

I.MX IN AUTOMOTIVE

CARL CHIEN / FAE



EXTERNAL USE



SECURE CONNECTIONS
FOR A SMARTER WORLD

i.MX Automotive Customers

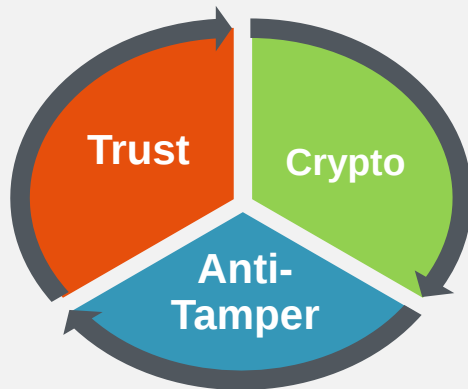


- NXP has solid, long-standing customer relationships with nearly every automotive manufacturer and Tier 1 supplier in the world. We know what it takes to meet the stringent requirements of the global automotive market
- NXP has dedicated account teams for most car OEM's including BMW, GM, Ford, Chrysler, Daimler, VW/Audi, Fiat, Renault, PSA, Volvo, and Hyundai Kai

WHY I.MX?



Product Longevity



i.MX Applications Processor Values

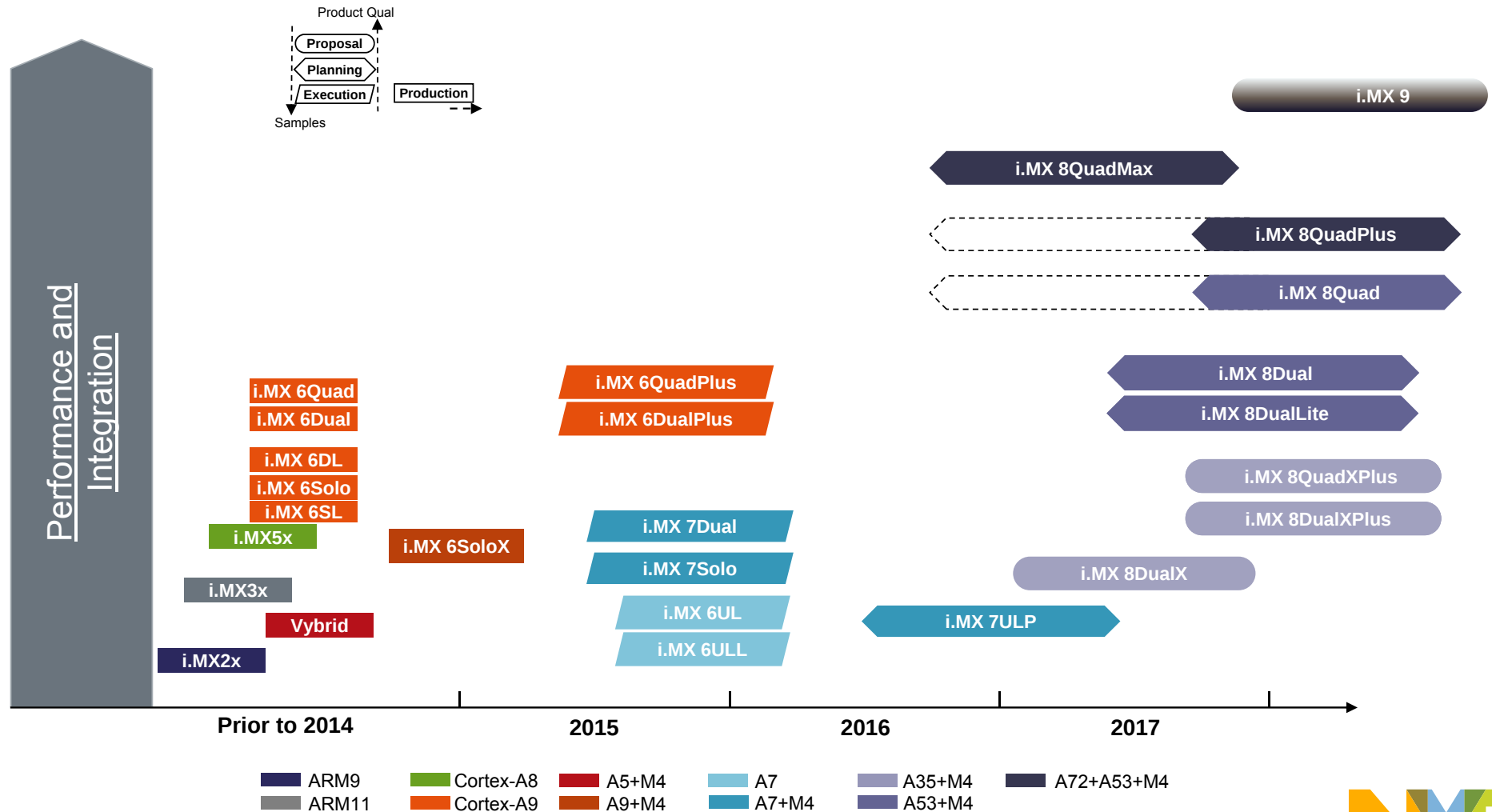
- **Scalability for Maximum Platform Reuse**
 - Pin compatibility and software portability
 - CPU (single/dual/quad, asymmetric), GPU, IO
 - Software: Linux, Android, Windows-embedded, RTOS
- **Trust**
 - Longevity: minimum of 10-15 years in all markets
 - Quality, robustness, zero-defect methodology
 - Security and Safety
 - Qualifications: Automotive AEC-Q100, JEDEC Industrial and Consumer
www.nxp.com/productlongevity
- **Enablement for Ease of Use**
 - Industry-leading ecosystem, partnerships and support
 - Design collateral, distribution, communities
 - System solutions: SoC, sensors, memory, PMIC, connectivity



