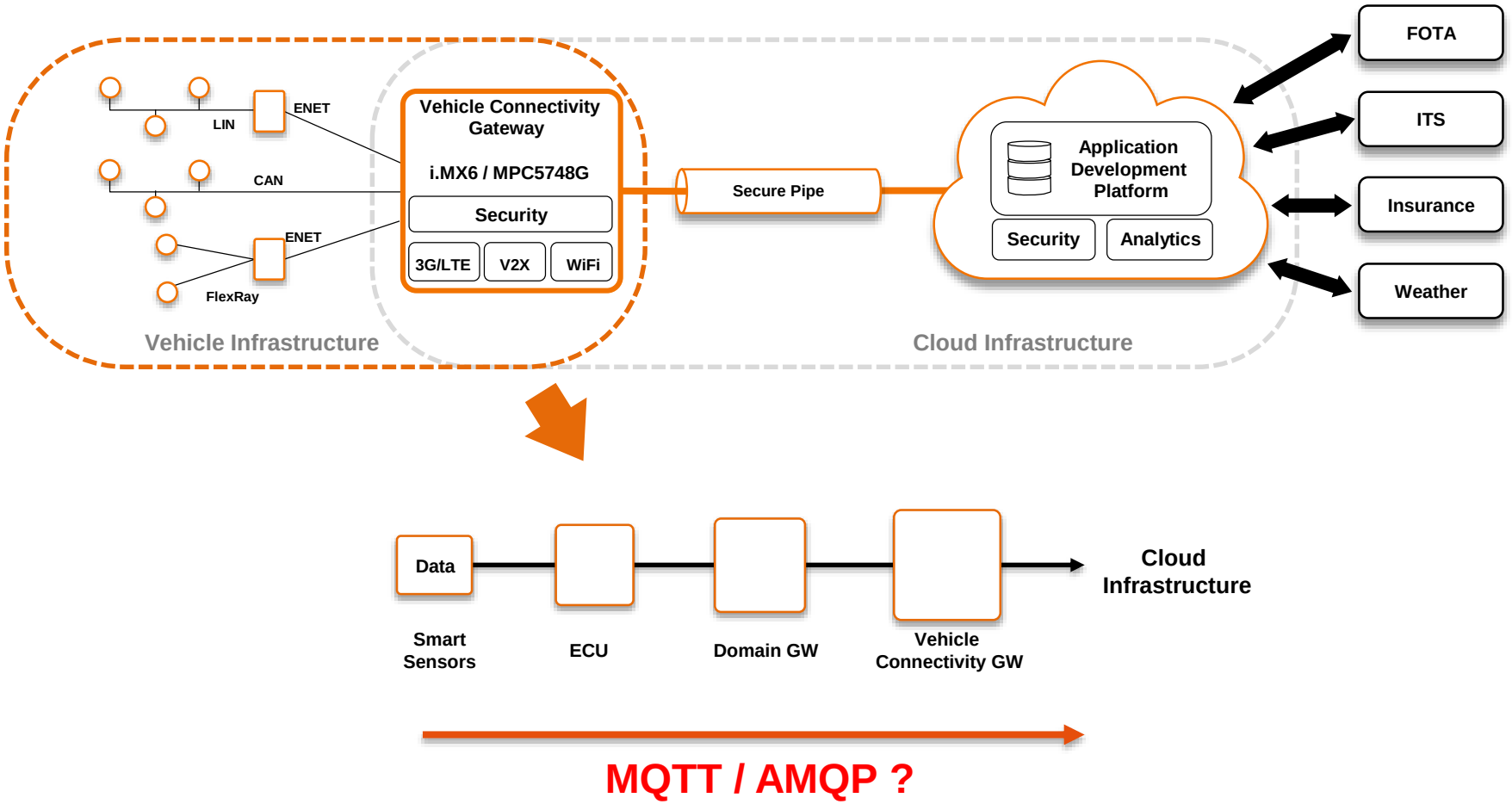
One opinion…



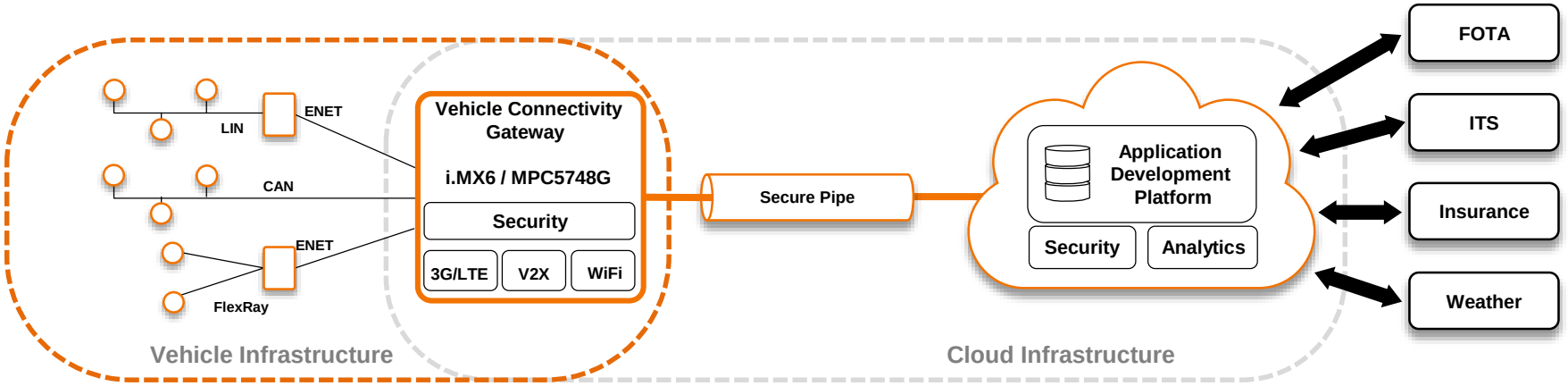


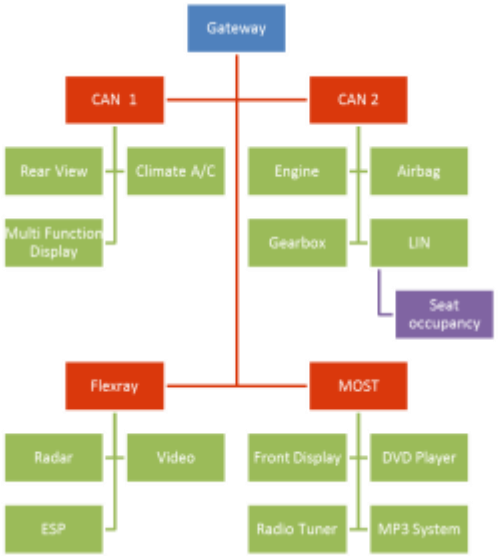
- Client / Server is in keeping with existing vehicle connectivity
  - i.e. Video, Audio, Web
- Small # of IoT Data & Nodes
  - Client / Server model
  - Few services to bind
  - Complexity of scaling up?
- Large # of IoT Data & Nodes
  - Publish / Subscribe model
  - Automated publishing to services
  - Focus on Security & Access Control

So…End-to-End IoT Protocols then?

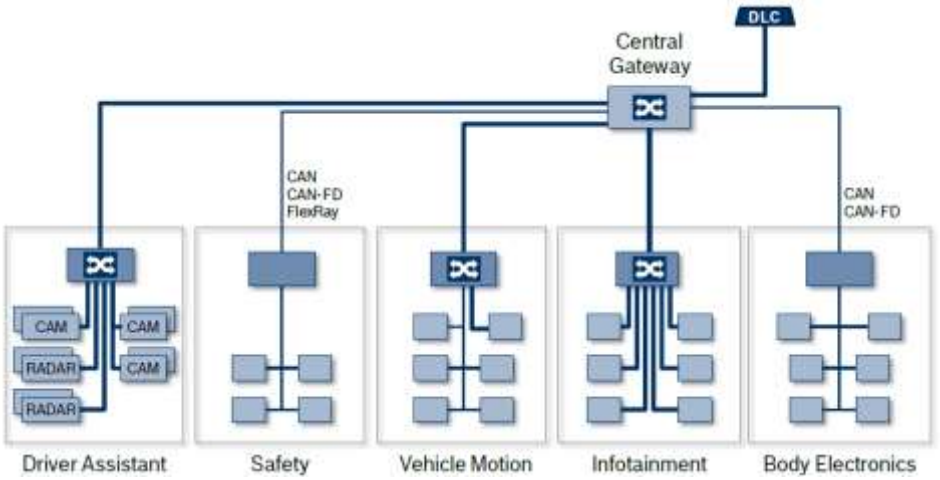


Vehicle Network Topology





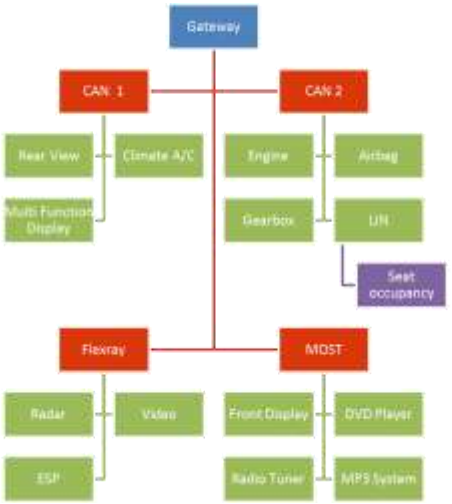
[1]



[2]

[1] Source: Vehicular Networking, Christoph Sommer
[2] Source: Bosch, 1TPCE WG

Vehicle Network Topology



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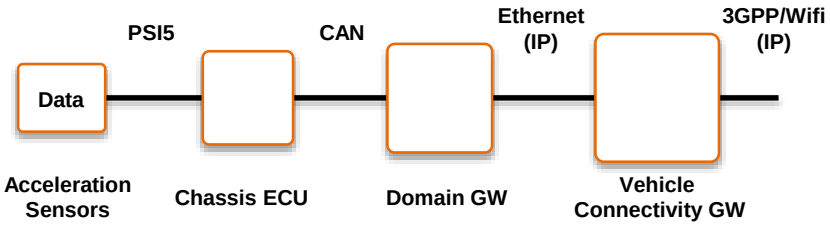
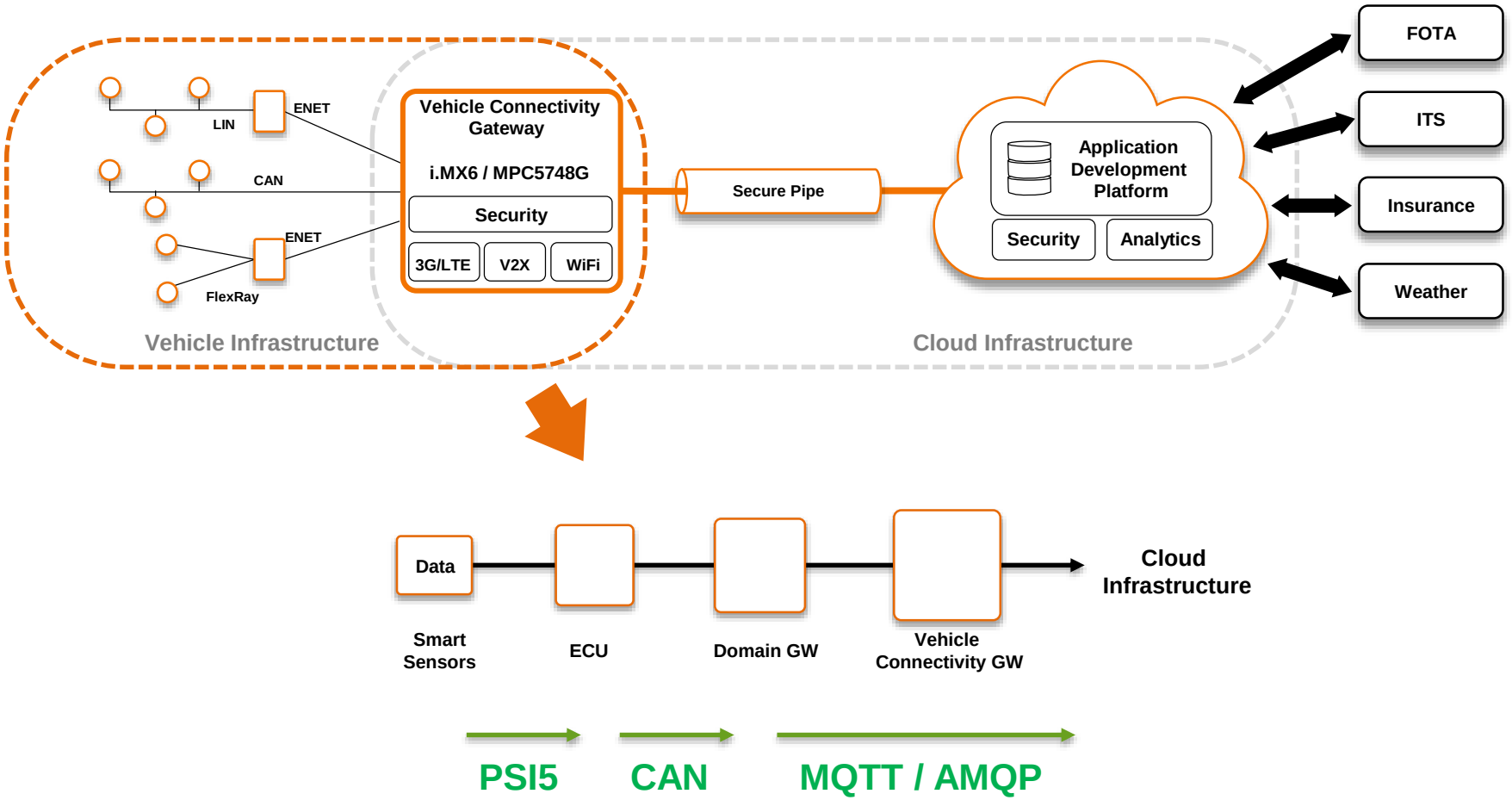


