Vehicle Service-oriented Gateway Opportunities and Enablement

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Agenda

• Market Opportunities
• Introduction to the Service-oriented Gateway
• NXP MPC-LS Chipset Solution and Enablement
• Unlocking Value of Connected Vehicle Data
• Related Presentations/Demo @ NXP Connects
VEHICLE BIG DATA opportunities

CONNECTED VEHICLES
38 MILLION
Shipped in 2018*

VEHICLE DATA
4+ TERABYTES
Vehicle data generated per hour**

*Sources: *Strategy Analytics, 2019; **ABI Research, 2018

Represents global data
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
The gateway has central access to vehicle data which can enable new services and opportunities.
Automotive Gateway is Central for Vehicle Communications
Gateway Rise and Evolution

- No or limited connectivity
- No or limited security
- Basic routing
- Limited bandwidth / scalability (kilobit / Megabit interfaces)

- High-speed wireless interfaces (4G→5G, Wi-Fi)
- High security, isolation, public key crypto, contextual firewall, intrusion detection
- Advanced routing, vehicle OTA, analytics, ECU consolidation, new services
- High-bandwidth, scalable architectures (Gigabit interfaces)

Gateways are evolving into “Service-oriented Gateways”
Key Gateway Use Cases

- The Gateway is becoming the central, critical component in vehicle architectures
  - System security, OTA management, applications/services, analytics, vehicle compute, and more
- Gateways are shifting to software-centric solutions → introducing new services
  - Enables OEM differentiation, operational efficiency, and new revenue generation
  - Improves customer satisfaction

- Protocol and Data Translation
  - Network protocol-to-protocol translation
  - Raw data-to-contextual information

- Network Security
  - High-performance contextual firewall
  - Intrusion Detection and Prevention System
  - Authentication and Secure Messages
  - Network Key Management

- Over-the-Air (OTA) Updates Management
  - Remote upgrades (new features, safety/security patches…)

- Apps Processing / Services
  - ECU consolidation
  - Analytics (edge processing and edge-to-cloud)
  - Remote monitoring and condition-based maintenance (prognostics / vehicle health monitoring)
  - Centralized functions (vehicle identity, power strategy…)
  - Agile deployment of future functionality
## Service-oriented Gateway Services

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
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<tbody>
<tr>
<td>Vehicle-wide Over-the-Air (OTA) Updates</td>
<td>Deployment of remote apps, machine learning models, security and safety patches…</td>
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<tr>
<td>Edge-to-Cloud Data Analytics</td>
<td>Edge processing of vehicle data, pre-processing for cloud analysis and machine-learning models</td>
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<tr>
<td>Virtual ECUs</td>
<td>Consolidation of vehicle ECUs to reduce system cost, weight, cable harness complexity</td>
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<tr>
<td>Intrusion Detection and Prevention</td>
<td>Real-time vehicle network security monitoring and updates for protection against new cyber threats</td>
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<td>Data Logging and Forensics</td>
<td>Centralized “black box” capability for analysis, including filtering and pre-processing of vehicle data</td>
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<tr>
<td>Centralized Vehicle Security</td>
<td>Remote key provisioning, secure key management, cryptographic functions and secure OTA and services</td>
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<tr>
<td>Many more services to come…</td>
<td>Provides platform for services innovation and supports new initiatives like Mobility-as-a-Service (MaaS)</td>
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Gateway to Service-oriented Gateway Evolution

Service-oriented gateways require ~10x performance and networking
Learning from Mobile Market Product Evolution

Communications → Applications & Services
kbps → Gbps Data Rates
Massive Increase in Processor Performance
Over-the-Air Updates
Enhanced Security

Higher-speed Connectivity + Applications/Services + OTA Updates
= Growth and New Opportunities
MPC-LS Vehicle Network Processing Chipset for Service-oriented Gateways