WHY I.MX? SCALABILITY

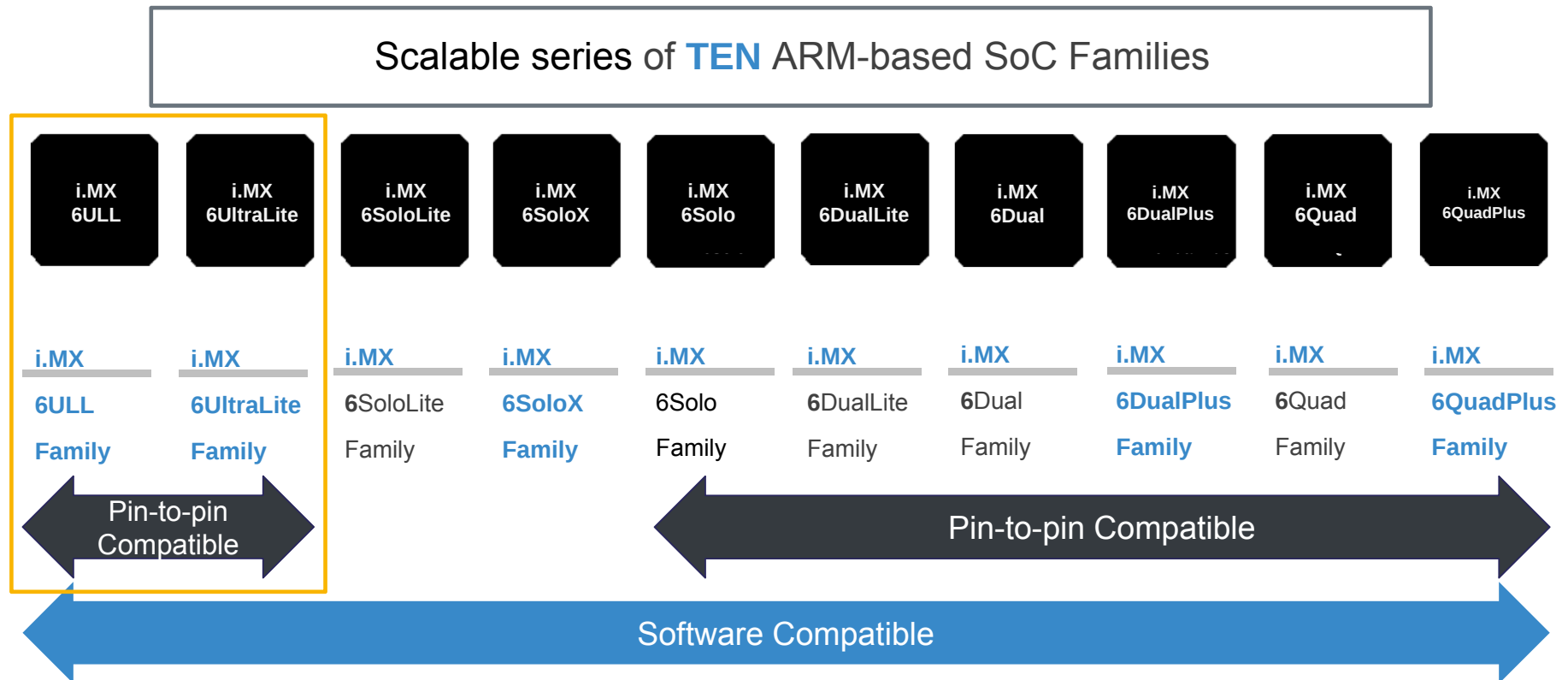


i.MX Roadmap



i.MX 6 Series: Supreme Scalability and Flexibility

Leverage One Design into Diverse Product Portfolio

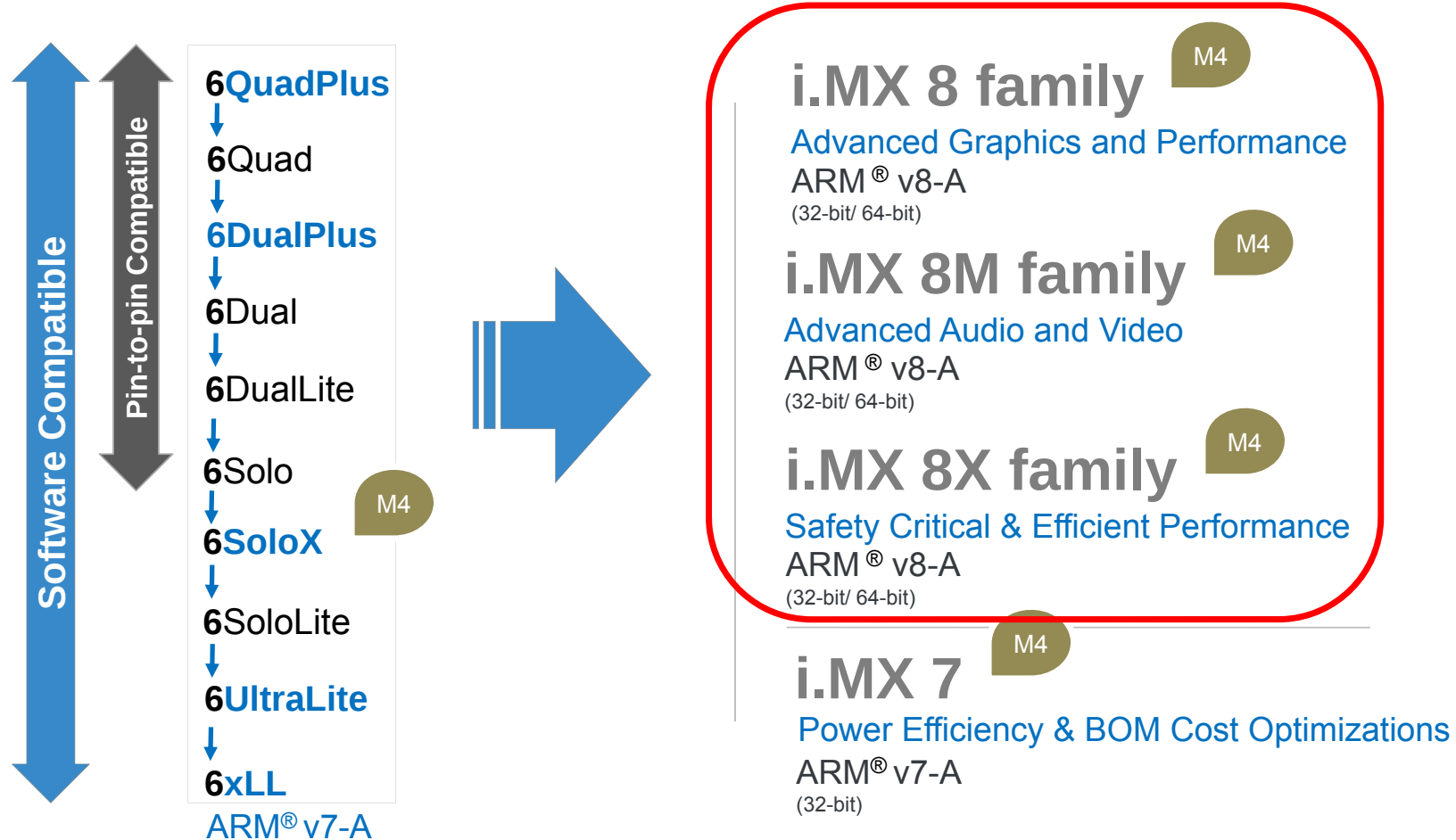


Expanded series for performance, power efficiency and lower BOM

i.MX 8 FAMILY



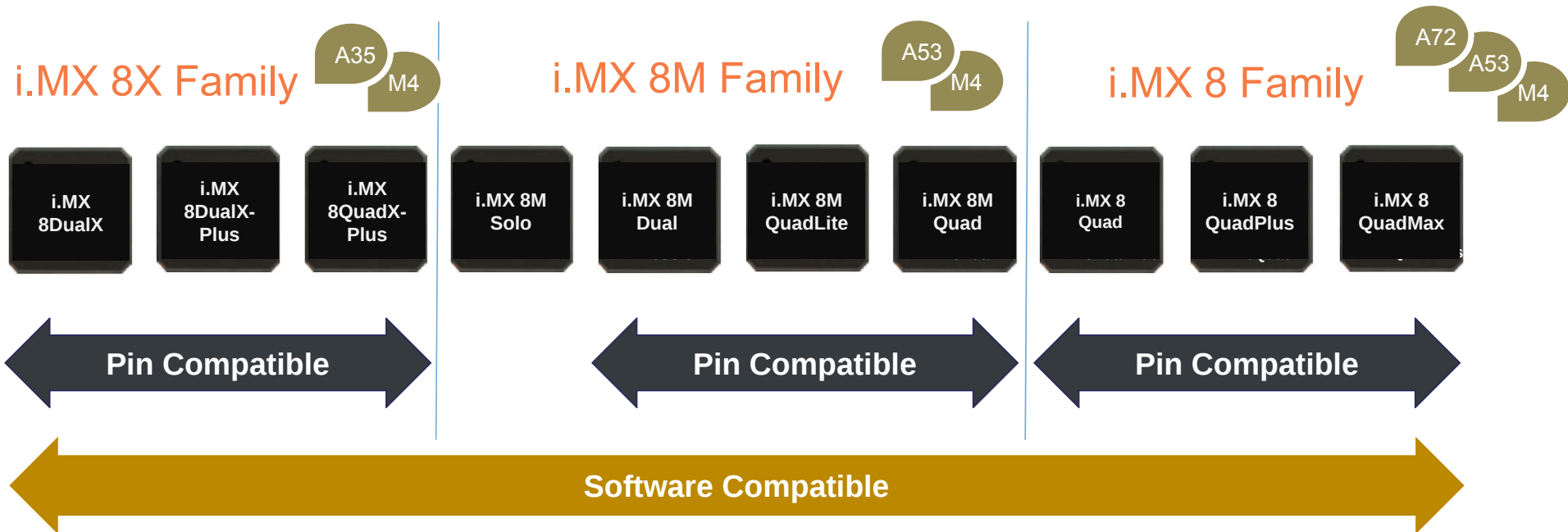
i.MX 8 Series: 3 families of parts with targeted features



i.MX 8 Series: Supreme Scalability and Flexibility

NEW

Scalable series of **THREE** ARM-based SoC Families



i.MX 8 Family

*Up and
To The
Right*



	CPU	GPU	Virtual	Vision	Display	VPU	DDR
 i.MX 8QMax	3.5x	5x	New	10x	4x	8x	3x
 i.MX 8QPlus	2.5x	2.5x	New	5x	4x	8x	3x
 i.MX 8Quad	1.5x	2.5x	New	5x	4x	8x	3x



