

# Smart CAR solution with Freescale : Trend and considerations

Freescale 김태현

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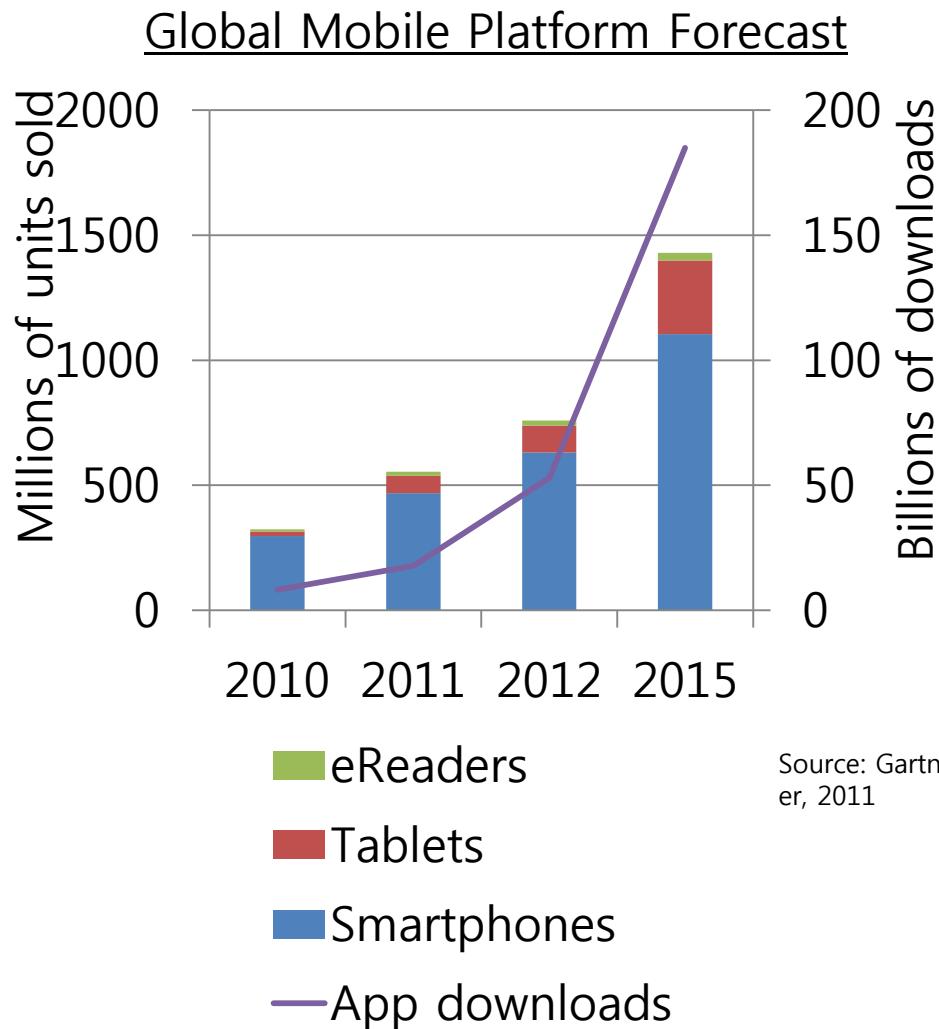


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# What's happening in the consumer market ?

- Mobile platform sales to consumers are rocketing
- Automotive infotainment volumes are tiny in comparison
- Pace of innovation makes future requirements impossible to predict