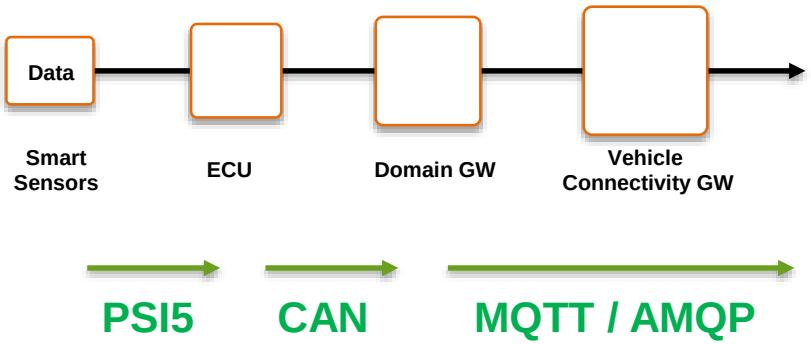
- **Many different electrical architectures**
- Many comms protocols between end nodes and external world
  - CAN, CAN-FD, Ethernet, MOST, FlexRay, LIN, SENT, PSI5, I2C, I2S, MSC, SPI, CSI-2, …
- No single unified transport layer used in the vehicle today
  - Gateway nodes are important for IoT data
  - IoT transport layers use layer 3 IP

[1] Source: Vehicular Networking, Christoph Sommer

End-to-End IoT Protocols?

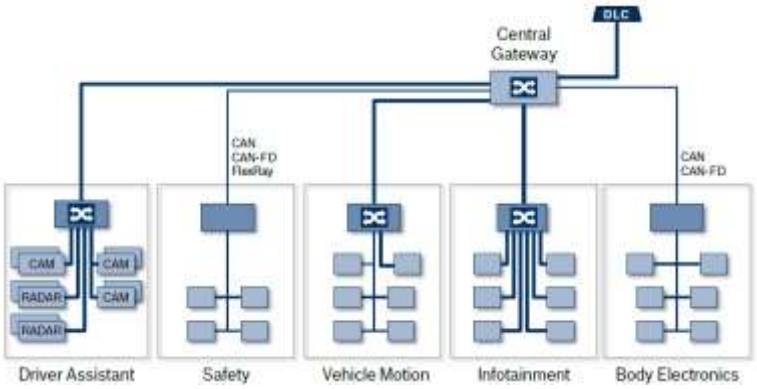


Why not?



- IoT protocols use IP at Layer 3
  - IP down to the sensor would be better
  - Ethernet making steps here
- …but not hard real-time & expensive (today)
- Gateway functionality is needed in Auto IoT
- …but are potential weak points
  - Need strong security
  - ‘Hacking’ internal GW is more physically intrusive vs OTA

Rise of Automotive Ethernet

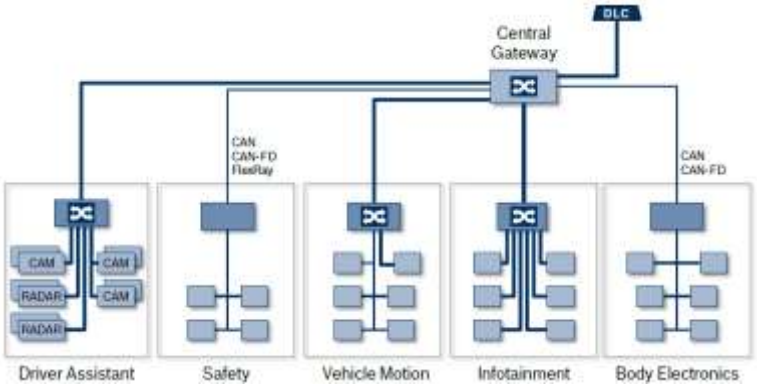


[1]

- Automotive friendly Ethernet
  - OPEN Alliance
  - Robust PHY:
    - BroadR-Reach, IEEE 1TPCE
- Audio Video Bridging (AVB)
  - Time synchronised streaming
  - Replacing MOST for Audio / Video streaming in vehicle
- Time Sensitive Networking (TSN)
  - Next-gen AVB
  - Expanding # of data transports (1722a)
  - Real-time control data

[1] Source: Bosch, 1TPCE WG

Automotive Ethernet & IoT



[1]

- Relevance to Auto IoT?
- Changing Vehicle Architectures
  - Taking advantages of Ethernet
- Migration towards higher performance centralised processing
  - E.g. Sensor Fusion
  - High speed, deterministic links between centralised nodes
- TCP/IP becomes more affordable
- Gets closer to end-to-end solution

  ...but, some time away

[1] Source: Bosch, 1TPCE WG

Big Data & Analytics

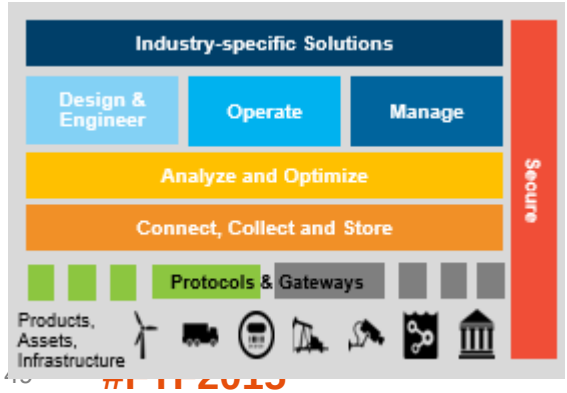
What is Big Data

Data has four dimensions namely volume, velocity, variety and veracity in the era of big data.
Our architecture is designed to handle this diversity of data by layered stages of data processing and scalable technologies embedded in the architecture.

Velocity	Variety	Volume	Veracity
Stream processing and in-memory DB enables real time processing of data.	Stream processing and ETL capability can normalize variety of data format.	Scalable technologies (e.g., distributed file system) enables to handle vast amount of data.	Analytics solutions are robust to veracity such as uncertainty and inconsistency of data

Ready for Big Data

IoT Automotive Platform



What is Analytics

IBM has full coverage for analytics not only by technologies but also expertise to monetize big data by analytics.

Unstructured Data

Structured Data

+

Future

Current

Past

- Cognitive
- Statistical Optimization
- Optimization
- Predictive Model
- Simulation
- Prediction
- Alert
- Query/Drilldown
- Ad-hoc Reporting
- Standard Reporting

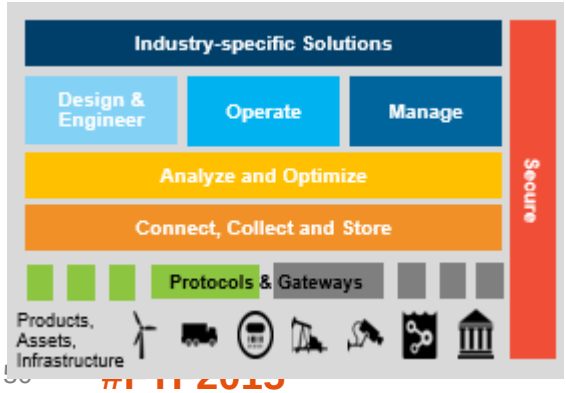
Analysis to provide action (**Prescriptive**)

Analysis to provide prediction (**Predictive**)

Analysis to provide cause **(Descriptive)**

Ready for Analytics

IoT Automotive Platform



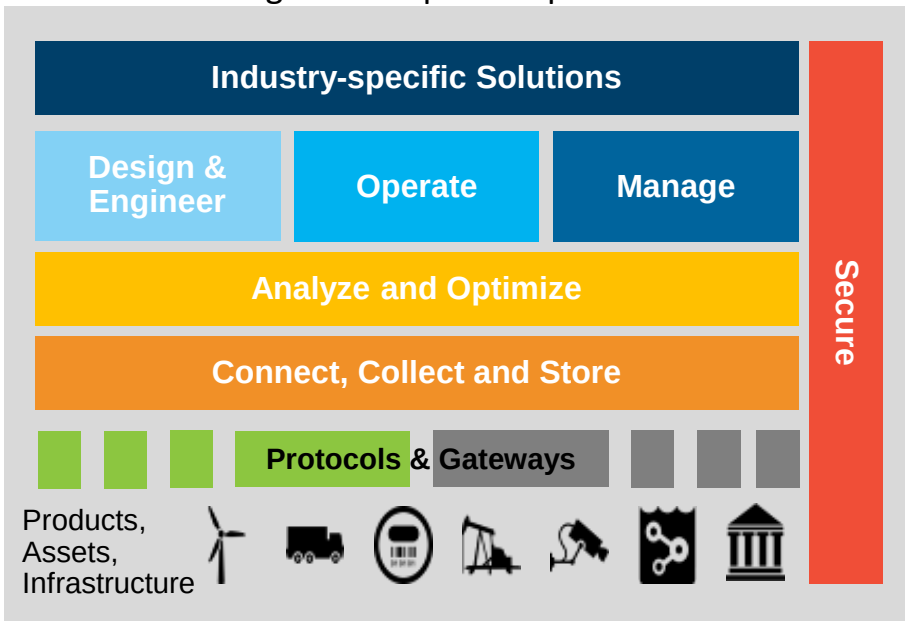
IoT Automotive Platform

Intelligent & Industry Applications

Understand automotive formats & standards, industry analytics services
Provide OOB value add applications, Integration to provide platform

Operate
infrastructure safely and securely from rollout to production

Design and Engineer
things and applications addressing requirements management and complex system design processes



Manage
the lifecycle of things ensuring safe, reliable and predictive operations

Secure
intelligence and action is critical from the thing up through industry solutions

Connect, Collect and Store
information from a range of things with range of volume, variety and velocity

Analyze & Optimize
information from across the lifecycle leveraging insight for action