i.MX 8 - *The Dance of the Logos*

LPDDR4

OctoSPI

HDMI
HIGH-DEFINITION MULTIMEDIA INTERFACE
2.0

((HDCP))
2.2

PCI **3.0**
EXPRESS™

SERIAL
ATA **3**

USB 3.0

Full upgrade across
all major peripheral
classes

i²C
BUS **3.4Mbps**

DisplayPort

MIPI
DSI

MIPI
CSI

embedded
DisplayPort

NXP

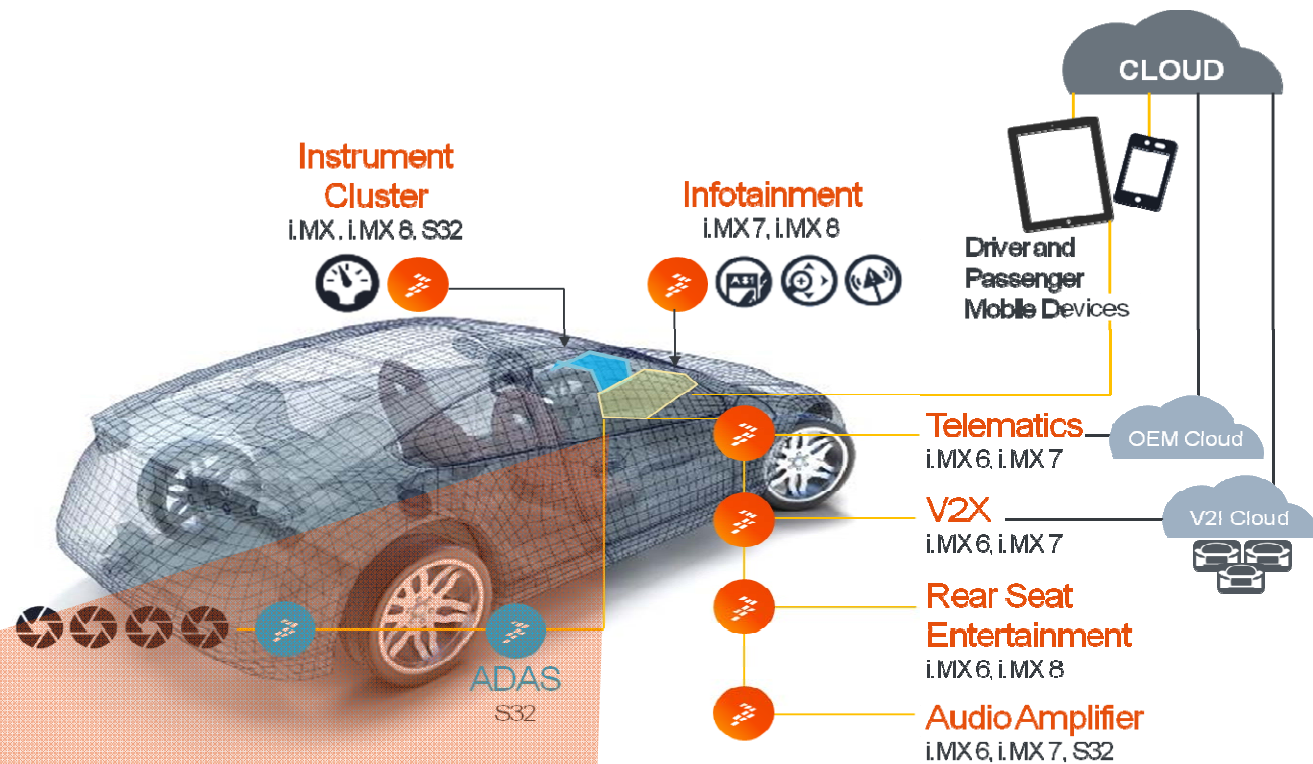
i.MX 8 FAMILY

eCOCKPIT SOLUTIONS



Full Integration

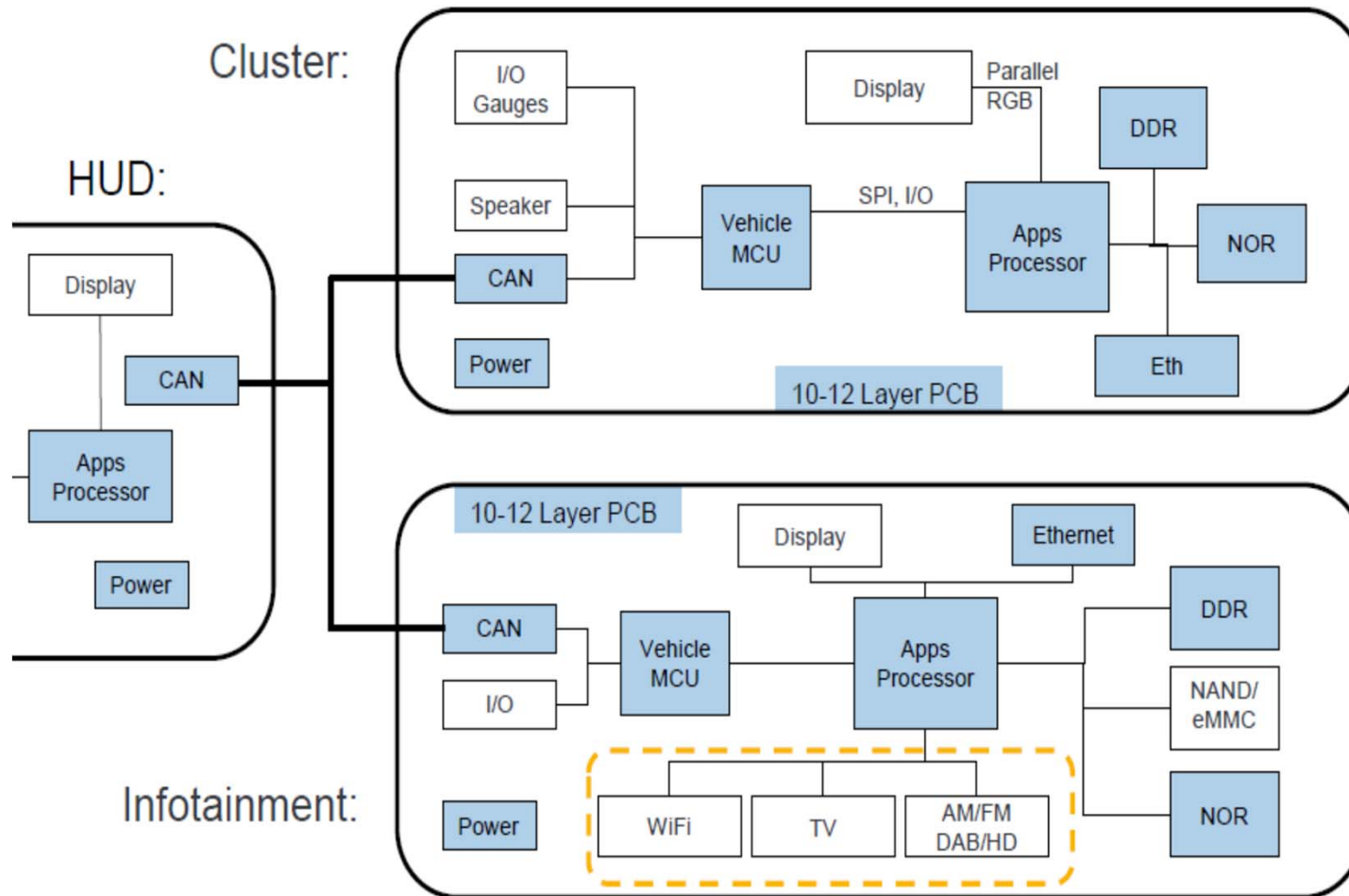
eCockpit on i.MX 8 Family



e-cockpit
i.MX 8 Series
Cluster, Heads Up Display,
Infotainment, Driver Awareness

http://www.nxp.com/products/microcontrollers-and-processors/arm-processors/i.mx-applications-processors/i.mx-8-processors/i.mx-8-family-processors-transforming-inter-actions-in-ways-youve-never-imagined/i.mx-8-family-arm-cortex-a53-cortex-a72-virtualization-vision-3d-graphics-4k-video:i.MX8?tab=Design_Support_Tab

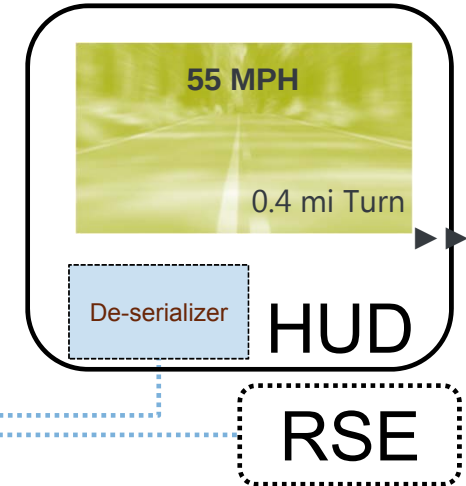
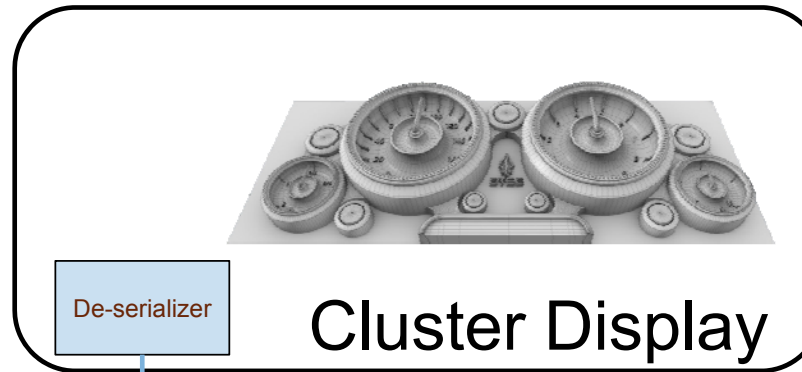
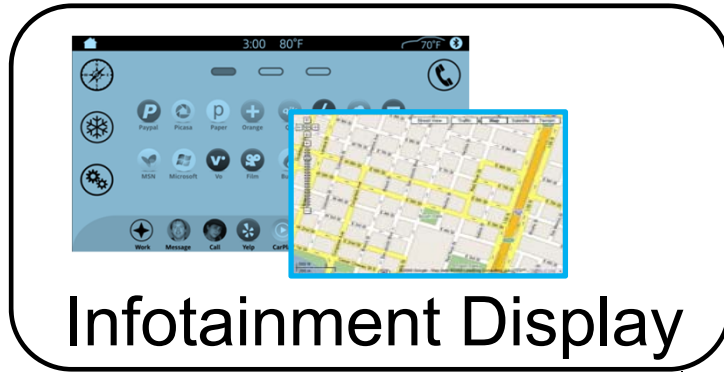
Before eCockpit ... Function Duplication over Multiple Platforms



Duplicated:
ECU housing and design NRE
10 layer cluster PCB
5-6 power supplies / circuit protection
Applications Processor & Software
256MB DDR / 128MB NOR
Cluster VMCU + ASIL B OS
Speaker
CAN Tx/Rx and harness
Debug ports and hardware
Discrete components and connectors

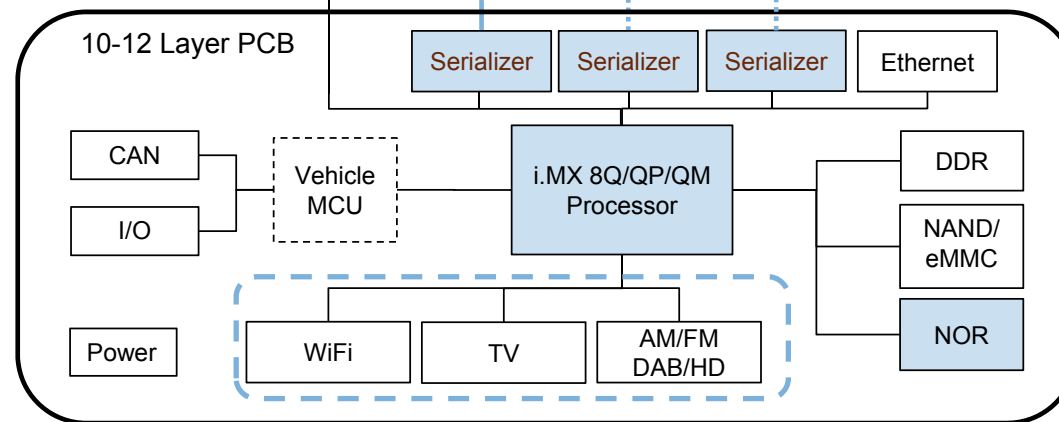
i.MX 8 eCockpit Design example

Single Supplier for All Graphics and Display Processing



Eliminated:

ECU housing and design NRE
10 layer cluster PCB
5-6 power supplies / circuit protection
Applications Processor & Software
256MB DDR / 128MB NOR
Cluster VMCU + ASIL B OS
Speaker
CAN Tx/Rx and harness
Debug ports and hardware
Discrete components and connectors



Additional e-Cockpit ECU requirements:

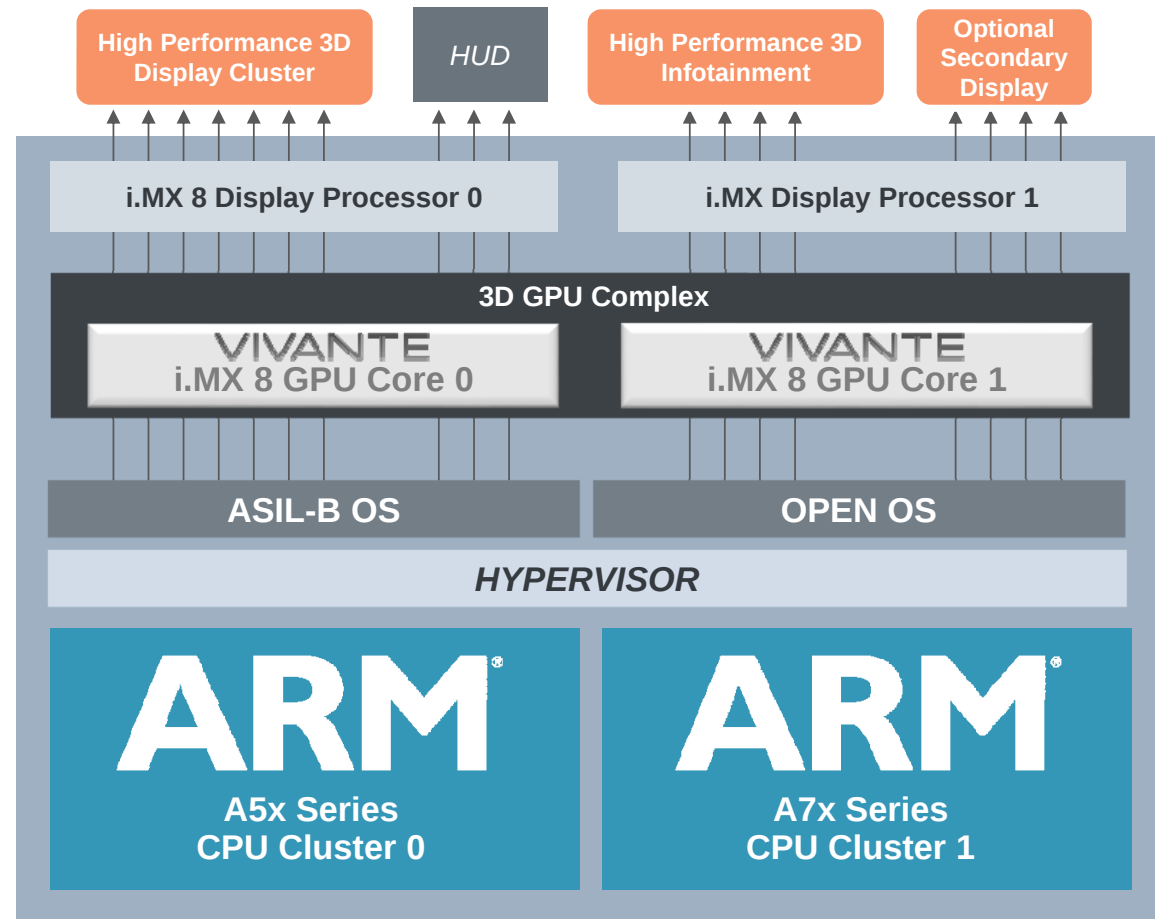
Advanced Applications Processor (Delta from Infotainment SoC)
ASIL B ARM Hypervisor
Additional DDR / Additional program NVM
Cluster plus optional HUD LVDS Serializers
Cluster plus optional HUD Deserializers



i.MX 8 Family eCockpit Solutions

Advantages

- *Dual Independent Display Controllers*
- *Configurable GPU Cores*
 - *Single Monolithic GPU*
 - *Dual Independent GPUs*
- *Industry Standard ARM enablement*
- *SoC Level Virtualization*



i.MX SOFTWARE



Leadership Software – i.MX Linux Enablement

i.MX 6 and 7
series GA on
Linux kernel
4.1 (Oct/16)



- Silver Member of Linux Foundation
- AGL Working Group Bronze Member
- Over the past 15 years shipping i.MX applications processors, there have been 39,000+ Linux downloads



- *Multiple i.MX 6 series customer engagements are using GENIVI solutions*
- *NXP has more compliant platforms than ANY semiconductor vendor*



- Reference: <http://www.genivi.org/compliant-products>

i.MX **Android** Enablement



Commitment: **11** (*soon to be 12*) Android OS versions released over past 8 years

Broad Acceptance: **25,000+** downloads of BSP to date

Fast Development: **~4 months** from development start to production release on multiple Android versions

Cross market robustness: **Automotive, Embedded/Industrial, Consumer**

Continued support: New OS releases for **min. 2 years** after silicon production

Leadership: i.MX – only Android system shipping in a **top 5 OEM infotainment platform** today

**Android
Nougat
coming
1H/17**



Strongest Operating Systems for i.MX Applications Processors

Supplier	i.MX 6, 7 and 8 series ARM Cortex-A technology	i.MX 6SoloX, i.MX 7 and 8 series ARM Cortex-M technology
NXP Semiconductor	Yocto Linux OS and Android OS (Brillo OS on selected devices)	FreeRTOS
Mentor Embedded	Linux OS and Nucleus RTOS	Nucleus RTOS
Micrium	uC/OS II and III RTOS	uC/OS II and III RTOS
QNX	Neutrino RTOS	-
Green Hills	INTEGRITY RTOS	-
Adeneo	Windows Embedded	
Express Logic	ThreadX RTOS (coming soon)	ThreadX RTOS (coming soon)

i.MX HARDWARE



i.MX 6 Reference Designs (with Production Silicon)

- All Boards NXP designed
- All Boards NXP supported
- Common set of boards for 6Q/D/DL/S
- SoloLite will have its own EVK

				
i.MX 6Quad • Dual DDR	i.MX 6Dual • Dual DDR	i.MX 6Dual Lite • Dual DDR • EPD	i.MX 6Solo • Single DDR • EPD	i.MX 6SoloLite • Single DDR • EPD

SABRE-AI for Auto
(\$1499)



SABRE Platform for Smart Devices (\$999)



SABRE Board for Smart Devices (\$399)



i.MX 6SL EVK
(\$599)



✓			✓	
✓		✓		
✓				
				✓

i.MX 6 maximizes use of reference boards across derivative parts

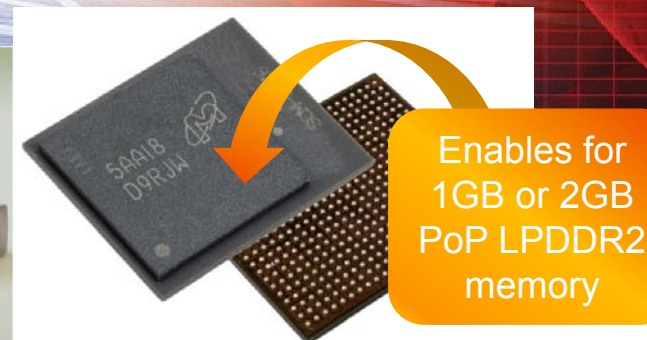
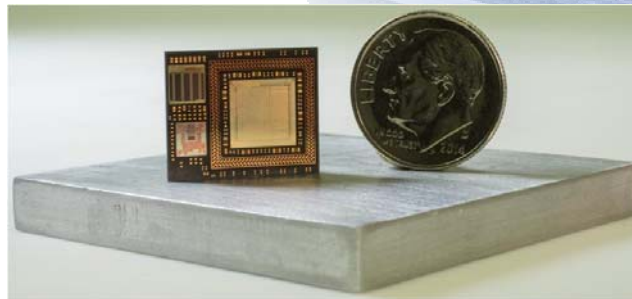
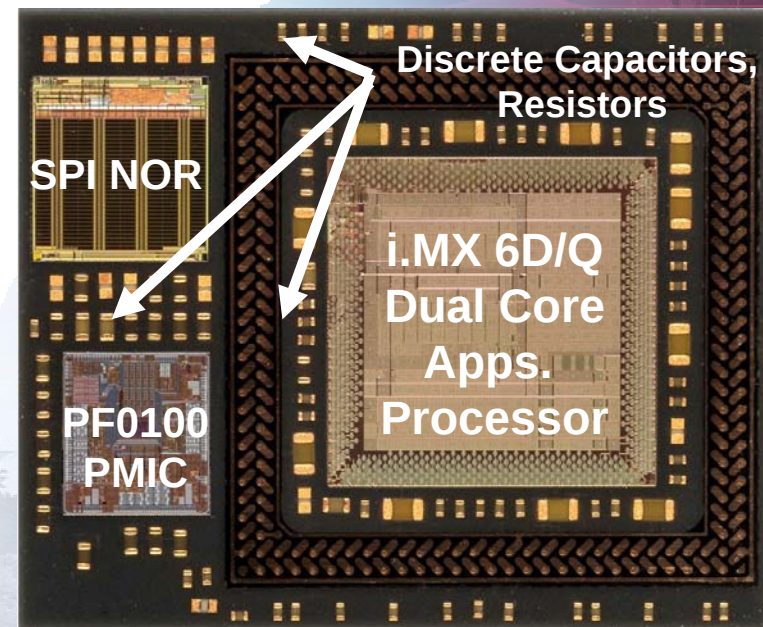