# Is this the future of Automotive Infotainment ?

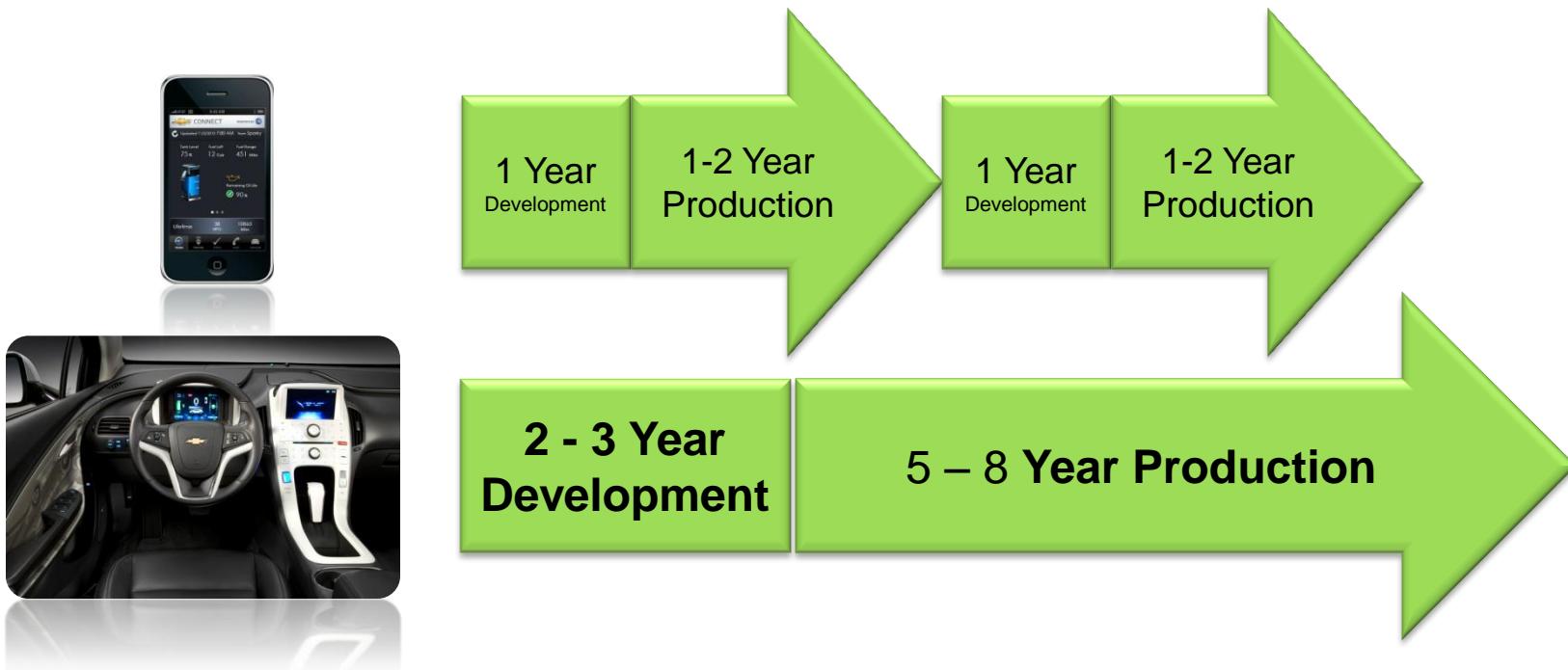


Or this ?



Android-based Infotainment system in production in China

# The Automotive Electronics Paradox



Customer Expectations:

Consumer Electronics: Fun and Features

Automotive Electronics: Quality and Safety

*Customer Expects A Car to Behave Like Their Car, Not Their PC*

# Rear Seat Systems



\$600 Tablet vs. \$2K rear seat system

Car as a Wi-Fi access point

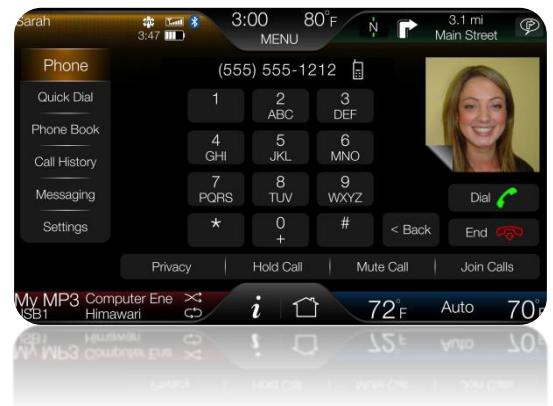
# Application Classes in the Car

- Car / Telematics / Embedded Applications
  - Run on the embedded infotainment system
  - Behave like a car, not a consumer device
- Applications brought into the vehicle
  - Run on a Smart phones, tablet, etc
  - Either standalone or connected to the embedded infotainment system
- Cloud Applications
  - User interface on the embedded infotainment system
  - Application resides in the 'cloud'



# Wide Area Network connectivity modes

- Embedded Modem
  - Radio Antenna can be optimized for in-car use
  - Not dependant on user's cellphone availability
  - Requires separate phone SIM and data plan
- Off-board modem
  - Uses cellular modem in driver's mobile device
  - Connection via USB or BT (WiFi in future ?)
  - No problems with keeping the mode m up to date