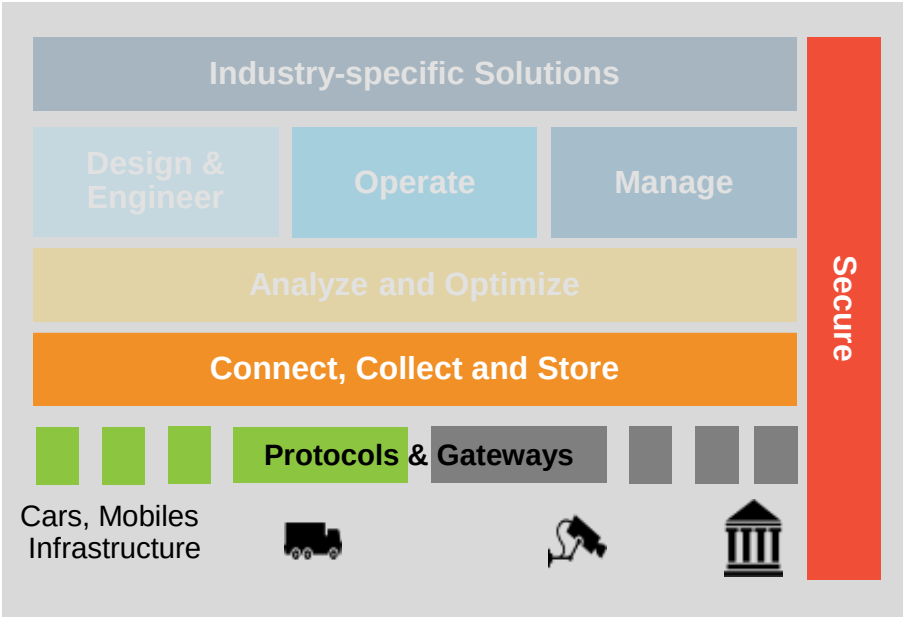
IoT Automotive Platform
Vehicle & Data Gateway

Vehicle Data Gateway
(Internet of Things Foundation / MessageSight)

Connecting – and Registering the connected “things”

Collecting –and managing a time series view of data

Commanding – applications that directly interact with connected “things”



API Management
- Secure gateway
- Promote internal code re-use
- Externalise APIs for monetization/drive new services
- Control over internal and external API use

File Transfer
(Aspera)

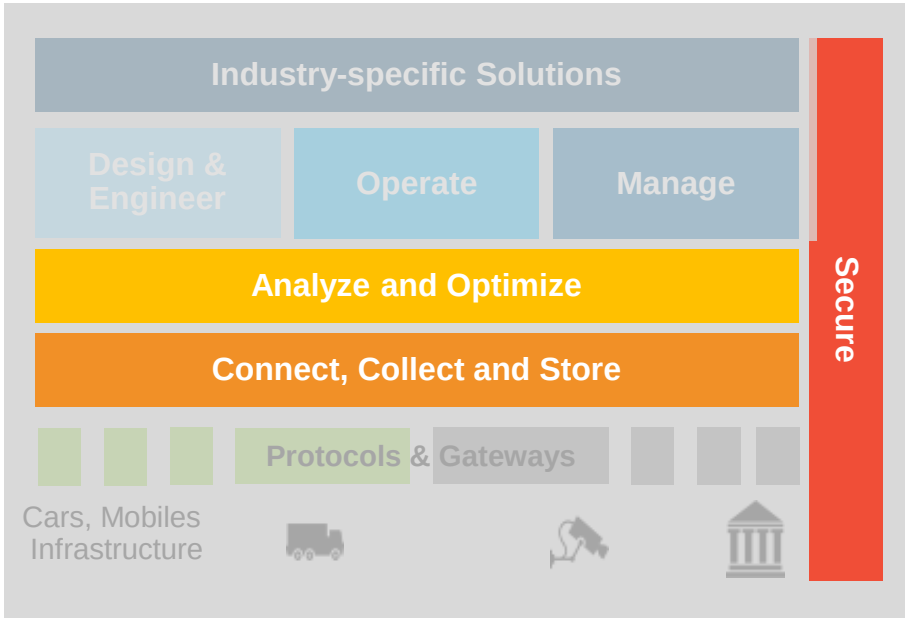
IoT Automotive Platform
Near Real-Time & Big Data Analytics

*** IBM Spark announcement: 3500 IBM Researchers, educate 1million data scientists in Spark**

Stream Computing

Processing analytics of real-time data in motion

(InfoSphere Streams, Apache Spark)



Predictive Analytics

Unlocking the insights in big data

(SPSS)

Reporting

Extracting the insights in big data

(Cognos)

Data Warehouse

Simplifying the warehouse to reduce skills needed and operating costs. (DB2)

Hadoop System

Storing structured and unstructured granular data for new types of analysis

(Big Insights)

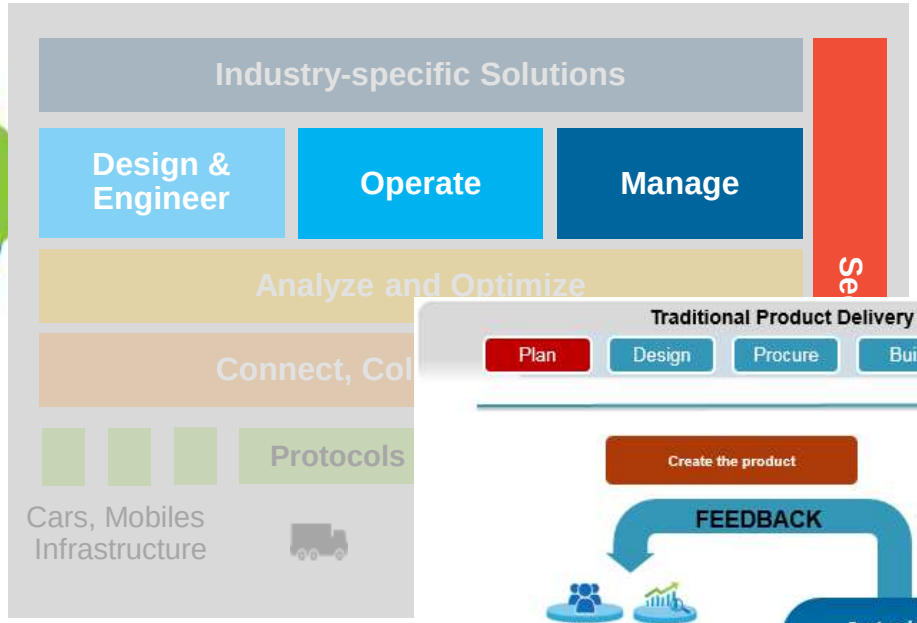
freescale

IoT Automotive Platform

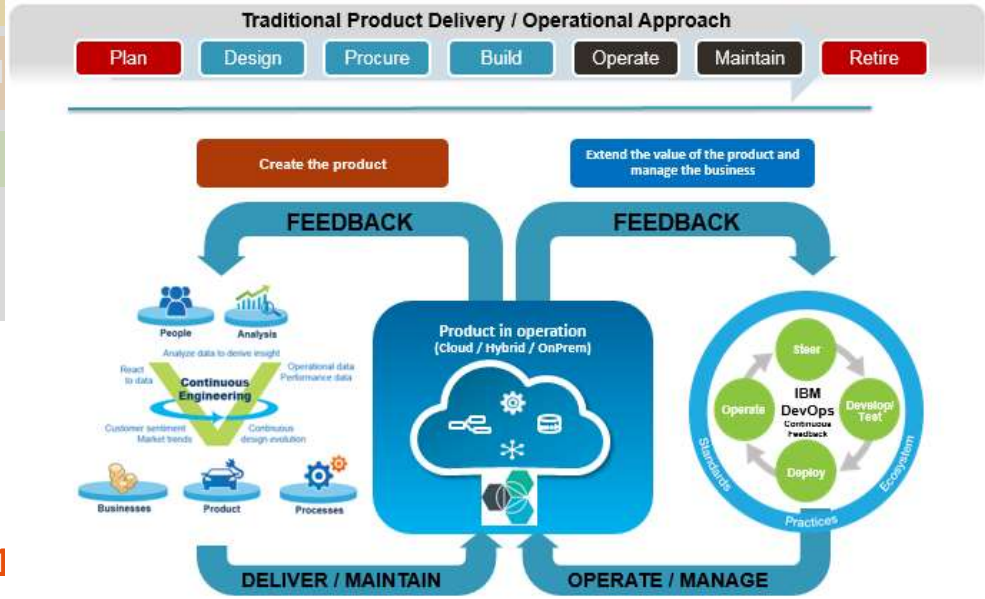
Software Development

Smarter Product development for embedded, enterprise, cloud software

(DevOps Service
JazzHub
Rational Rhapsody)



Agility is Strategic:
Closing the Loop on Internet of Things solutions
(Doors
Rational Requirements Composer)



Manage assets at scale
- Vehicle/Driver Registration
- Map Management (Maximo)

IoT Automotive Platform
Industry-specific Solutions

Connected Vehicle Applications & Services

Smarter Solutions to industry problems
Building on core platform with industry understanding and focussed analytics

IoT Automotive Analytics Enabling Services Innovations

Intelligent Fleet Mgmt & Traffic Optimization	Vehicle Product Engineering & Service Optimization	Predictive Maintenance
V2X Safety Services	Personalized Infotainment & Commerce Services	Highly Automated Driving

Industry-specific Analytics Solutions

Automotive APIs | Vehicle standards (SAE,BSM, ETSI, CAM/DEMN..) | Complex Rules Interface

Big Data from Connected Vehicles

Vehicle GPS/Position Data
- Max Freq: 1 HZ (update every second)
- Min Freq: update every 10s
- Support the resending when communication is recovered
- …

Driver and vehicle information
- Driver driving start time and end time
- Vehicle type and configuration
- …

Vehicle Probe & OBD Information
- RPM, Fuel Consumption , Temperature
- **SAE BSM, ETSI CAM/DEMN …**

Driving Record
- Braking, Image, Video…

External Data
- Map, Weather Monitoring & Forecast, Traffic Info

Big Data Analytics: Deep analytics upon streaming data

Discover Insights from Data

Driver
- Driving Behavior
- Mobility Pattern
- Service Usage Pattern

Fleet
- Business Performance
- Regular Route
- Operation Efficiency

Vehicle
- Diagnosis
- Condition& Status
- Maintenance plan

Highly Accurate Map
- Road Condition
- Terrain
- Traffic
- Weather …

2015

Mobility Footprint Profiling

- Modeling individual & group behaviors with privacy considerations

Individual Mobility Pattern Analytics

Meet Jim – a **Homeworker**

- Intensive driving everyday, kids to school
- Very limited area

POI map view

Calendar view

Meet Amy – a **Commuter**

-Home to/from office in working hours

-Leisure & shopping at weekend

Group Mobility Pattern Analytics

Based on the individual mobility patterns, the customers can be further analyzed for fine-grained segmentation

- What are these customers' tags (e.g., lifestyles, driving habits, etc.)?
- What are the frequencies & probabilities that they pass by specific zones or types of zones?
- Are any of them good candidates of a new marketing campaign?