Heterogenous multi-core processing
- Real-time + high-performance applications

Automotive meets enterprise networking
- CAN FD, LIN, FlexRay™ interfaces
- Up to 10 Gigabit Ethernet with packet acceleration

End-to-end security from vehicle to cloud
- Embedded Hardware Security Module for cryptography and secure key management
Bringing Together Automotive and Enterprise Networking to Enable Disruptive Opportunities
NXP MPC-LS Chipset Public Launch in February ‘19

NXP Enables Service-Oriented Gateways for Automakers to Unlock Value of Connected Vehicle Data

Automotive-grade chipset revolutionizes vehicle gateways with secure applications processing and network acceleration

NXP Semiconductors N.V. (NASDAQ: NXPI), the world’s largest supplier of automotive semiconductors, today announced a vehicle network processing chipset solution for high-performance service-oriented gateways, which enables automakers to unlock the value of connected vehicle data and offer new services. The MPC-LS chipset solution combines the proven NXP automotive MPC560i microcontroller and enterprise networking IC/4G communications processor to offer the high levels of performance and networking required for service-oriented gateways. For development, evaluation and demonstrations, the chipset solution is supported by an evaluation board, enabling software and a growing ecosystem.

Vehicle data-driven services such as usage-based insurance, predictive maintenance and over-the-air upgradeable vehicles are projected to reach up to $790 billion in revenue by 2025. These services and the information derived from connected vehicles are aimed to transform the automotive industry with new revenue opportunities, improved user experiences, safety and security enhancements and cost reductions. To enable these new opportunities, centrally located service-oriented gateways must securely process and route massive amounts of data across the vehicle, which requires a vehicle network processing solution to meet the demand.

NXP helps automakers, suppliers and emerging global entrants develop new vehicle networking platforms of the future today. The production-ready MPC-LS vehicle network processing chipset virtually brings together real-time and applications processing along with automotive and enterprise networking technologies.

Key features include:

- High-performance quad-core 64-bit Arm® processors for services and edge analytics
- One 10 Gigabit and four Gigabit Ethernet interfaces for high-bandwidth networking
- Ethernet packet acceleration efficiently processes to provide robust network
- Real-time processing of vehicle data from CAN, Ethernet and FlexRay™ networks
- Hardware security for trusted boot, cryptography and secure key management

Our MPC-LS chipset is “a catalyst to unlock all the #connectedvehicle data that’s going through the car.” NXP’s Brian Carlson talks to @DesignNews about helping automakers enable service-oriented gateways for new revenue streams, safety and more. #EW19

NXP Chipset Could Lay Foundation for New Services in the ...

Processors would enable faster communications, setting the stage for vehicles to use data in new ways.

designnews.com

10:00 AM - 25 Feb 2019
MPC-LS Vehicle Network Processing Solution

- Enables Next-gen CAN-Ethernet Gateways
  - Automotive Gateway + Network Processing (Gigabit Ethernet Packet Routing) + Applications
    - MPC5748G + LS1043A (MCU + MPU)
    - Production chipset available today

- Feature Set
  - CAN Signal Gateway (MPC5748G)
  - 4x Arm Cortex-A53 (LS1043A)
  - Packet Forwarding Engine (DPAA Frame Manager)

- OS Support
  - AUTOSAR: Real-time CAN gateway
  - FreeRTOS (MPC5748G)
  - Linux and QNX: Ethernet routing, applications processing
**MPC5748G Automotive Gateway Microcontroller**

**Key Characteristics**
- PowerPC Architecture: 2x e200z4 + 1x z2 cores, FPU on z4 cores
- 160 MHz max for z4s and 80 MHz on z2
- HSM Security Module supports both SHE and EVITA low/medium standard
- Media Local Bus supports MOST communication
- 2 x USB 2.0 (1 OTG and 1 Host module) support interfacing to 3G modem and infotainment domain
- Up to 2x Ethernet 10/100 Mbps RMII, MII, +1588, AVB (with Ethernet switch)
- CAN module supports CAN FD
- SDHC provides standard SDIO interface
- Low Power Unit provides reduced CAN, LIN, SPI, ADC functionality in low power mode
- Designed to ISO 26262 process for use in ASIL B
- Packages: 176 LQFP, 256 BGA, 324 BGA
- -40 to +125C (ambient)
- 3.0V to 5.5V