Small Package Options for i.MX Processors

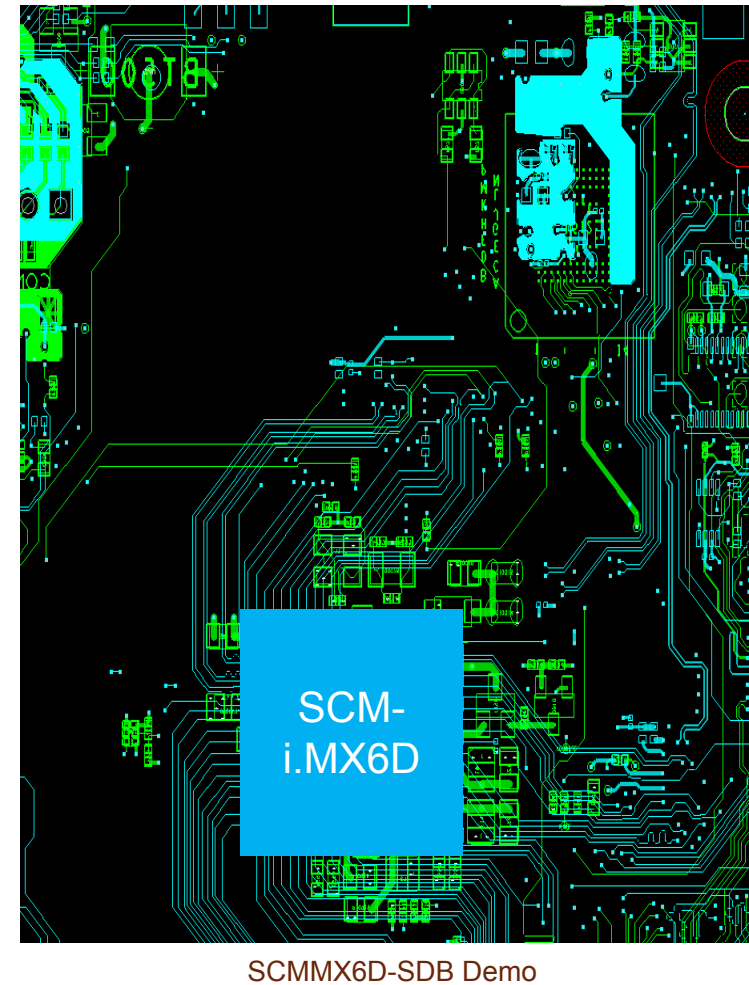
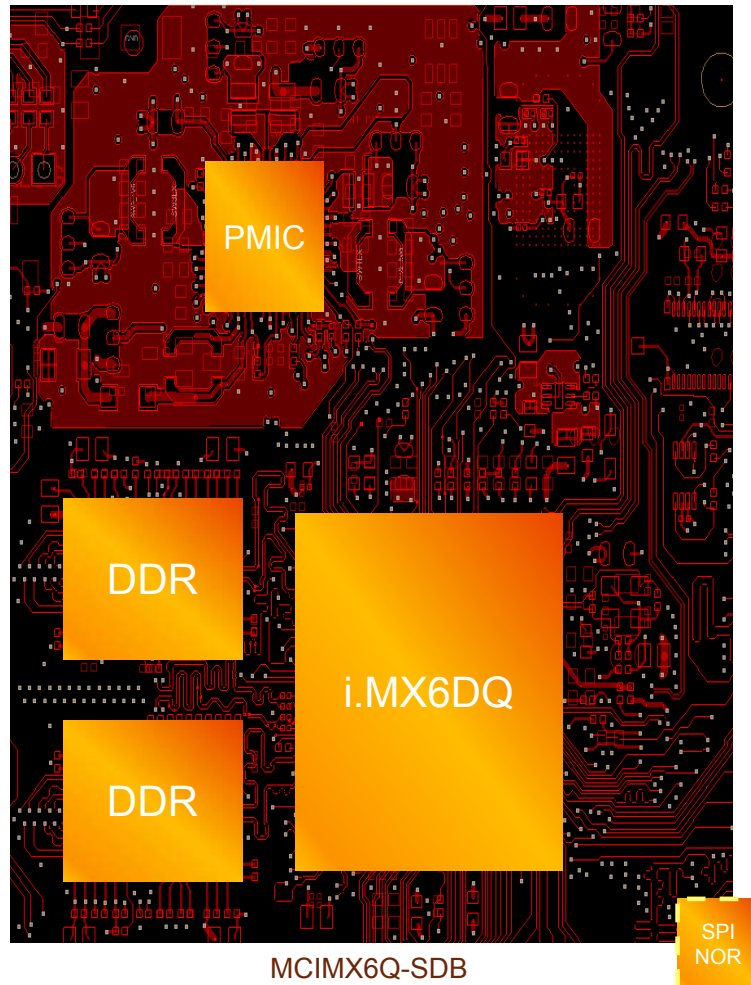
i.MX product families	Smallest Ball Grid Array (BGA) planned	Package on Package (PoP)	Single Chip Module (SCM)	3rd-party System on Module (SOM)
i.MX 6Quad i.MX 6Dual	21x21, 0.8p, FC-PBGA 624	12x12, 0.5p, FC-CSP 569	17x14, 0.65p, 1GB or 2GB LPDDR2, 16MB SPI NOR + PMIC	Many
i.MX 6SoloX	14x14, 0.65p 17x17, 0.8p	Not planned	Launching soon	Several
i.MX 6UltraLite	9x9, 0.5p 14x14, 0.8p	Possible if good business case	TBD	Several
i.MX 7Dual i.MX 7Solo	12x12, 0.4p 19x19, 0.75p	Possible if good business case	TBD	Several

Introducing the SCM-i.MX 6D/6Q

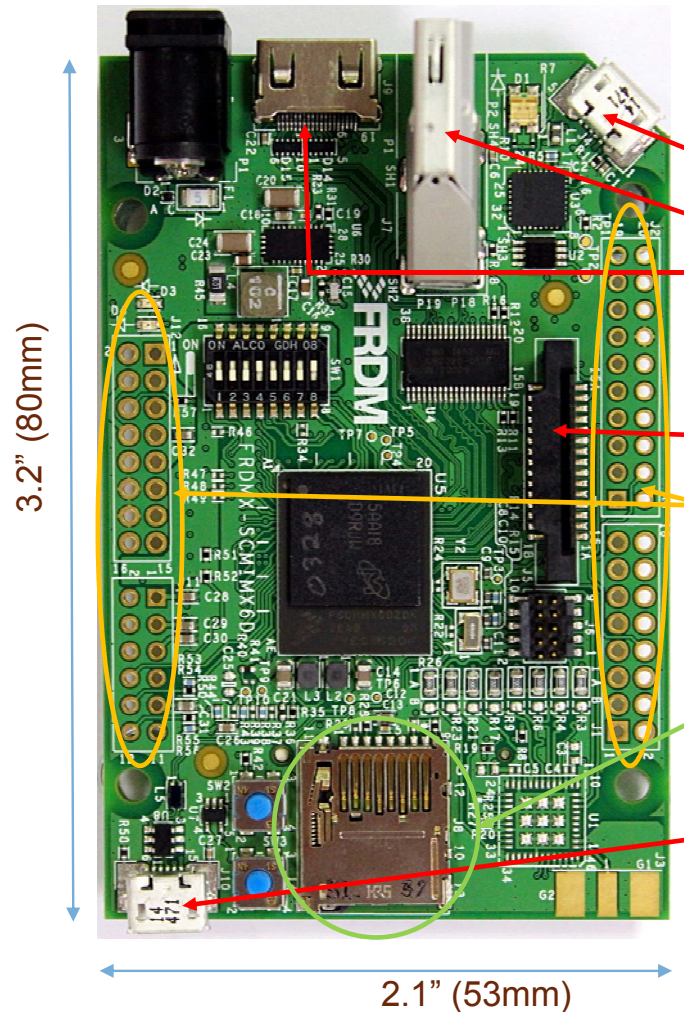
- It's the **world's smallest single chip system**.
- Solution integrates **fully featured dual-core or quad-core processor**, fully integrated power management system, memory, and enhanced security features in a single chip system module, all in **the size of a dime**.
- **Breakthrough time to market**—get there in about 6 months or less.
- **Highly integrated** with NXP's high-end dual and quad core apps processor, which provides full suite of features and functions addressing broad range of customer needs.
- **Unprecedented ultra-small form factor** with greater than 50% reduction over current discrete solutions.



PCB Space Reduction Achieved by SCM-i.MX 6Dual/6Quad



SCM-i.MX 6Dual/6Quad Quick Start Board

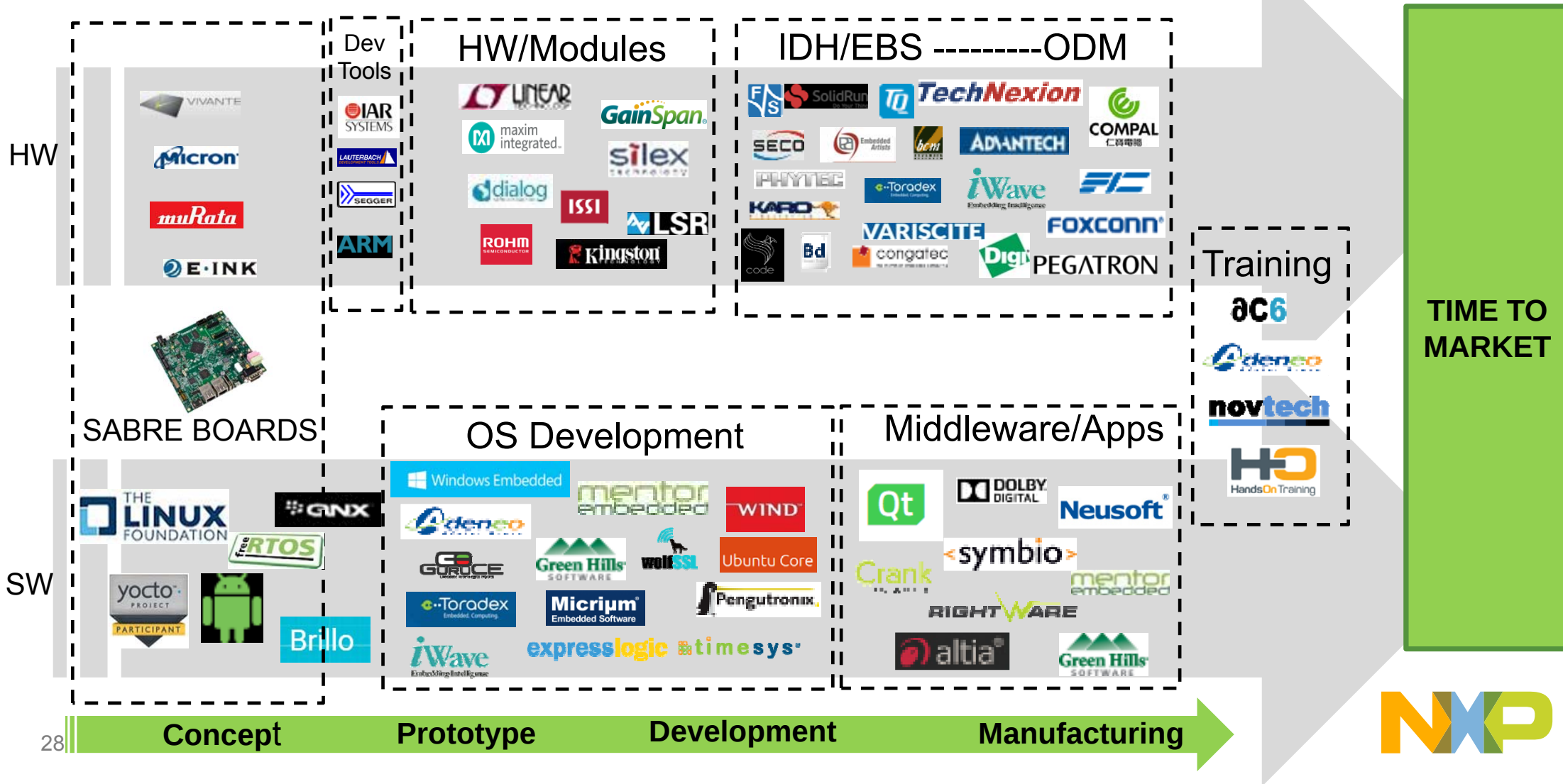


- SCM-i.MX6D (1GB LPDDR2 + PMIC PF0100 + 16MB SPI NOR)
- Micro-SD card socket
- Standard SD card socket
- HDMI connector
- JTAG (10 pin)
- USB (UART to USB serial debug)
- USB device mode
- MIPI Camera connector (compatible with Raspberry Pi 2 camera module)
- LVDS display (w/ cap. touch) connector (compatible with Element14 9.7" LCD display with mini-HDMI connection)
- Wi-Fi available via SDIO interface* (compatible with Murata SD module)
- Arduino R.3 header compatible (no ADC)
 - AUDMUX, SPDIF, ENET (10/100), SPI, UART muxed with Arduino headers.

i.MX ECOSYSTEM



i.MX Ecosystem. Many Markets, Many Choices

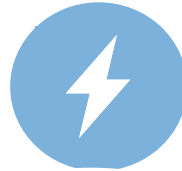


MICR Software and Service (MSS)



Software, Professional Support & Services

Complimentary Software & Tools



Kinetis Design Studio, Software Development Kit, Pin Config, Power Estimator/Analyzer, Bootloader, RTOS, Linux & Android BSPs, Manufacturing tools...