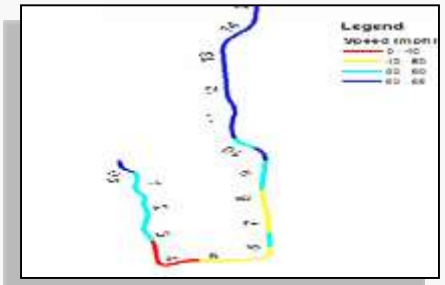
Spatiotemporal Driving Behavior Analysis UBI

Driver Behavior With Context

driver behavior context
driver behavior context
driver behavior context
driver behavior context

Driver Statistic Profiling

- Driving distance , trip times, average mileage / trip and etc
- Context (weather, route attributes, etc.) aware driving behavior (hard breaks, acceleration, speeding, idle and etc)

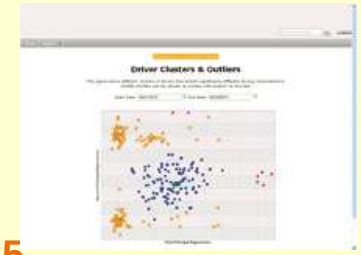


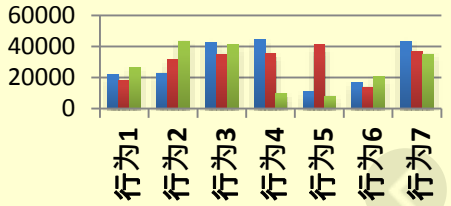
Driver Comparison and Scoring

- Context aware comparison and scoring across multiple drivers
- Outlier driver detection

Driver Pattern by Behavior

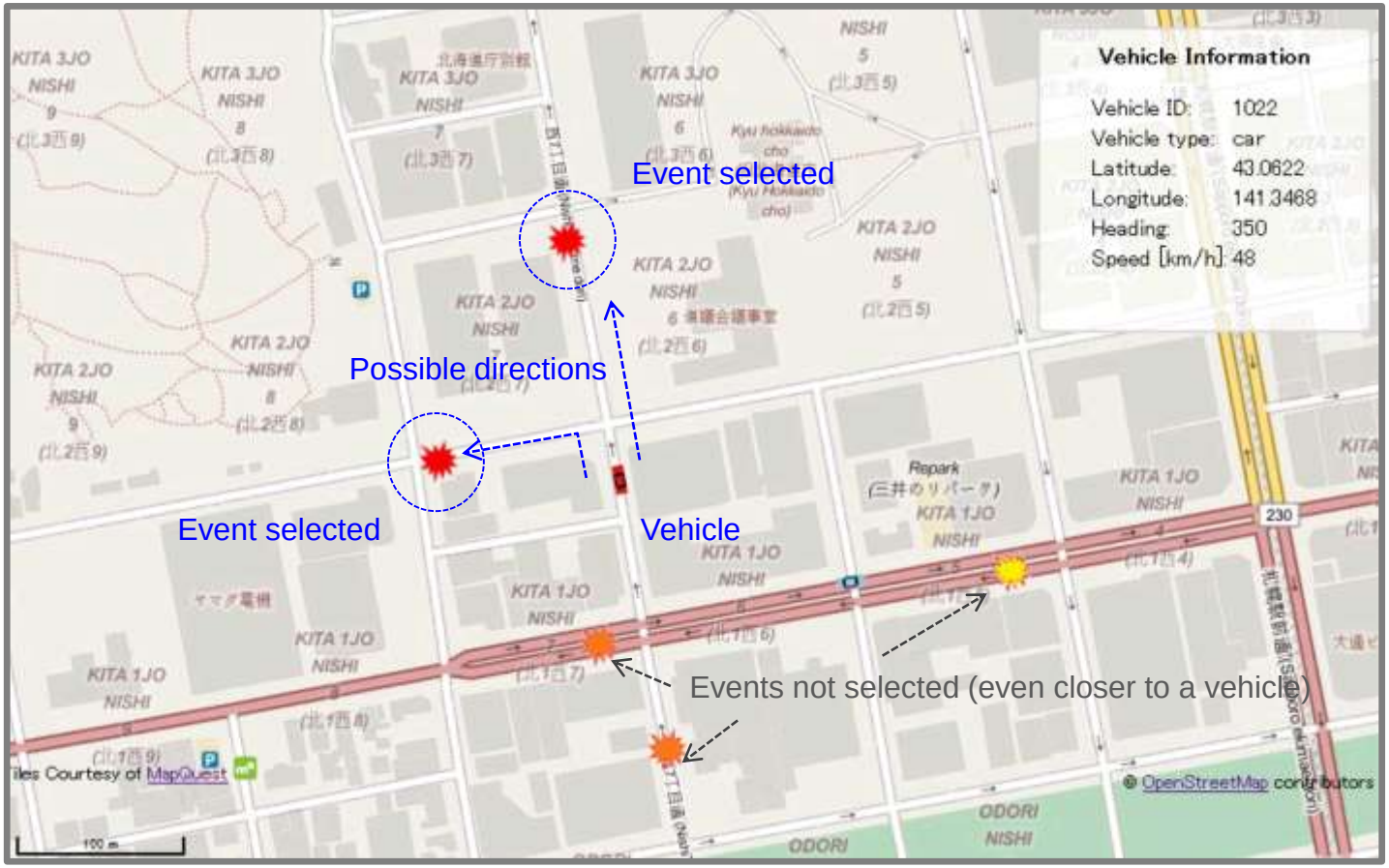
- Driver pattern analysis and segmentation by relative behavior profiling / scoring results





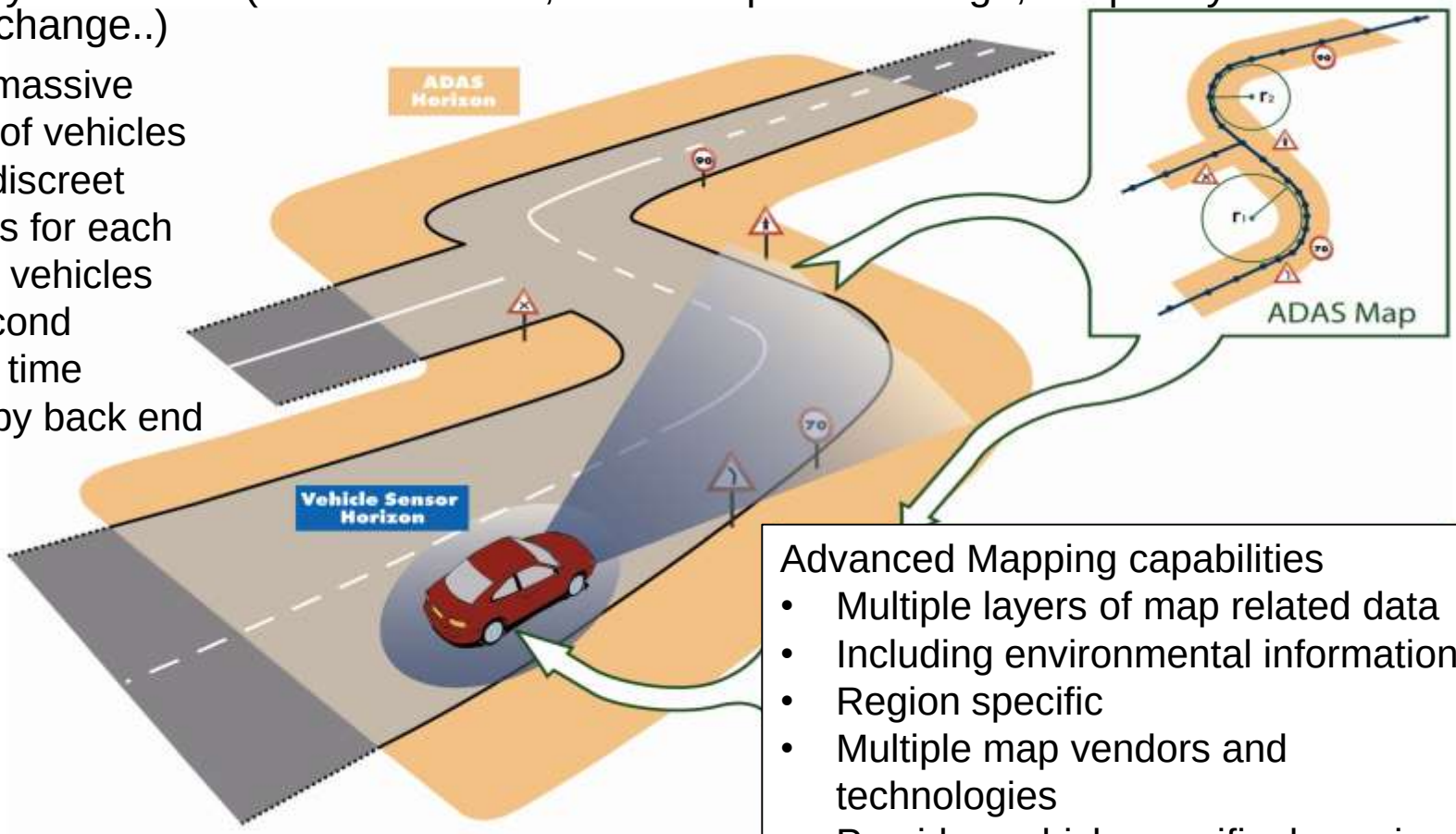
Topology Aware Alerting

- Notify events based on the road network, i.e., relevant events on traveling direction are selected.



Autonomous Vehicle (Advanced Driver Assistance) Support

- Change ADAS pre-setting based on possible paths and geometry data
- Include dynamic data (road conditions, variable speed limit sign, temporary road network change..)
- Scale to massive numbers of vehicles
- Perform discreet operations for each individual vehicles
- Micro-second response time required by back end platform



Advanced Mapping capabilities
- Multiple layers of map related data
- Including environmental information
- Region specific
- Multiple map vendors and technologies
- Provides vehicle specific dynamic maps

Continental Corp developing Cloud-enabled data platform to provide greater visibility and safety

Smarter, connected cars made with **Continental Corp.**

Challenge

Smart Mobility

Today's drivers expect their vehicles to deliver the same features as other mobile devices—that is, to act as the mobile extensions of their connected lives. Networked mobility will empower drivers by linking the next generation of vehicles to the internet of things.

Solution

Anticipating Road Hazards

Continental Corp. is developing a cloud—enabled data platform to enhance vehicles' anticipatory capabilities, using onboard sensors and crowdsourced vehicular data to predict traffic conditions.

Result

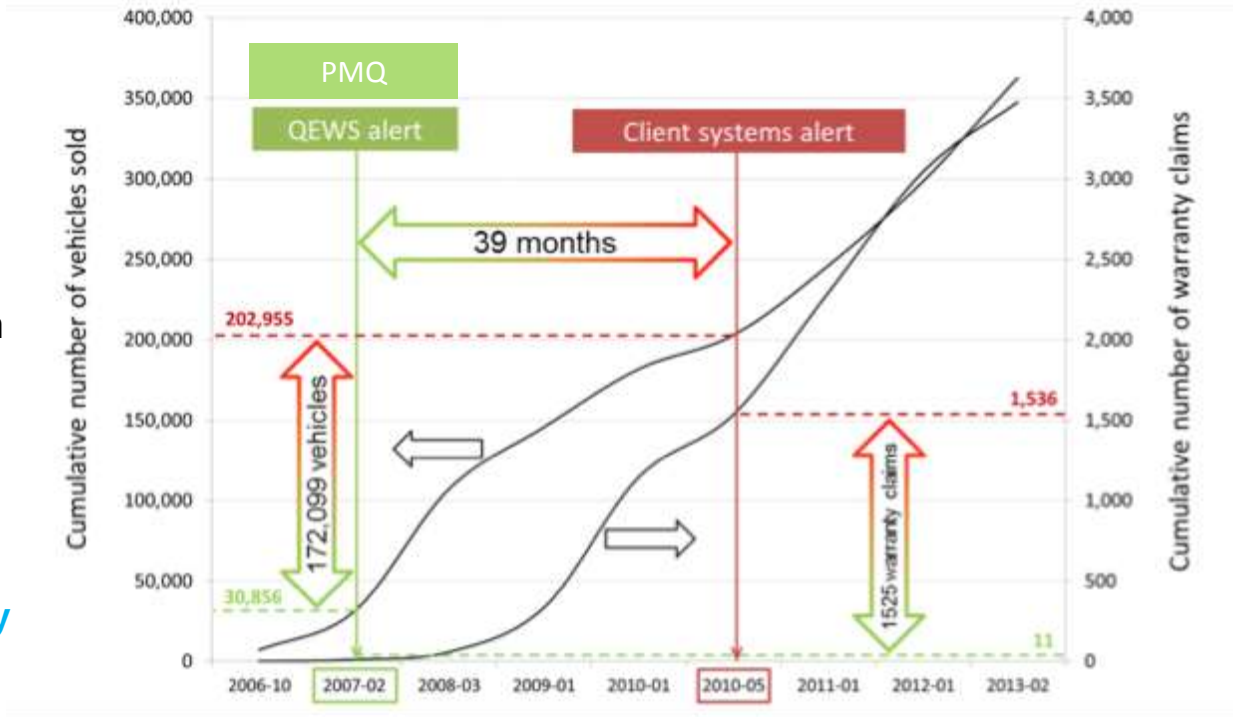
Greater Visibility & Safety

The platform effectively extends “visibility” beyond what drivers can physically see, potentially making mobility smarter, safer and cleaner.

Predictive Warranty Analytics

Automotive Manufacturer asked a simple question: Does my warranty claims data suggest any proactive action?