The NXP MPC5748G device provides real-time automotive networking and CAN gateway stack

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*Features (and quantity) depend on package and device version*
The NXP LS1043A device provides applications processing (services) and Ethernet packet routing acceleration.

Key Characteristics:
- 4x Arm Cortex-A53 @ up to 1.6 GHz
  - 19.5k DMIPS
  - SpecInt2k6 – 5.95, Rate -15
  - NEON SIMD in all CPUs
- 1x36b (including ECC) DDR3L/4 up to 1.6GT/s
  - 6.4GB/s memory BW
- High Speed IO
  - Multiple PCIe Gen2 controllers
  - Multiple Ethernet MACs (up to 10G)
- Security
  - 10Gbps Crypto Acceleration
  - IPsec, SSL
  - Trust Architecture
    - Secure Boot
    - Secure Debug
    - Secure Storage
    - Tamper Detection
    - HW Enforced Partitioning
    - ARM TrustZone
- Functional Safety:
  - ASIL B
  - ECC protected memories
  - Fault localization, containment and recovery
  - Soft lockstep with determinism
  - Excellent support for virtualization, containerization
- Package: 23x23mm, Unliidded FCBGA, .8mm pitch (780 pins)
Service-oriented Gateway Software Architecture

<table>
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<tr>
<th>SoA App</th>
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<td>e.g. Vehicle Services like Virtual ECUs, MaaS services</td>
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Service-oriented Architecture (SoA)
- SoA Apps are the “Services”
- Applications built with “service” layer of abstraction
- SoA App not bound to specific OS, SoC, or even ECU
- Framework supports dynamic deployment of services
- Simplifies Over-the-Air (OTA) updates
- Streamlines development and deployment of services
- T1s/OEMs develop/deploy a Service rather than an ECU

High-level Operating System (HLOS)
- e.g. Linux, QNX, Integrity, VxWorks

Hypervisors / Containers
- e.g. XEN / OpenSynergy
- Linux Containers (LXC)

Processor Core
- e.g. Arm Cortex-A53

Service-oriented Architecture will Drive Rapid Innovation Deployment

Please attend AMF-AUT-T3657 - “Service-Oriented Architecture—Design and Implementation Using Automotive Linux BSP” for more details.
MPC-LS VNP System Solution

MPC5748G Auto Gateway

- Secure Element (NCJ38A)
- Safety MCU (S32K)
- SBC (MC33300)
- SPI-10-CAN Microchip
- CAN PHY TJA1046
- CAN PHY TJA1046
- FlexRay TJA1085
- LIN PHY TJA1021/24
- LIN PHY TJA1021/24

1-Port

100/1000 MAC

5-Port Ethernet Switch: SJA1105

1Gbps

LS1043A Network Processor

- Ethernet PHY 1000BASE-T1
- Ethernet PHY
- 32-bit DDR4
- eMMC
- PCIe Expansion

Digital IN

Digital OUT

OBD

CAN PHY TJA1046

Eth PHY

100/1000 BASE-TX

NXD Device

COMPANY PUBLIC 18
Big Data, Big Opportunities Today

Carmakers
- Proof of concept
- Benchmarking
- Vehicle data insights
- New services deployment

Application Developers
- Innovation platform
- Software development
- Test and validation
- Demo showcase

Cloud & Service Providers
- Symbiotic compute
- Over-the-Air (OTA) updates
- Machine learning deployment
- Edge service deployment

✓ Evaluation Board (EVB)
✓ Reference Development Board (RDB)
✓ Software Enablement
✓ Demonstrations