Complimentary Support



NXP Development and Reference Boards
NXP Communities
Technical Information Center
Systems Engineering (Apps) Organization
Distributor and Field Application Engineering

Professional Services

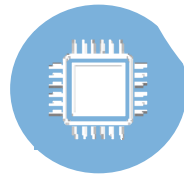


Managing Skills Gaps & Engineering Capacity
Global Staffing Capability
Vested Interest in Mutual Success
Graphic, Security, Linux/Android, Cloud.

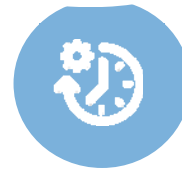


Embedded Processing
Solutions

Hardware Services



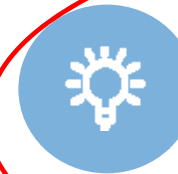
1st Time Boot
Schematics & Layout Review
Design Simulation



Professional Support

Risk Reduction
Fast Answers
Hot Fixes

Software Products / Technology



AVB, Miracast, HDCP2.x, TRLE, TEE, Home Kit, CarPlay, Android Auto, MICROEJ AUTOSAR, GPU Driver optimizations, AGL, Genivi, XBMC, HAB

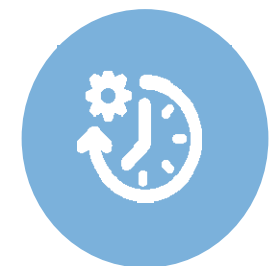


Available Software Products / Technologies

- **AVB** (Audio Video Bridging) (nxp.com/AVB)
 - Delivering high quality A/V over Ethernet
 - End node (full-stack or audio only) and AVB bridge solutions available
- **TEE** (Trusted Execution Environment) (nxp.com/TEE)
 - Used to implement a safe zone within the application processor
 - TEE offers protection against software attacks in a rich OS environment (like Android or Linux)
- **TRLE** (Tessellation Run Length Encoding) (nxp.com/TRLE)
 - NXP's TRLE technology provides an efficient, lossless image compression that leverages use of GPUs while minimizing memory requirements.

[Android™ Auto](#), [Apple® CarPlay\(TM\)](#), [AUTOSAR® MCAL for i.MX Applications Processors](#), [MIRACAST™ for Linux](#), [Homekit / Mfi](#), [Thread Connectivity Stack](#)

Check our website for more information: www.NXP.com/SWtech



MSS Case Study



AVM Platform

Solution

i.MX6 D
i.MX6 DL
+
Linux 3.14.28 BSP
+
Fast Boot/HAB
+
Professional Services

Function	Required Time (sec)	Measure Time (sec) i.MX6 D 3.0.0 + Audio Patch
Splash screen	0.5	0.266
Park assist Camera Video	1.5	1.39
Park assist Camera Audio	1.5	1.41
Splash Video	2.0	1.6
Park assist HMI	4.6	2.8



Achievements:

- Fast boot (with HAB) for splash video, rear view camera and early audio
- Provided example Qt QML park assist assist application.
 - Cameras are displayed prior to HMI boot, then HMI is added without flicker in camera feeds.
- Provided requested features on 2 different customer boards
- Assisted customer with integration of HMI strategy into their application.



Telematics platform

Solution

i.MX6S/Q
+
Linux BSP
+
Professional
Services



Accomplishments

- Development of a Test and Debug environment
- Support and maintenance of the Linux kernel

Telematics Platform

Solution

i.MX6 DL
+
Linux 3.14.28 BSP
+
Professional Services



Achievements:

- Custom BSP port to customer board including :
 - IEEE1588 Timestamping
 - Spansion NOR H/W protection PPB (persistent protection bit) & Automatic ECC
 - USB SIM reader
- Optimized Ethernet PHY
 - Support BCBP PHY to link up within 150ms after Power-up
- Support for single image file and alternate image programming method

Instrument Cluster

Solution

i.MX6DualPlus
+
Linux BSP
+
Professional Services



Achievements:

- Captured business away from competitor
- Hit delivery milestones on time!

Instrument Cluster

Solution

i.MX6(DL/DP)
+
Integrity BSP
+
3D Graphics
+
Professional Services



Achievements:

- Qualified graphical stack to secure customer release plan
- Delivered the first ports to GHS Integrity for the 4.x and 5.x version of the driver, supporting i.MX6DQP and i.MX6DL
- Hardened and stabilized the Graphical stack

BMW Backup Camera

Solution

i.MX 6DualLite
+
Autosar MCALs
+
Integration
Consulting



Achievements:

- Provided RTM Release and Support
- Assisted Partner/Customer with integration into their application.

Payload Camera

Solution

i.MX6D
+
Linux BSP
+
Professional Services



AVB Audio switch

Solution

i.MX6Quad
+
Linux BSP
+
AVB audio
+
Professional
Services



Achievement:

- 1st commercial solution with Audio-Video Bridging

Solution

i.MX6 D
+
Linux 3.10.53 BSP
+
Miracast Sink
+
HDCP 2.2
+
MSFT PlayReady
+
Professional Services



Micro Projector

Gas Pump

Solution

i.MX6 D
+
Linux 3.14.28 BSP
+
MQX 4.2.0 BSP with
OpenAmp
+
Professional
Services



Achievements:

- Innovation project with MQX+ Linux running on each core of i.MX6 D with intercore communication
- Major cost reduction in Hardware (5 boards reduced to 1)
- Due to service team involvement, NXP will displace competitor device with Kinetis for final production solution.



Solution

i.MX6 Q
+
Linux 3.14.28 BSP
+
Professional Services



Audio Switch

Achievements:

- Rewrite audio drivers to use FIQ for switching at lower level instead of user space.
- Create audio drivers for audio sound cards and codecs used on customer board: AK5384, AK4425, AK4122, TAS5558
- Enable SPDIF
- Extended support for 96kHz for audio I/O
- Extend audio routing to provide the ability to take any of the four wired inputs (2 TOS link, 2 Analog), and switch them to any of the 6 outputs (4 amplified, 1 Digital COAX, 1 Analog).



Enterprise IP Phone

Solution

i.MX6DL
+
Android BSP
+
Networking (Eth)
+
Security
+
Professional Services



Requirements

Port Android support to existing production quality HW platform
Develop and integrate middleware customer specific features into Android: Networking, Security
Connectivity: BT
Provide support until production launch (planned in Q1'17)

Achievements

Established NXP as a platform provider
4 intermediate milestone releases made on time to customer

i.MX AUTOMOTIVE



Automotive Solutions

Infotainment



Instrument Cluster

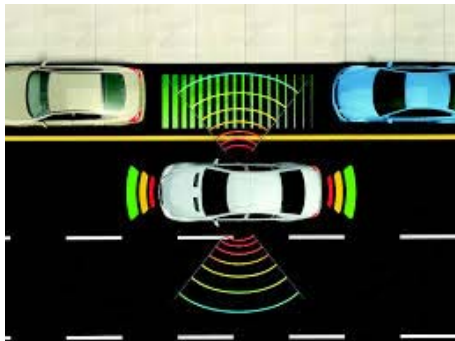


Mid-Level Instrument Cluster

Highly-integrated, cost-effective, single-chip, programmable solution supports adding ADAS functions.



Surround View Park Assist System



Smart Key



HUMAN MACHINE INTERFACE

ANDROID TRIPLE DISPLAY

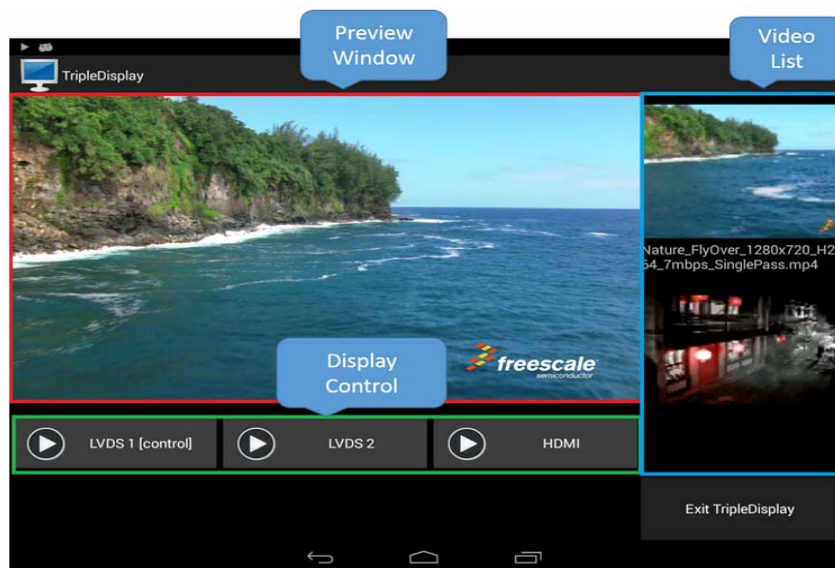


Android Triple-Display

- The user can play different video by clicking control button for specifying the target device

Triple display output

- 1x 1080p HDMI
- 2x 720p LVDS



← Main Display UI

Multiple Display Applications



Rear Seat Entertainment

- Media Playback
- TV
- Games
- Controls



KTV

- HDMI TV
- VOD
- AD.