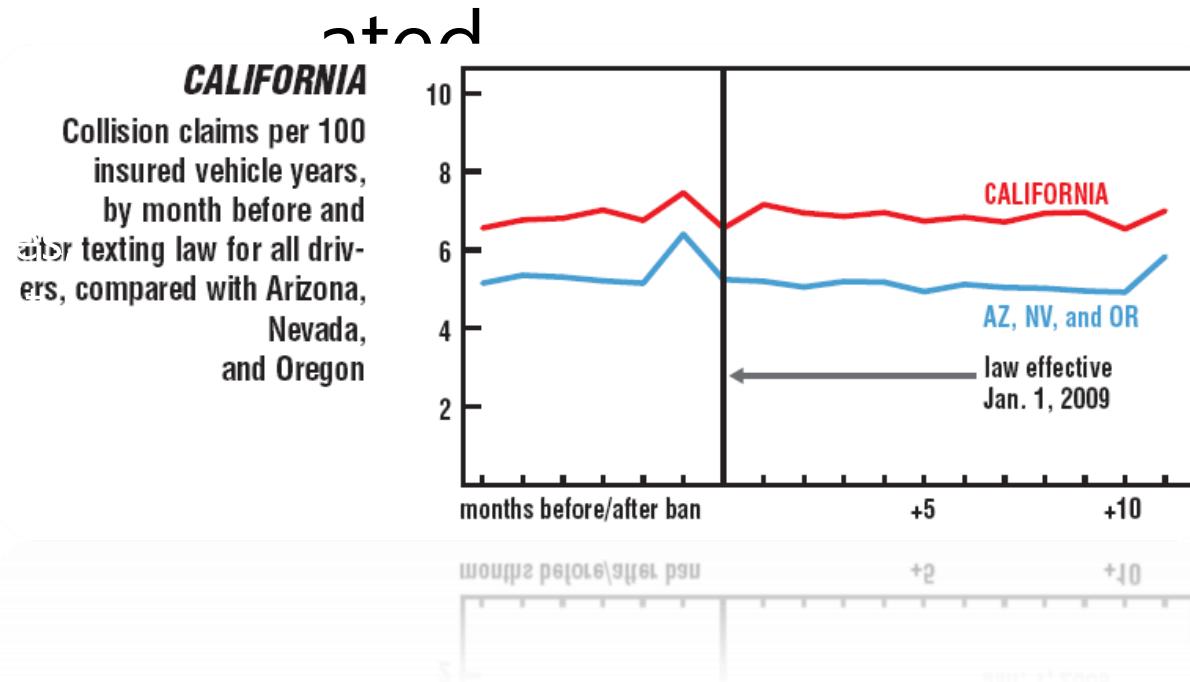


*Control Points: who owns the consumer?*

# The Driver Distraction Debate

- In an ideal world, no distractions at all are allowed and the driver concentrates 100% on the task of driving
- In the real world....a Virginia Tech Transportation study found the **Top 10 driver distractions** to be:
  1. Using a wireless device, such as a cell phone
  2. Talking and interacting with passengers
  3. Reaching for CDs, food, falling objects or other internal distractions
  4. Programming radio stations or tinkering with dashboard controls
  5. Using an electric razor, applying makeup or other actions related to personal hygiene
  6. Unwrapping a burger, opening a canned drink or other movements when eating at the wheel
  7. External distractions such as pointing out a billboard or pedestrian
  8. Talking or singing to oneself
  9. Smoking
  10. Daydreaming

# Sources of distraction cannot always be eliminated



- Prevent some applications from running in the car (video games, etc.)
- Enable useful applications to run with minimal driver distraction

# Which applications should run on the embedded infotainment system ?

- Applications which have a high level of interaction with vehicle systems
  - HVAC controls
  - Navigation on an Electric Vehicle
  - Ecodriving
  - Parking camera applications
  - Vehicle Diagnostics
  - Others ?
- Applications expected by the driver as standard features
  - Navigation on high-end cars
  - Media player
  - Radio

# Which applications are better running on the mobile device or cloud?

- Applications which are likely to evolve rapidly or can be more effective in the cloud
  - Social media
  - Internet-based search
  - Location-based services
  - Anything that hasn't been invented yet!
- In all cases the User Interface should be controlled by the embedded infotainment system
  - Minimize distraction
  - Prevent unsafe events