Accelerating Transformation Across the Automotive Ecosystem
MPC-LS Vehicle Network Processing (VNP)
Evaluation Board (EDB)

- Real-time Gateway Processing
- Applications Processing
- Gigabit Ethernet Acceleration
- Embedded Security

Part Number: MPC-LS-VNP-EVB
- Price: $2150  Available: Now for approved customers
- Designed for evaluation and demonstrations
- Includes SW enablement and demonstrations

NXP Components:
- MPC5748G (MCU), LS1043A (Comms Processor), SJA1105SEL (5-port Ethernet switch), PF8200 (Power Management IC)
- TJA1081TS (FlexRay), TJA1024HG (Quad LIN), TJA1044GT/3 (CAN HS), TJ1102HN (Dual Ethernet PHY), TJA1048T (Dual CAN), SJA1105QEL (5-port Ethernet Switch)
- MK26FN2MOVM18 (Kinetis MCU-2MB for OpenSDA)
- NTS0102 (Dual-supply Transceiver), NX5P309UK (Power Switch)

www.nxp.com/MPC-LS-VNP-EVB
MPC-LS Vehicle Network Processing (VNP)
Reference Design Board (RDB)

- Real-time Gateway Processing
- Applications Processing
- Gigabit Ethernet Acceleration
- Embedded Security

Part Number: MPC-LS-VNP-RDB
- Price: $749  Available: July’19 for approved customers
- Reference Design: 90% of BOM is Automotive Grade
- Includes SW enablement and demonstrations

NXP Components:
- MPC5748G (MCU), LS1043A (Comms Processor), SJA1105SEL (5-port Ethernet switch), PF8200 (Power Management IC)
- TJA1081TS (FlexRay), TJA1024HG (Quad LIN), TJ1102HN (Dual Ethernet PHY), TJA1048T (Dual CAN Transceiver)
- NTS0102 (Dual Supply Transceiver), NX5P3090UK (USB Power Switch)
MPC-LS-VNP-RDB Key Features

**MPC5748G Automotive Microcontroller**
- AEC-Q100, Grade 2
- ISO 26262 ASIL B Functional Safety
- Processors
  - (2 x) Power Architecture® e200z4 @ 160 MHz
  - (1 x) Power Architecture e200z2 @ 80 MHz
- 6 MB embedded flash, 768 KB SRAM
- 8 x CAN FD + 4 (Non FD) w/SPI expansion
- 100 Mbps Ethernet, AVB
- 2 x FlexRay, 4 x LIN
- Embedded hardware security module (HSM)
  - Supports SHE and EVITA standards

**LS1043A Microprocessor**
- (4 x) Arm® Cortex®-A53 64-bit processors
  - Up to 1.4 GHz
- Gigabit Ethernet data path acceleration
- 10 Gbit/s crypto acceleration
- 2 GB DDR3L @ up to 1.6 GT/s
- 8 Gbit NAND flash
- 512 Mb Serial NOR flash
- 8 Gbit eMMC
- 2 x 100 Mbit/s + 2 x 1Gbps + 1x 1/2.5/10 Gbps Ethernet, IEEE® 1588v2
- 3 x USB 3.0
- AEC-Q100, Grade 3 (Grade 2 available)

**SJA1105 Automotive Ethernet Switch**
- AEC-Q100, Grade 2
- SJA1105S: 3 x 100 Mbps + 2 x 1 Gbps ports
- 1024-entry MAC address learning table
- Hardware support for IEEE 802.1AS and IEEE 802.1Qav for AVB networks

**Power Management IC**
- PF8200 PMIC
- Configurable and programmable outputs to power the core processor, memory and a wide range of peripherals