Advertising Machine

HUMAN MACHINE INTERFACE

MIRACAST SOURCE/SINK



Miracast

Miracast is a peer-to-peer wireless screencast standard formed via [Wi-Fi Direct](#) connections in a manner similar to [Bluetooth](#). It was created by the [Wi-Fi Alliance](#) and billed as an [open](#) alternative to [Apple's AirPlay Mirroring](#). Both the sending and receiving devices must be Miracast certified for the technology to work.

<http://www.wi-fi.org/wi-fi-certified-miracast%E2%84%A2>



Miracast allows a portable device or computer to send, securely, up to [1080p](#) HD video and [5.1 surround sound](#) ([AAC](#) and [AC3](#) are optional codecs, mandated codec is LPCM — 16 bits 48 kHz 2 channels).

Miracast Source/Sink Example



Miracast Source/Sink from FSL BSP

- Android Jelly Bean 4.2 or later version adds Miracast Source support by default. NXP expands the software to support Miracast Sink:
 - Wi-Fi P2P
 - RTSP streaming decoding (up to 1080P resolution)
 - Compatible for variable Wi-Fi cards
 - Silex AR6233X SDIO card (Atheros AR6103)
 - Realtek 8723AS SDIO card
 - Delivery:
 - Freescale proprietary java archive and native library
 - Simple APIs to customize Miracast Sink Application.
 - Demo Sink Application
 - Non- Supported features:
 - TDLS (Tunneled Direct Link Setup)
 - HDCP (High-bandwidth Digital Content Protection)

<https://community.freescale.com/docs/DOC-102180>

HUMAN MACHINE INTERFACE

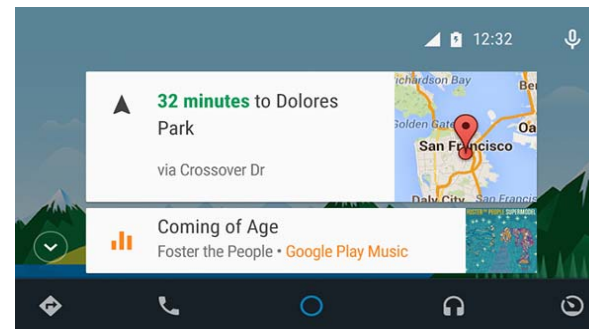
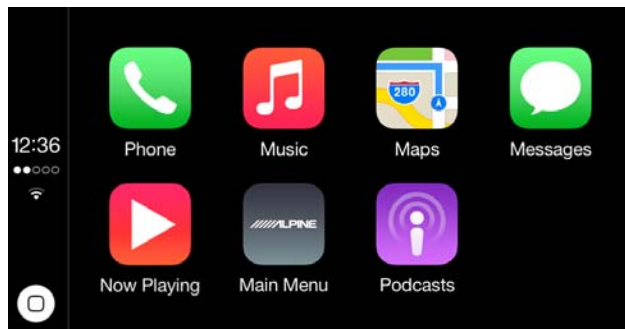
CARPLAY AND ANDROID AUTO



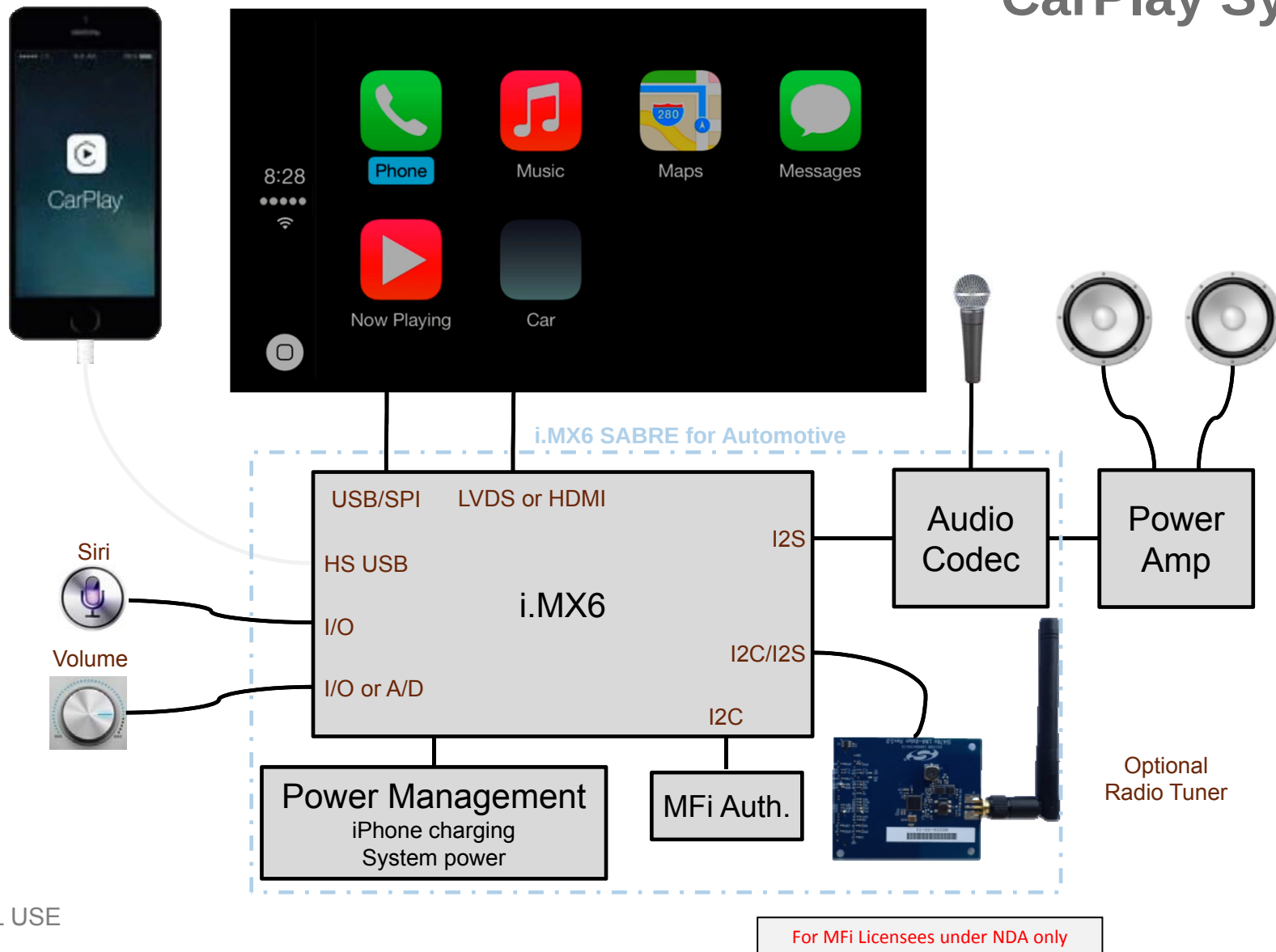
Introduction to Apple CarPlay and Android Auto

Apple CarPlay and Android Auto provide a user interface optimized for the driver and “projected” onto the automotive infotainment system, almost entirely controlled by the phone.

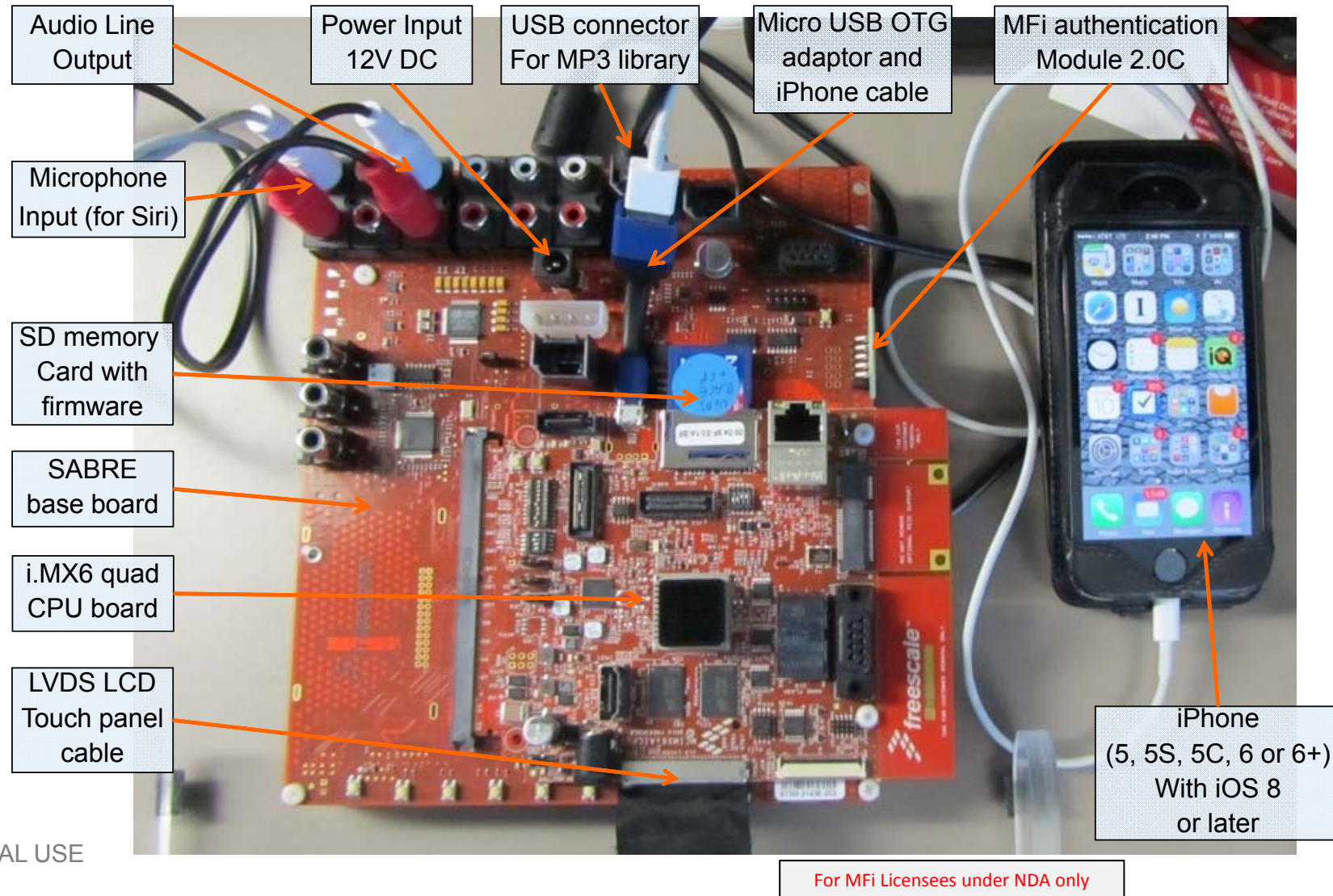
- The functionality is limited to that appropriate for the driver
 - No video playback, no emails, no facebook, no web browsing, no typing
- Key functionality
 - Navigation, hands-free phone, audio playback, hands-free messaging
 - many functions are voice activated (Siri or Google Now)
 - user interface icons are large and Apps are simplified



CarPlay System



Apple CarPlay Demo Setup: Overall System



VIRTUAL INSTRUMENT

DIGITAL CLUSTER



Digital Cluster

- Virtual cluster demo is built on top of the Linux fast boot demonstration published in the IMX Community.
- The boot time is roughly **1.5s**. The demonstration is based on L3.0.101_4.1.1 BSP release running on i.MX6QSDP board.