- We used our Predictive Maintenance & Quality (PMQ) offering to identify a critical warranty pattern.
- PMQ (QEWS) detected a problem in warranty claims data **39 months earlier** than the clients' existing systems.
- By the time the clients' systems detected the problem, an additional **172K vehicles** had been sold and an additional **1,536 warranty claims** had been made.



Honda R&D Co. Ltd, uses predictive analytics to improve performance and safety of its electric vehicle batteries

50% reduction

in CO2 emissions by commercializing EV technology

Boosts confidence

and customer satisfaction with EVs by improving performance

Improves design

by analyzing massive amounts of operating data

Business Challenge: Because all-electric vehicles (EVs) do not use gasoline like traditional or hybrid cars, they rely entirely on their batteries for power. Honda R&D Co., Ltd., a division of Honda Motor Co., Ltd., wanted to better understand what factors had the greatest impact on battery performance and longevity.

The Smarter Solution: Honda R&D can now gather and analyze near-real-time battery data from FIT EV on the road in Japan and the United States. Analysis can identify which operating factors, such as road conditions, charging patterns and trip length, have the greatest impact on battery life. Further analysis can help the automaker predict when batteries need replacing, so it can alert owners in advance.

"Data gathered from the real-world operation of our vehicles is critical to predict the longevity of current batteries and greatly influences future product design."
—Senior Chief Engineer, Automobile R&D Center,

Leading Automotive organizations partnering with IBM today to build eco-systems for connected vehicles

Open platform for connected vehicle

Toyota[1] and IBM are working together to build an application development platform called T-Connect. It will be used by Toyota to launch a range of telematics and cloud-based services for automotive

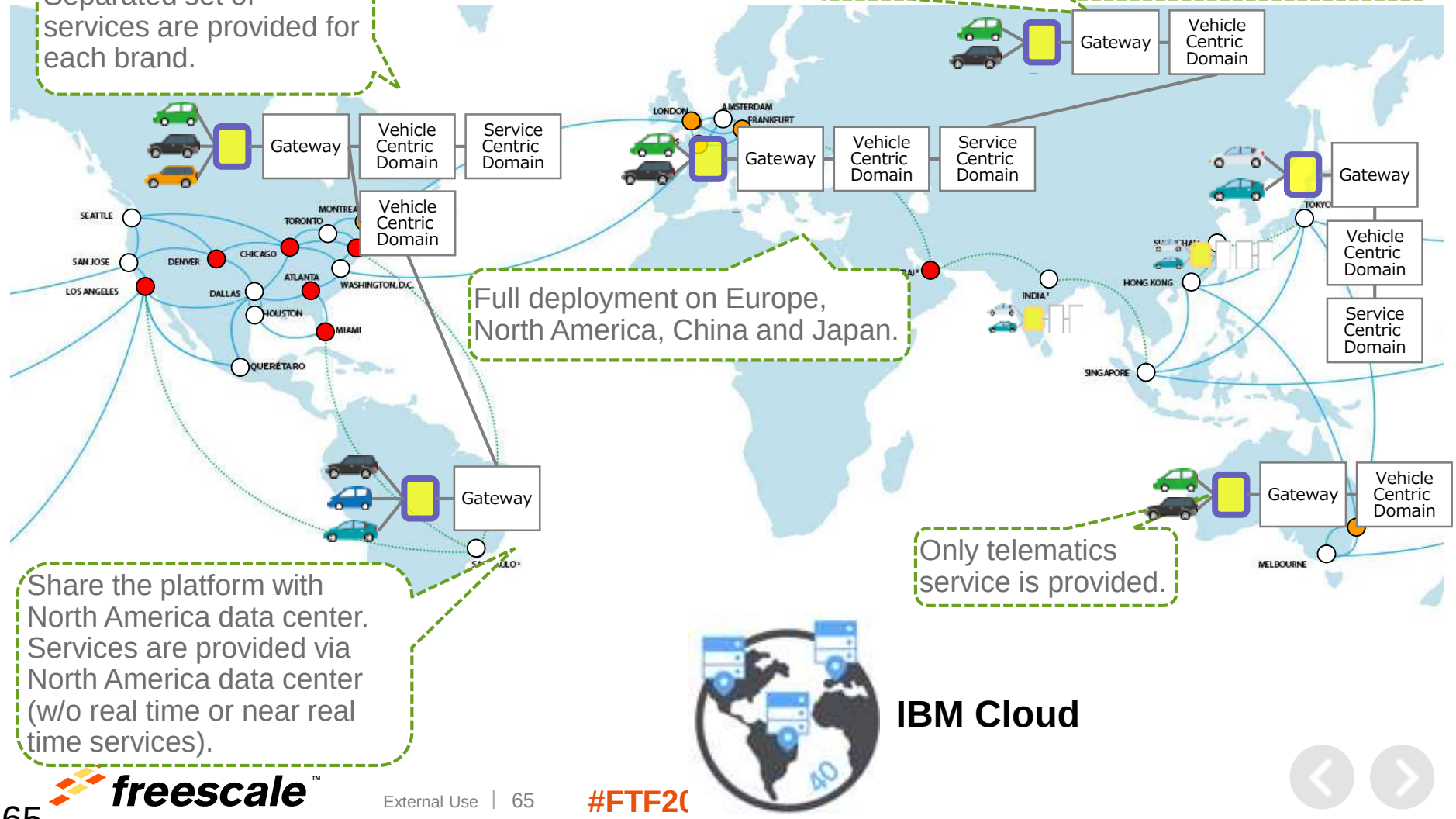
Driver and passenger services

PSA Peugeot Citroën[3] and IBM are working together to integrate the massive amounts of data from cars, phones, traffic signals, lights and other sources. Data will be analyzed in a cloud based, real-time environment to deliver essential services to both driver and passengers

Source: Please see speaker notes

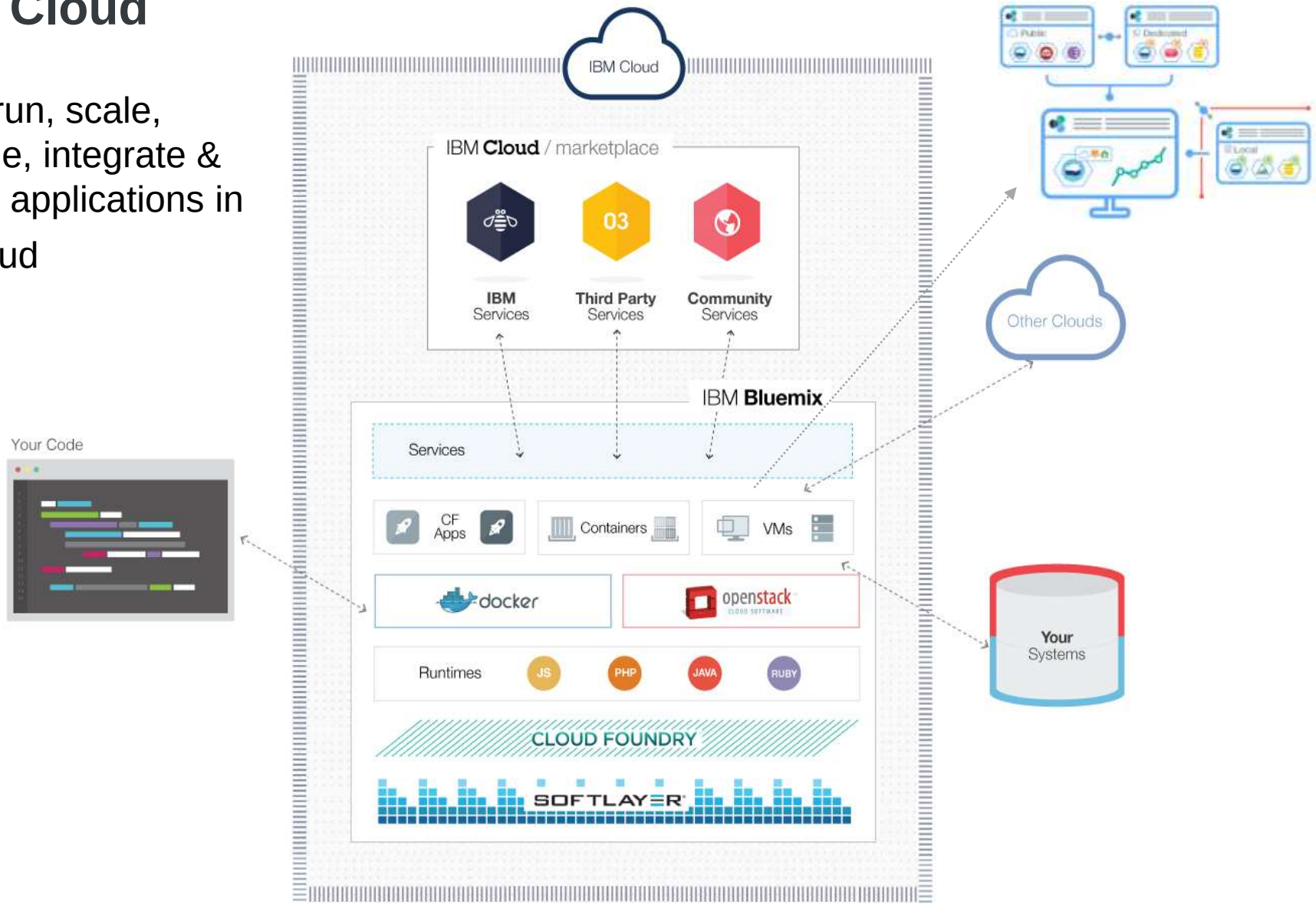
Where do you run an Automotive IoT Platform

example of a variety of deployment options.