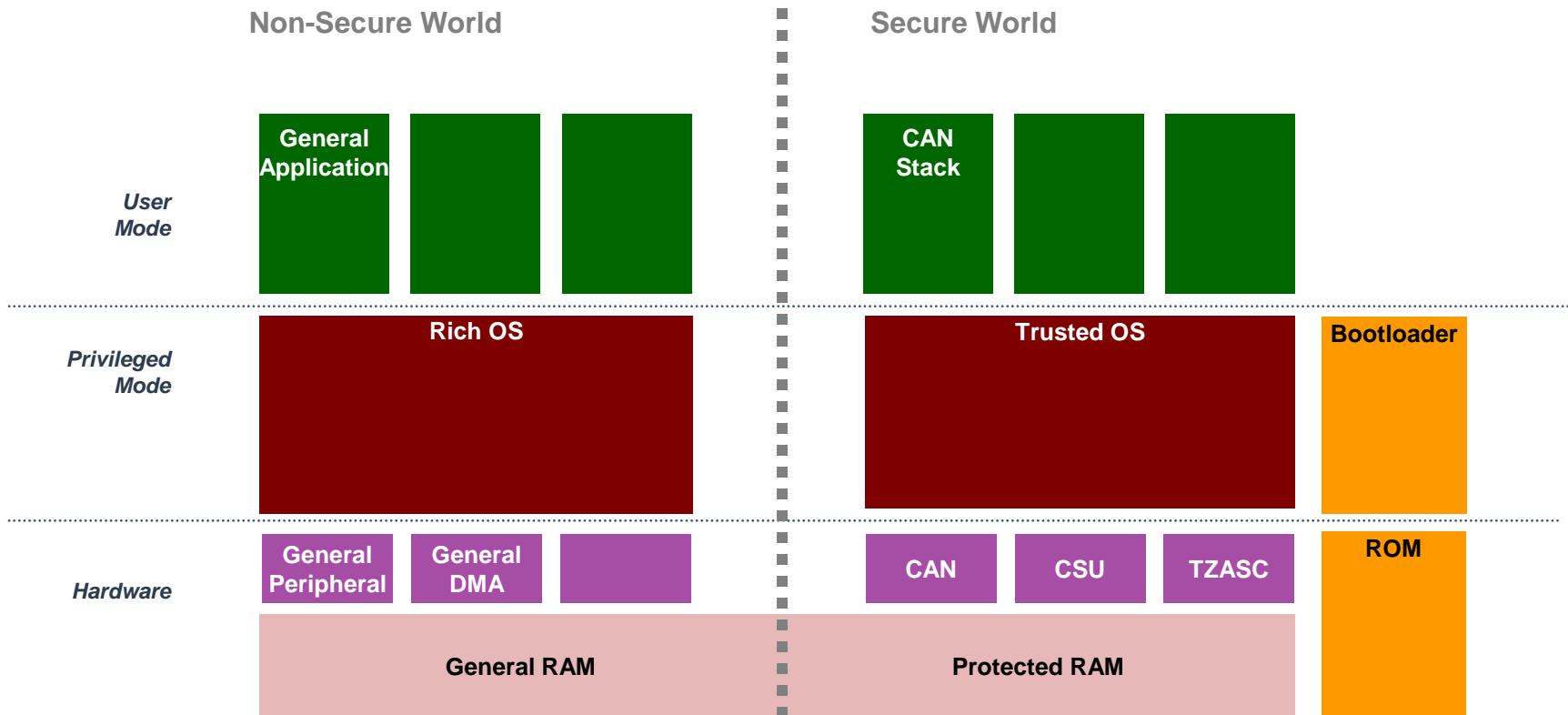
# Keeping “Apps” away from vehicle systems

- The “Always Connected” infotainment system is a huge security vulnerability
- 3<sup>rd</sup> party “Apps” are essentially untrustworthy

Options for protecting the car:

1. Use 2 different MCUs – one for vehicle gateway, one for infotainment
  - Does not prevent malware from sending a legitimate command to the gateway MCU e.g. “unlock the car”
2. Virtualization – untrusted SW domain isolated in memory and peripheral access
  - Performance impact
  - Should be complemented with hardware watchdogs

