FROM THE CLOUD TO THE CAR: THE END TO END PICTURE

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AGENDA

• Market trends
• Use cases
• Network evolution and landscape
• Security considerations
• Vehicle telematics
• Summary
Automotive Industry Megatrends

Autonomy  Electrification  Connectivity
VEHICLE BIG DATA opportunities

CONNECTED VEHICLES

38 MILLION
Shipped in 2018*

VEHICLE DATA

4+ TERABYTES
Vehicle data generated per hour**

Represented global data
Sources: *Strategy Analytics, 2019; **ABI Research, 2018
Vehicle Data Opportunities Will Transform the Automotive Industry

New Revenue Streams
Up to $750B* for data-driven services by 2030
77.4% millennials** willing to pay for updates

Enhanced Safety and Security
Fault detection & notification
Intrusion detection and prevention
Crash detection / emergency response

Improved User Experiences
Personalization, comfort and convenience
Post-sale feature upgrades
Location-based services

Reduced Costs
Predictive maintenance
Reduced warranty / recall exposure
Fleet management

Sources: McKinsey & Company, Monetizing Car Data, 2016; IHS Markit forecast, 2018
Use cases
Over-The-Air (OTA) use case

• **Over-the-Air firmware/software updates** is a key trend in the industry

• **Trend to move OTA Management function in Gateway ECU**
  - Centralized management of OTA deployment in-vehicle
  - Interface to OEM servers
  - Security is paramount

• **Utilizing OTA mechanism to deploy new features via SW in field** (Agile SW deployment)
  - Build performance overhead into hardware
  - In-field, test & deploy new customer features as use cases emerge
**Automotive SDN use case**

- Central configuration of data-plane switches in IVN
  - Support both TSN and BE traffic
  - Support switching and routing

- Use cases:
  - Dynamic network changes
    - E.g. Adding new services via OTA while maintaining optimum network efficiency
  - Error handling
    - E.g. Fast failover

- NETCONF CNC example:
Analytics Typical use cases (1)

• **Predictive maintenance**
  - Identify vehicle maintenance issues before they occur
  - Schedule maintenance when needed
  - Quickly identify the root cause of any problem
  - **Machine Learning (ML) at the edge** to detect safety relevant maintenance issues

• **Intrusion Detection and Prevention (IDPS)**
  - Uses anomaly detection techniques to identify malicious activity or faults on vehicle networks
  - Detects static anomalies (non ML)
  - Contextual anomaly – ML based
  - **ML at the edge** to detect attacks in real time
Analytics Typical use cases (2)

• **Crash detection**
  - Used to detect if a crash occurs
  - Indicates the severity of crash
  - Indicates likelihood of serious injury
  - Capture moments before crash
  - **ML at the edge** to detect crash real time

• **Usage based insurance**
  - Behaviour policy pricing
  - Premium based on driver use of vehicle
  - ML determine driver premium depending on several risk factors
  - **ML at the edge** to detect driver and usage
Analytics: Handling Data

- **On-Vehicle processing**
  - **Capture:**
    - Data to service (raw data to speed, temp, etc)
    - Data logging
  - **Process:**
    - Predictive data analytics (limited)
      - Deviation detection
      - Signal correlation, comparison to reference modules
    - Aggregate Diagnostic Trouble Codes (DTC) with other data and time stamps
  - **Share:**
    - Compression before offload

- **Off-Vehicle Cloud processing**
  - Correlation of data across multiple vehicles
  - Advanced predictions using historical and warranty data
  - Part defect history
Network evolution and landscape
The vehicle as a part of the larger Ethernet Ecosystem
From LAN to WAN to IVN

Residential

Enterprise

Mobile

xDSL

ATM

PDH

PDH/
Frame Relay

Access

Aggregation/Edge

Metro/Core-Edge

IP/MPLS

ATM

SDH

Transport

PDH
From LAN to WAN to IVN
From LAN to WAN to IVN
From LAN to WAN to IVN

Access
Aggregation/Edge
Metro/Core-Edge
Provider Backbone
Ethernet
IP/MPLS
OTN
Transport

Residential
Enterprise
Mobile
Wireless Connectivity Landscape

- **Ultra-short Range**
  - Ultra-short Range

- **Short Range**
  - Short Range

- **Wide Range**
  - Wide Range

- **Technologies**
  - 5G
  - CAT-M1
  - NB-IoT
Evolution of the Cellular Base Station

**THE PAST**
Conventional BTS
- Base Transceiver Station (Channel Cards, Radios, Amplifiers and Filters)
- Masthead Amplifiers
- Coaxial Cable
- Passive Antennas
- Small Cells

**5G SOLUTIONS**
- Remote Radio Head
- Active Antenna Systems
- Base Station Server (Channel Cards)
- Fiber Cable
- Fixed Wireless
- Small Cells

**Frequencies**
- 700 MHz
- 2.7 GHz
- 600 MHz
- 6 GHz
- 26-29 GHz
- 37-40 GHz
Security considerations
Secure Comms

IPsec and TLS can both be end to end
Vehicle telematics
Internal vehicle communications

Domain controller architecture

Zonal architecture
Example ECU architectures

Telematics Control Unit (TCU)

Secure Ethernet Gateway
Summary
Summary

• Market trends
  - Data is king!
  - Data volume, access and handling are key defining points

• Use cases
  - Enablement of new features is not a luxury, it’s something the user expects
  - OTA, SDN, remote diagnostics and analytics are key drivers

• Network evolution and landscape
  - Transport of a bit of data from the source to destination involves a myriad of technologies
  - 5G allows new levels of flexibility and scalability to enable new use cases
  - Ethernet is the common denominator

• Security considerations
  - A portfolio of techniques is available to protect data
  - End to end and/or point to point

• Vehicle telematics
  - Handling the data within the scope of the vehicle itself is non-trivial
  - TCU and Gateway ECUs are two of the key elements which complete this picture
NXP-CLOUDERA VEHICLE EDGE2AI ANALYTICS & MACHINE LEARNING
Architecture for Unlocking the Value of Vehicle Data

- **ANALYZE**
  - Self-Service Business Intelligence (BI)
  - Fleet Analytics

- **LEARN**
  - Historical vehicle data
  - Historical maintenance records
  - Historical usage characteristics
  - Historical failures

- **DEPLOY**
  - Design, MFG, Dealer Service, Warranty, etc.

1. **VEHICLE EDGE ANALYTICS**
2. **TRANSMIT**
3. **STORE, ENRICH & PROCESS**
4. **DATA AT REST**
5. **ENRICH**
6. **ENTERPRISE DATA LAKE**
7. **ANALYZE**
8. **LEARN**
9. **REAL-TIME ACTION**
Thank you
SECURE CONNECTIONS
FOR A SMARTER WORLD