ADVANCED DRIVER ASSISTANCE SYSTEMS

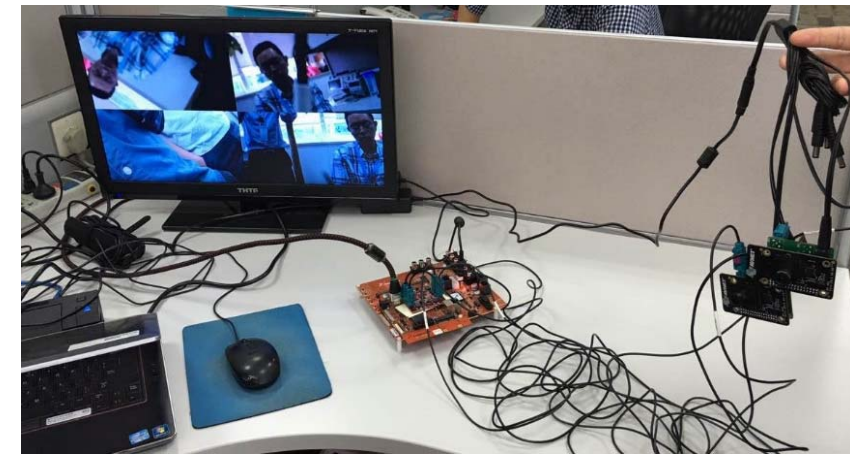
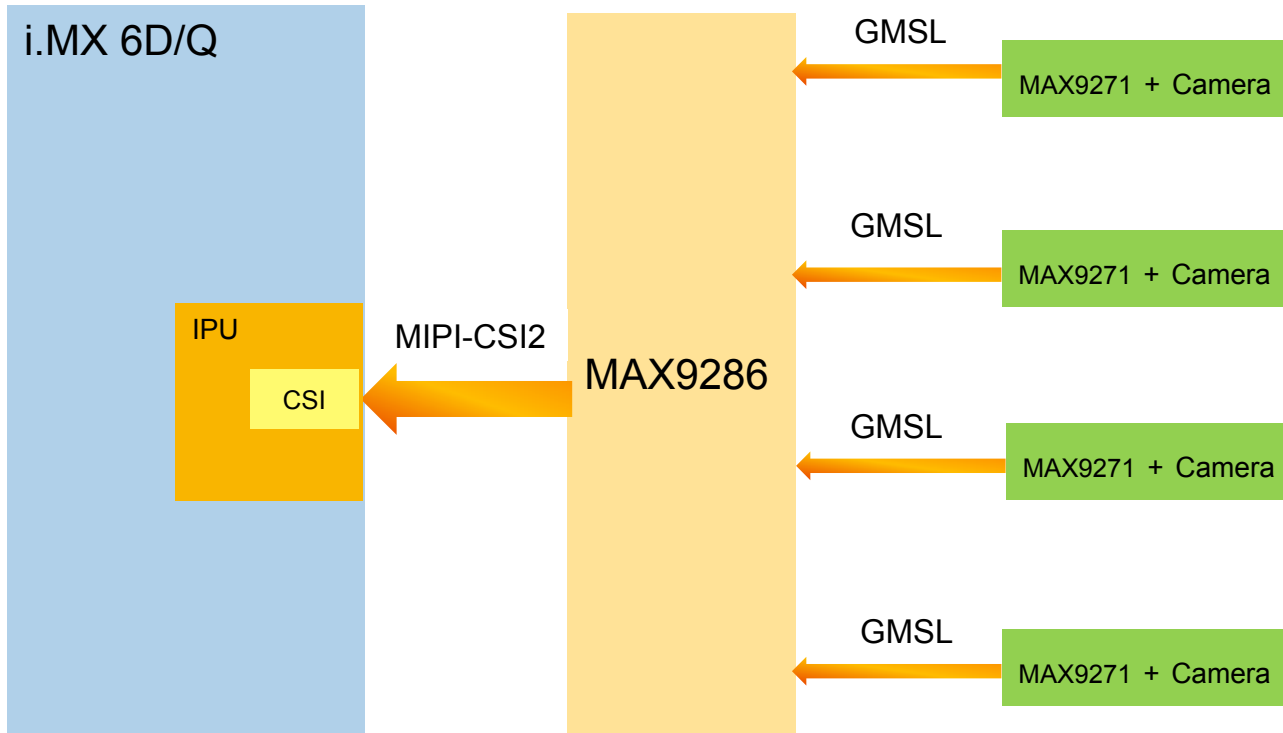
SURROUND VIEW



i.MX 6 ADAS/Surround View Solution Overview

Solution	Resolution	Part #	Feature
CVBS	D1 resolution ADAS	Intersil TW6865	CVBS -> PCIe
CVBS	D1 resolution ADAS	Intersil TW9985	CVBS -> MIPI CSI
LVDS	HD Digital (720p) ADAS	Maxim MAX9271+MAX9286	Camera->MAX9271(Coax) ->MAX9286(MIPI-CSI)
Ethernet	HD Digital (720p) ADAS	MPC5604+Ethernet Switch	Camera->MPC5604 -> Ethernet Switch

LVDS Surround View – Digital HD 720P



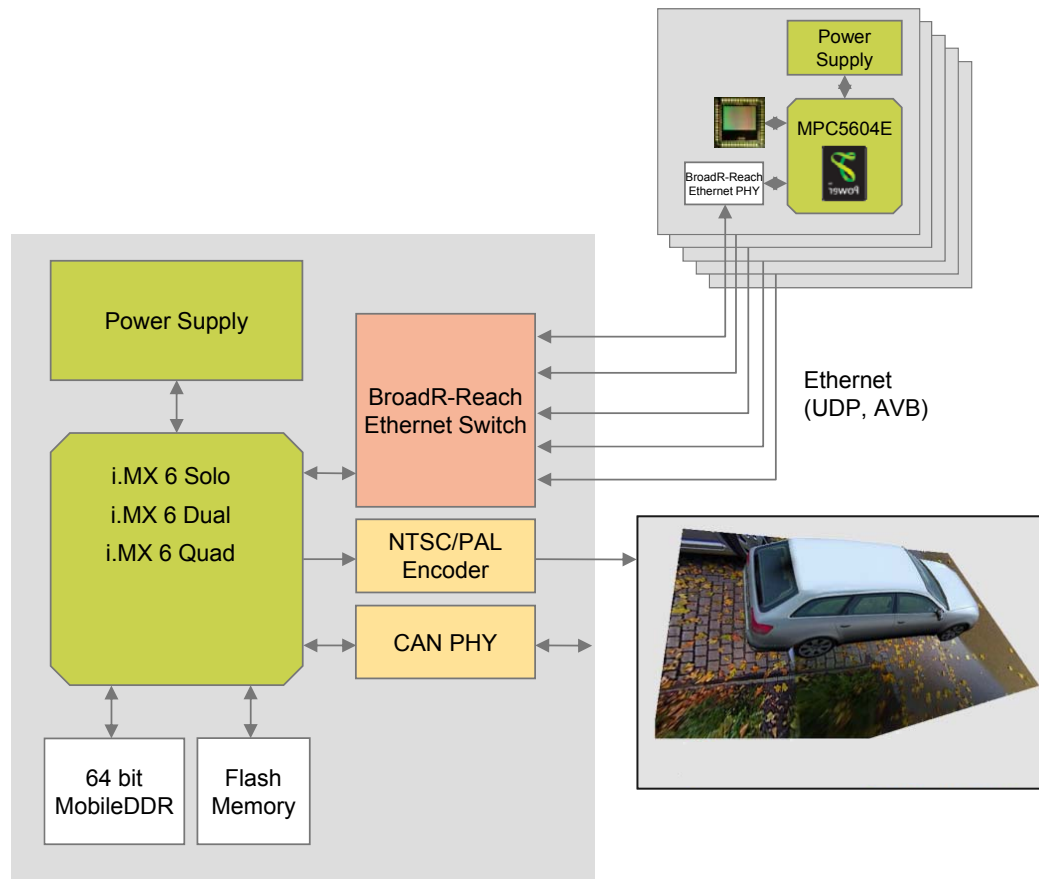
Ethernet Surround View – Digital HD 720P



MPC5604E + Ethernet
Camera SW application



Ethernet Surround View – UDP & AVB



Required:

- iMX6DQ platform
- Broadcom switch
- MPC5604E MCU
- OV camera sensor

* AVB is provided by software service

Summary

1. Why NXP i.MX?
2. Not only key features enabled for automotive. And also, targeting on e-book, e-POS, IoT and so on...
3. Brings a wide range of components to today's designs.

Sensor (G-sensor, e-Compass, Gyro, TPMS...), PMIC, NFC,
Wireless charger, MCU



SECURE CONNECTIONS
FOR A SMARTER WORLD