**Software**
- MPC5748G: AUTOSAR® OS, MCAL, Bare-metal
- LS1043A: Linux® (Yocto 2.5), fast path packet forwarding
- Inter-platform communications framework (IPCF)
- Demo applications
  - Datalogging to cloud for vehicle health
  - Ethernet packet acceleration
  - Software-defined networking
- Certification: FCC Class B and CE

**MPC-LS-VNP-RDB CONNECTORS**
- MPC5748C Console
- USB 3.0 (x2)
- 1000BASE-TX (x4)
- Automotive 100BASE-T1 (x2)
- FlexRay (x2)
- LS1043A Console
- CAN/CAN FD (x12)
- LIN (x3)
- +12VDC Power Input

*Features available in RDB. Each device supports additional features.
**MPC-LS-VNP-RDB Block Diagram**

- **Processors**
  - MPC5748G Automotive Microcontroller
  - LS1043A Communications Processor

- **Memory**
  - 2 GB DDR3L @ up to 1.6 GT/s
  - 1 GB NAND flash
  - 64 MB Serial NOR flash
  - 8 GB eMMC

- **Storage**
  - M.2 M-Slot for optional PCIe SSD

- **NXP Support Devices**
  - PF8200 Power Management IC
  - SJA1105SEL Ethernet Switch
  - TJA1024 LIN PHY
  - TJA1048 CAN PHY
  - TJA1081 FlexRay PHY
  - TJA1102 100 Mbps Ethernet PHY

- **PCB**
  - Single 6-layer board ~ 6.1 x 6.4 inches
  - 90% of BOM Automotive Grade
MPC-LS VNP Reference Design Board Connectors

- MPC5748G Console
- USB 3.0 (x2)
- 10GBASE-T
- 1000BASE-TX (x3)
- Automotive 100BASE-T1 (x2)

- FlexRay (x2)
- LS1043A Console
- CAN/CAN FD (x12)
- LIN (x3)
- +12VDC Power Input
MPC-LS VNP Reference Design Board Key Components

- LS1043A Console connector
- Dual-stacked USB connector
- RGMII EC1 and EC2 connector
- Aquantia 10G connector
- Auto Ethernet Port 1
- Auto Ethernet Port 2
- RGMII Ethernet PHY connected to SJA1105 switch
- Power
- Fault/Power LEDs
- M.2 M-Key connector (PCIe) for SSD, peripherals
- CAN connector
- LIN connector
- MPC5748G Console connector
- FlexRay connector
- Reset button
- TJA1105S
MPC-LS Demo Applications Software
MPC-LS Vehicle Network Processing Ecosystem
Airbiquity & NXP Vehicle OTA & Data Management Service
MPC-LS Vehicle Network Processing Ecosystem
Cloudera & NXP Edge-to-Cloud Streaming Data Analytics

See demo in the Technology Lab (Pedestal #209)
The NXP MPC-LS chipset enables service-oriented gateways
NXP Enables Service-Oriented Gateways for Automakers to Unlock Value of Connected Vehicle Data

- MPC-LS chipset combines proven NXP automotive microcontroller with enterprise networking communications processor
- Provides high level of performance and networking required for new Service-oriented Gateways
- Supported by reference design board, enablement software and growing ecosystem to accelerate product development
- Catalyst to unlock connected vehicle data for new opportunities that will transform the automotive industry
Related Presentations and Demo at NXP Connects

- **AMF-AUT-T3619** – “The Rise and Evolution of Gateways and Vehicle Network Processing”

- **AMF-AUT-T3662** – “Layerscape in Automotive—Multi-Arm Processors for Telematics, Gateway and AD Sensor Fusion”

- **AMF-AUT-T3657** – “Service-Oriented Architecture— Design and Implementation Using Automotive Linux BSP”

- **AMF-AUT-T3697** – “PF81/PF82 PMICs for High-Performance Applications Processors”

- **Demonstration** – **Technology Lab Kiosk #209** – “Unlocking Vehicle Data with the MPC-LS Chipset”
SECURE CONNECTIONS
FOR A SMarter WORLD