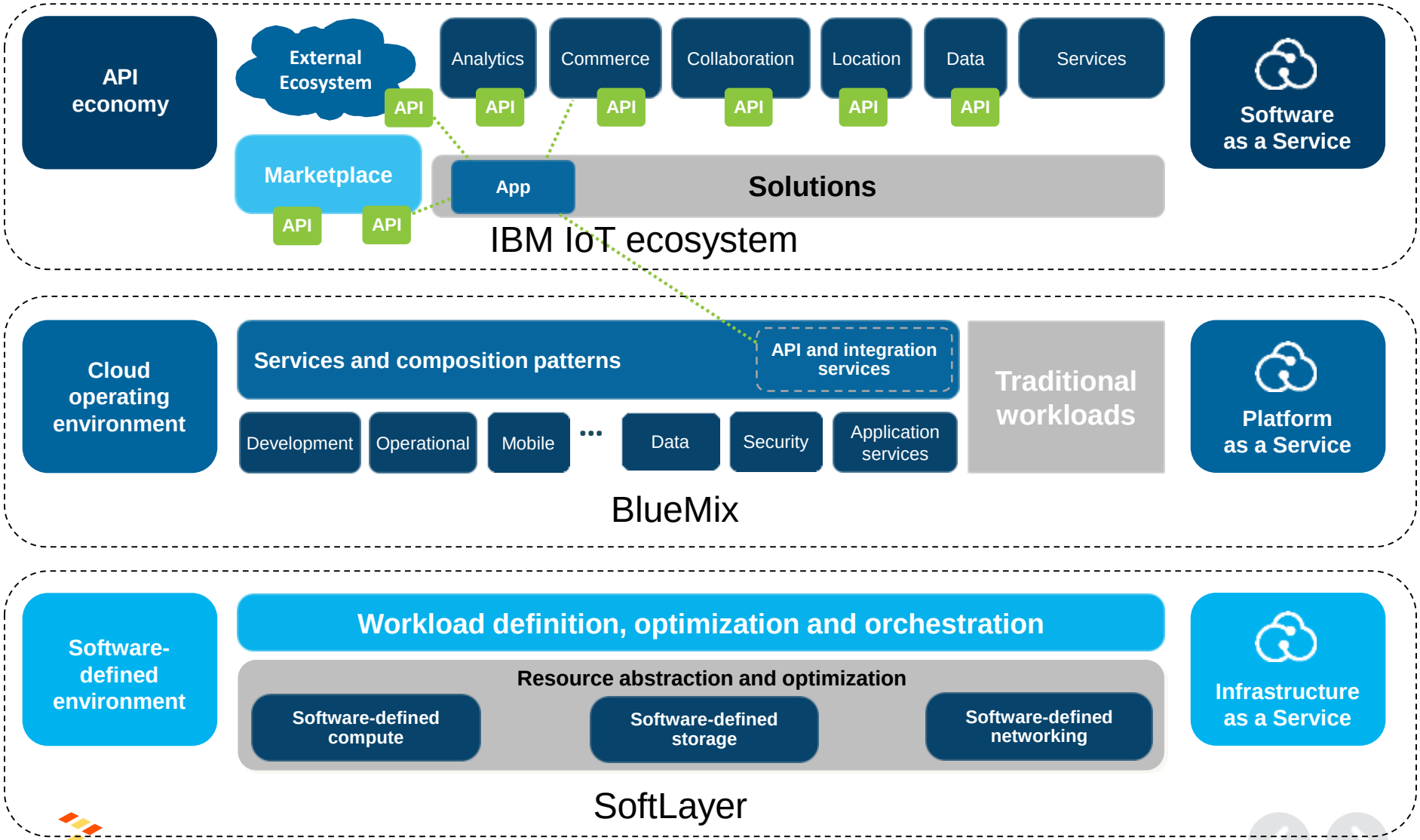
IBM Cloud

Build, run, scale, manage, integrate & secure applications in the cloud



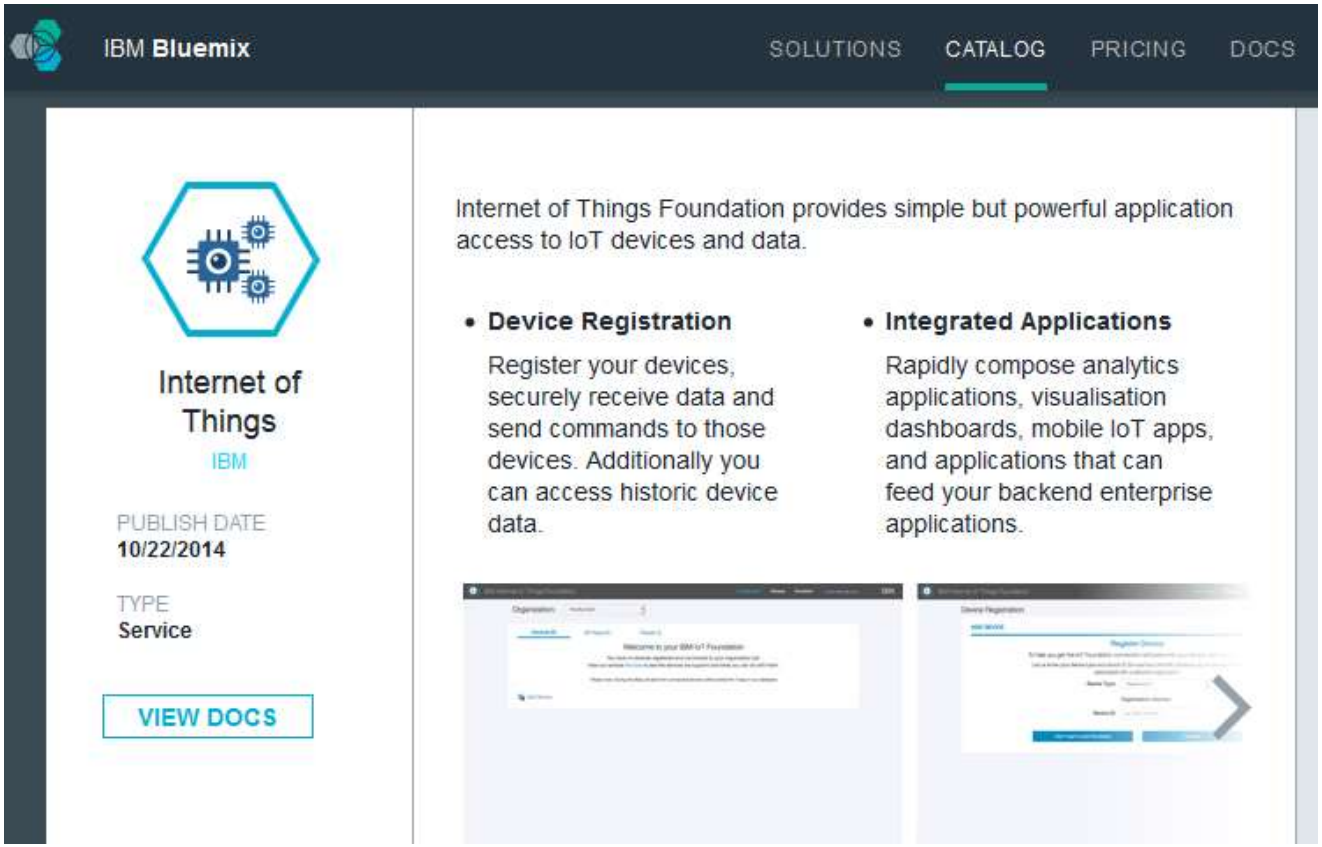
Evolution of Cloud

Typically start with packaged solutions, but evolve to compose solutions using IBM, 3rd-party, and self-written API's. Bluemix will be the IoT platform for those compositions.



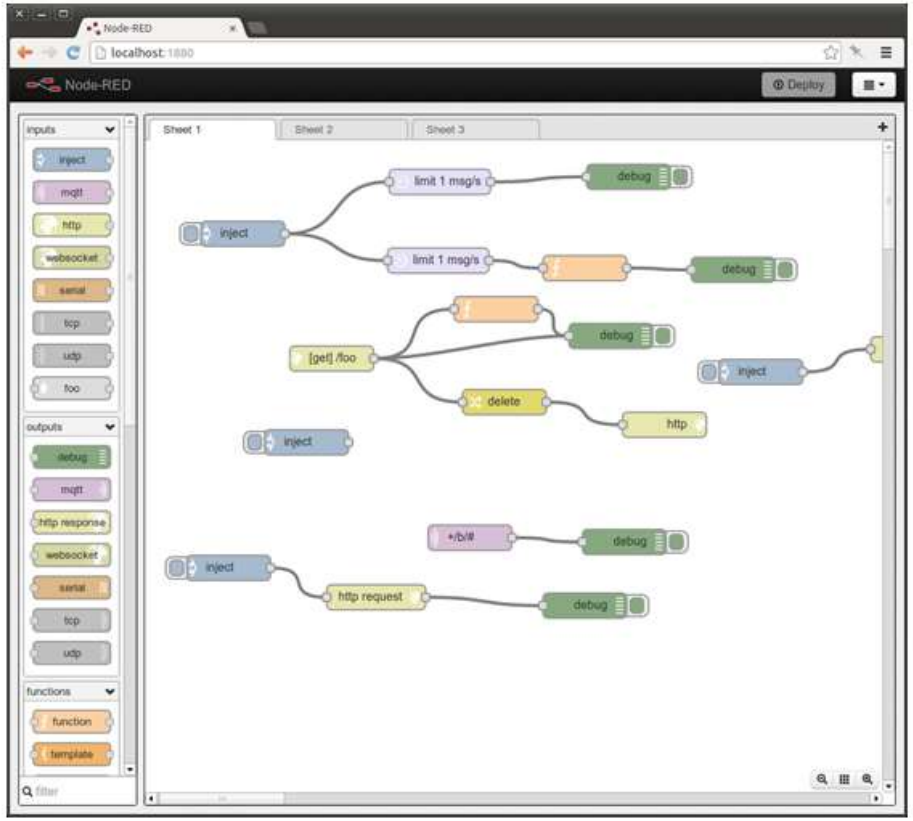
Getting Started with new Applications

- The Internet of Things Foundation is a Bluemix Service designed to make it simple to connect, assemble, manage and store internet of things devices & data

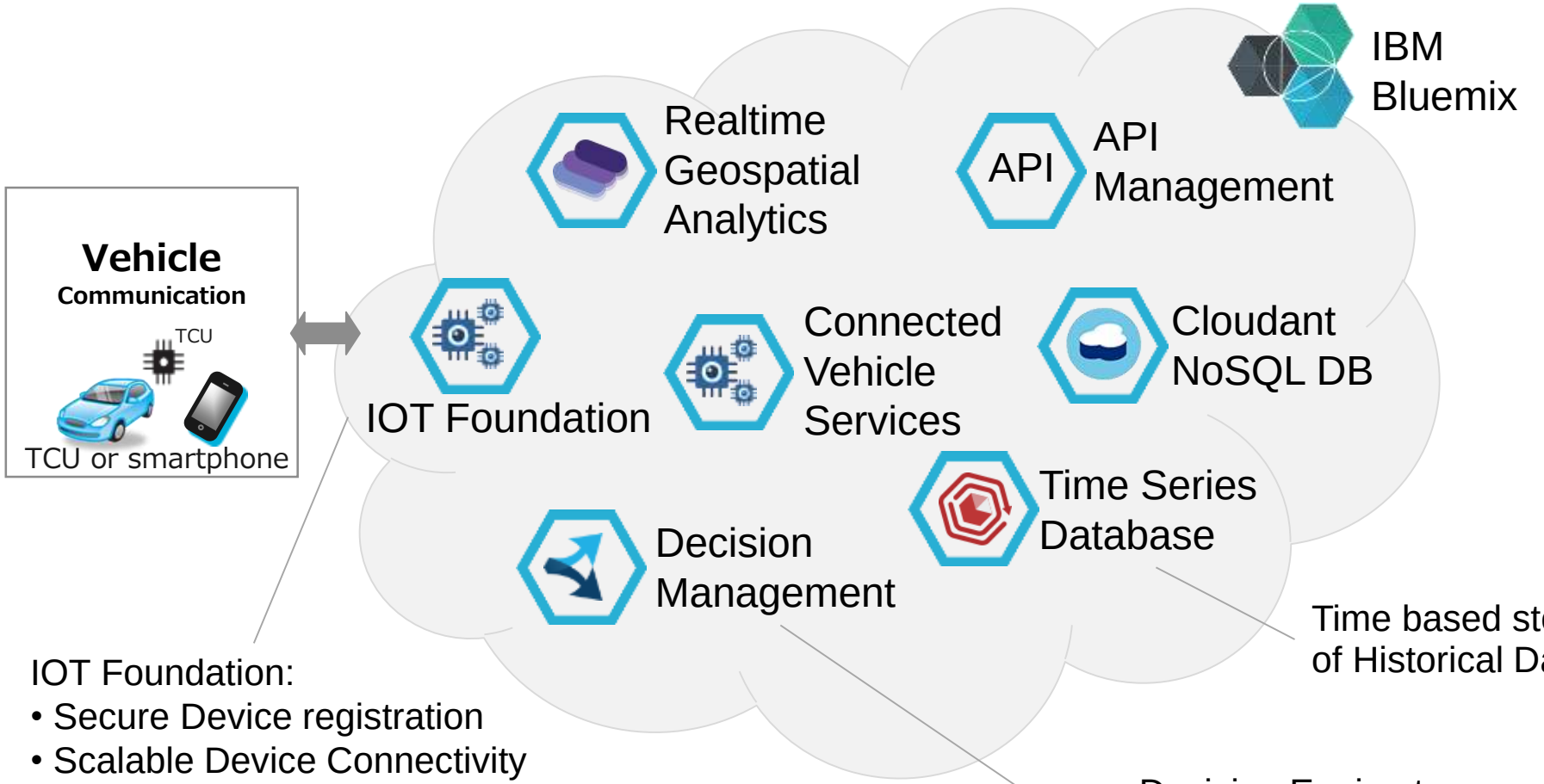


Simple wiring for IoT with Node-RED

- Node-RED makes it easy to wiring together the Internet of Things.
- It provides a browser-based UI for creating flows of events and deploying them to the runtime.
- The light-weight runtime, built in node.js, is ideal for edge-of-network environments or running in the cloud.
- It can be easily expanded to take add new nodes to the palette – taking full advantage of the node package manager (npm) ecosystem



Composable business model with Bluemix PAAS for new services



IOT Foundation:

- Secure Device registration
- Scalable Device Connectivity
- Securely receiving data and sending commands to devices
- Storage and access to historic data
- Open source MQTT based client

Goals for an IoT Automotive Platform to enable new Big Data & Analytics Services

Flexible

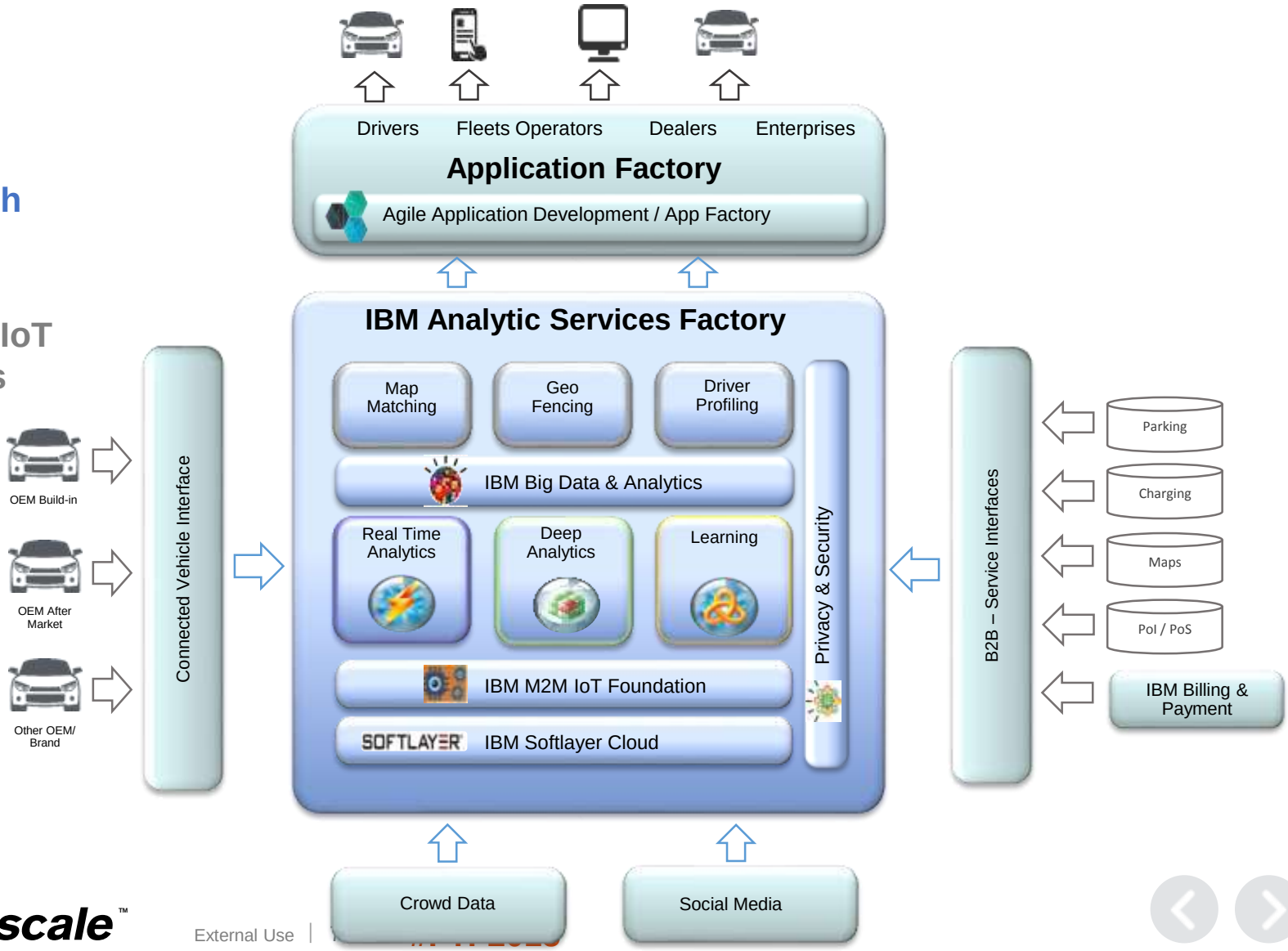
Secure

Scalable

Global Reach

Big Data & Analytics

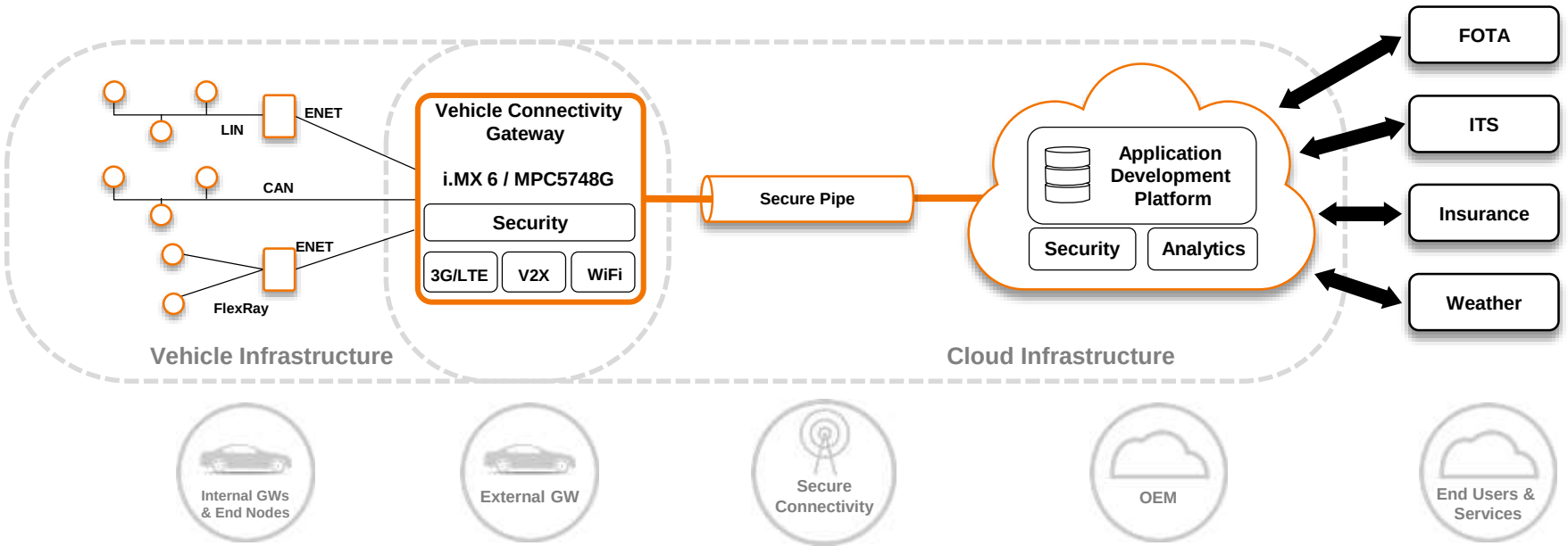
Automotive IoT Applications



Security Considerations

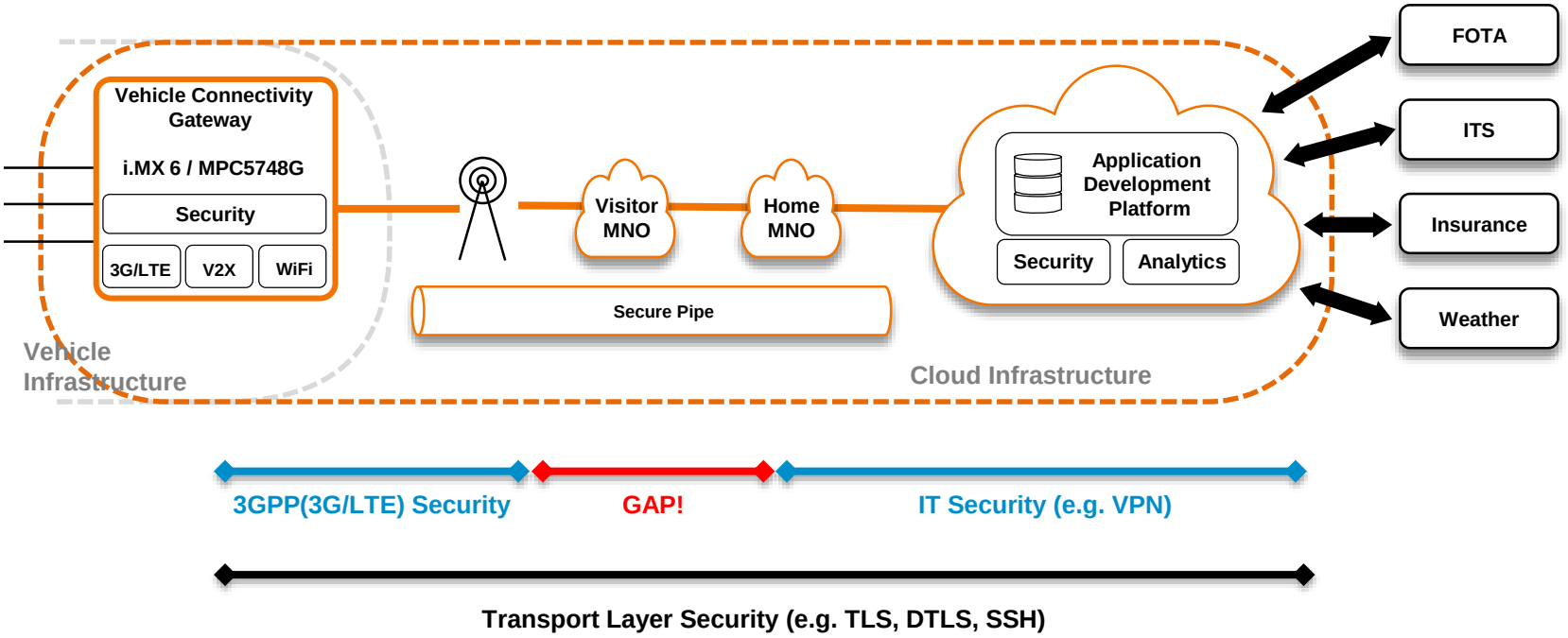
So, What about Security?

- Wide number of potential attack vectors

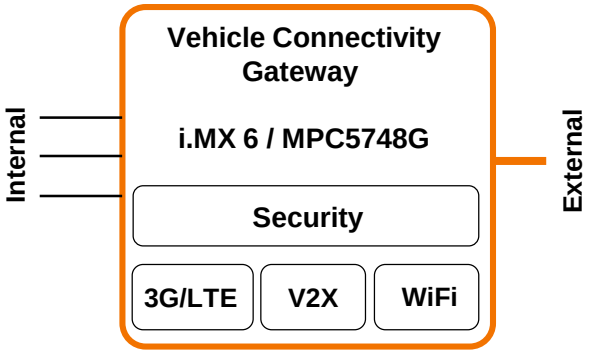


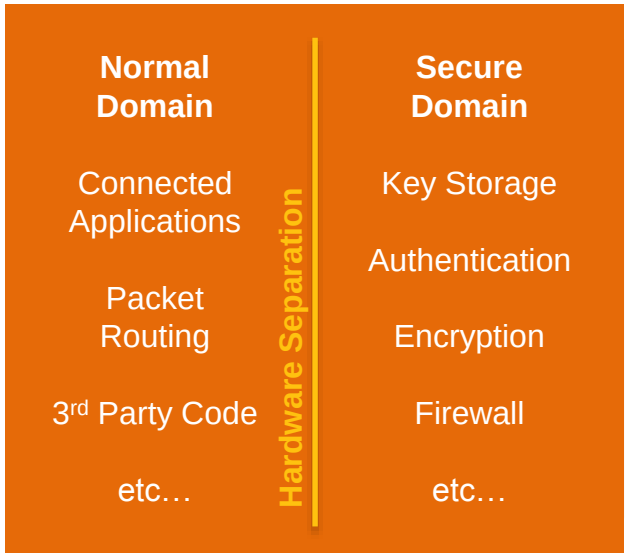
1. Security to the Vehicle

- Requires End-to-End security – why?



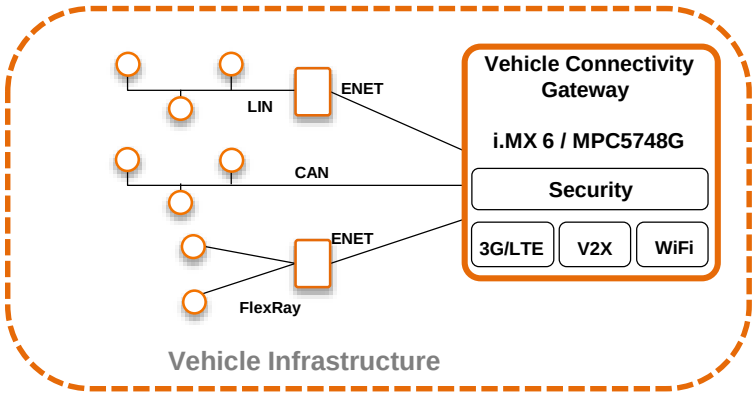
2. Securing the Entry Point of the Vehicle

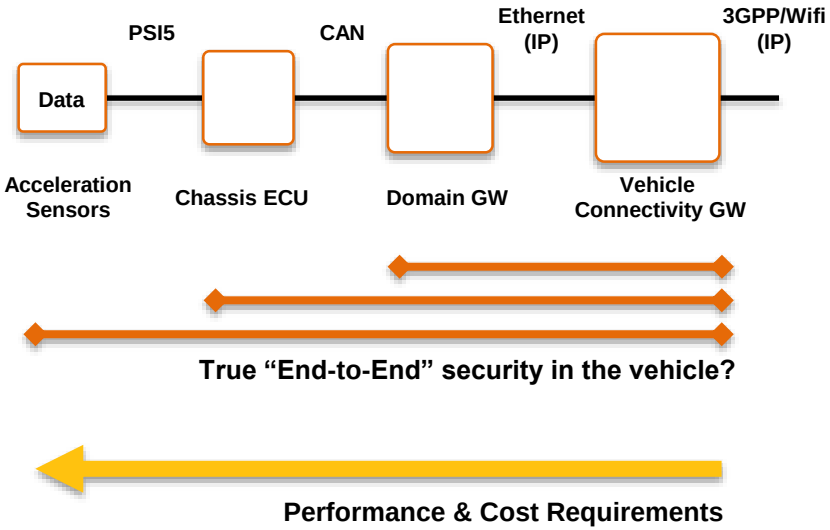




- Bridge between external & internal networks
- STRONG security required
  - Arguably, the most convenient node to attack
- Reduce the attack surface area
  - Isolate trusted resources in hardware
    - TrustZone
  - Hardware security module
    - CSE / HSM

3. Into the Vehicle





- End-to-End security difficult in the vehicle
- Gateway functionality is important
  - Aggregate many protocols down to a few
    - (e.g. CAN, CAN-FD, Ethernet)
  - Secure comms link up the tree
  - Physical: Central / Domain GW
  - Virtual: e.g. Chassis ECU (PSI5)
- Security required at these GW points
- Cost vs Risk for smaller nodes
  - Security features become greater proportion of cost

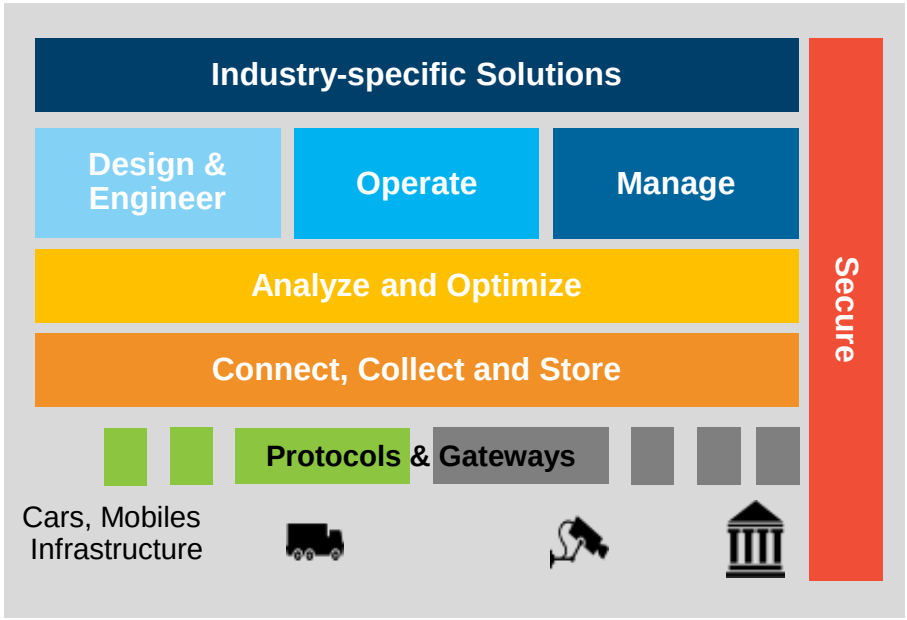
4. IoT Automotive Platform Security

Automated security testing Ideal for DevOps/Continuous Delivery (AppScan)

Anomaly detection, Event management (Qradar) & in-vehicle

Protect personally identifiable information (Guardium Data masking)

Database data security & activity monitor (Guardium)



Secure identity mgt and compliance (IBM Security Identity Manager)

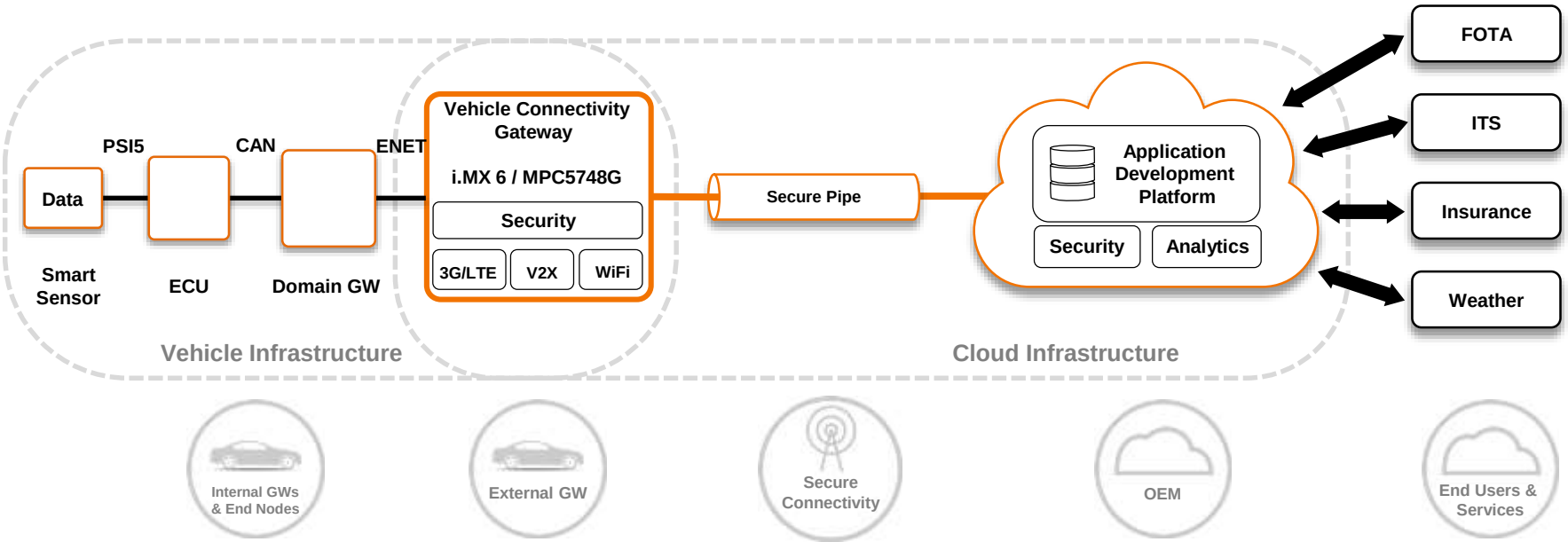
Log analytics (IBM Operations Analytics)

Secure device lifecycle management and configuration 'Silicon tokens'

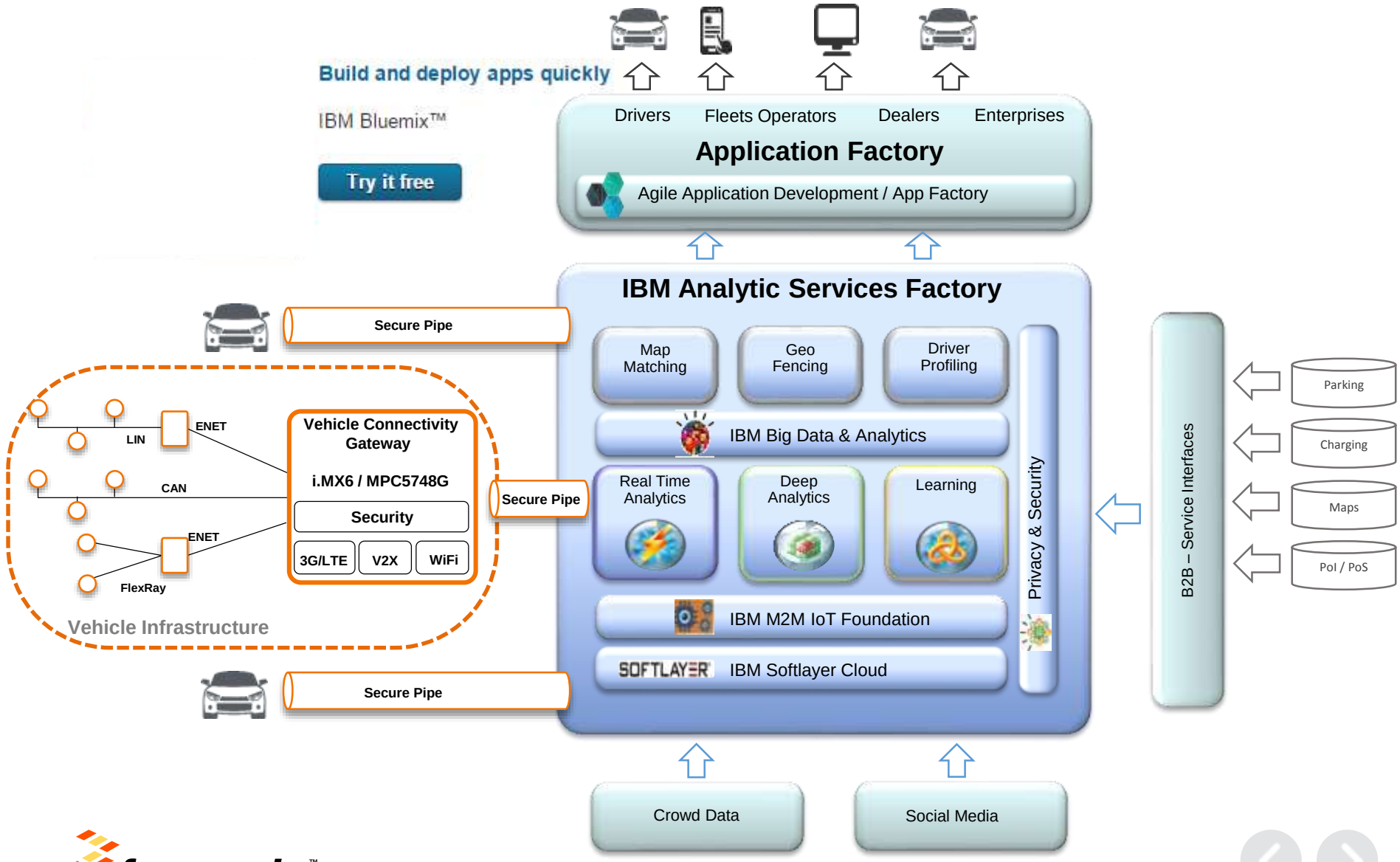
Secure Gateways (Internet of Things Foundation, MessageSight, Datapower)

Securing End-to-end

- Putting it all together…



Conclusion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