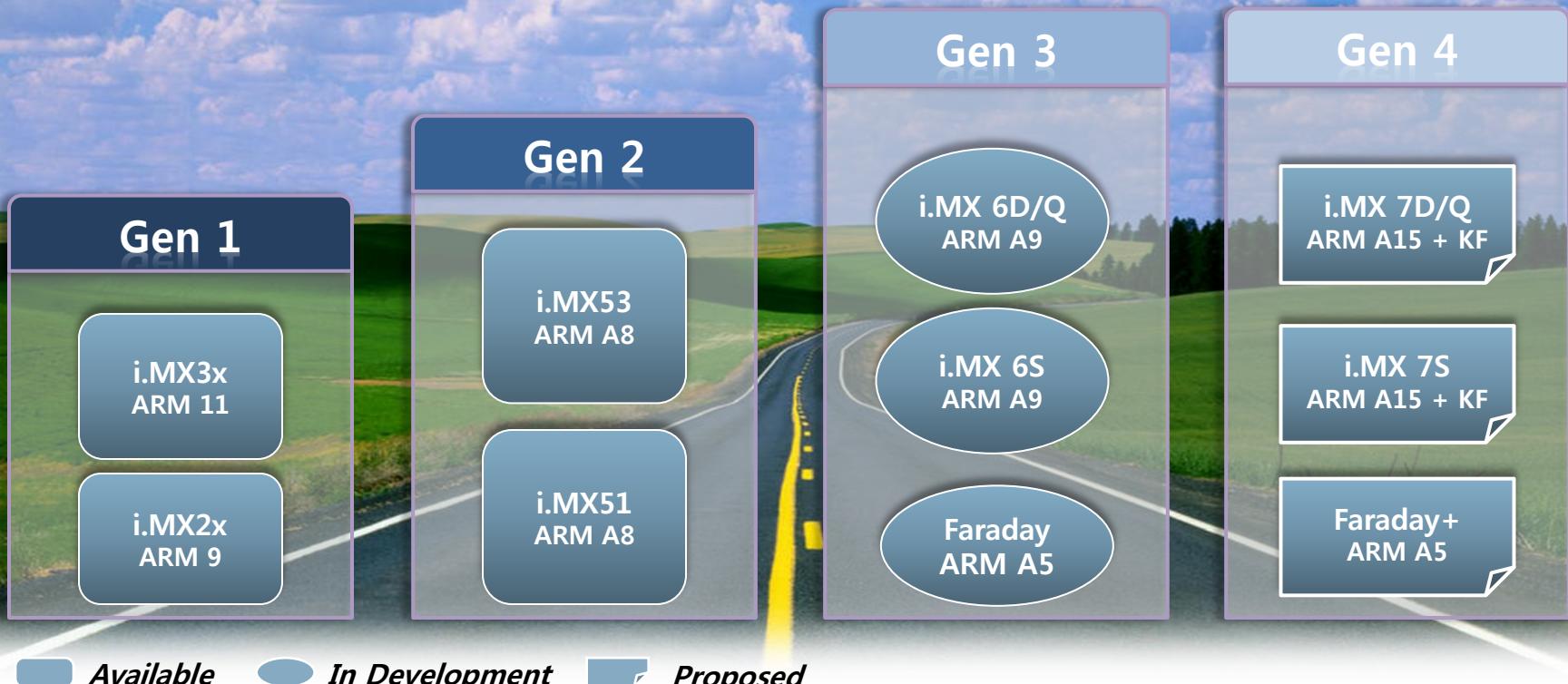
# i.MX TrustZone Virtualisation



# i.MX TrustZone Virtualisation Components

- Non-secure World
  - Rich OS
    - Linux/Android etc
    - Launched by Trusted OS
    - Manages general applications, services and HW
    - Runs SMP on multiple CPUs
  - General RAM
    - General SW & data
    - Shared access
  - General peripherals
    - Shared access
  - General DMA
    - Non-secure access only
- Secure World
  - Trusted OS
    - Real-time µ-kernel hypervisor
    - Launched at system boot
    - Manages critical HW/SW (e.g. CAN)
    - Runs on one CPU at a time
  - Protected RAM
    - Critical SW & data
    - Secure-world access only
  - Protected peripherals
    - CSU: peripheral isolation
    - TZASC: memory isolation
    - CAN
    - ...

# Infotainment Roadmap



# Infotainment Platform Roadmap

High-End  
Navigation  
Natural Language  
HD Video Decode  
Multiple Displays



High-Premium

Entry-Mid-Tier Nav  
Advanced Audio  
Entry Speech Rec  
Sophisticated GUI



i.MX35 family

QNX



Mid-Tier

Audio Connectivity  
GUI Support  
Segment -TFT LCD  
PDIMs

Faraday



i.MX25 / i.MX28 family



Connected Radio

# i.MX GENIVI Partners

*Turn-Key Compliant Solutions*



**WIND RIVER**

**Mentor Graphics**

**CANONICAL**

*Linux Services and Middleware*



**TELECA**  
**freescale**

*Security, Applications, Tools*



**pelagicore**



**dts**

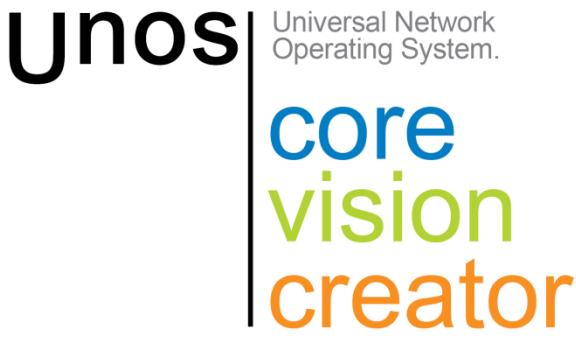


**secu****net**

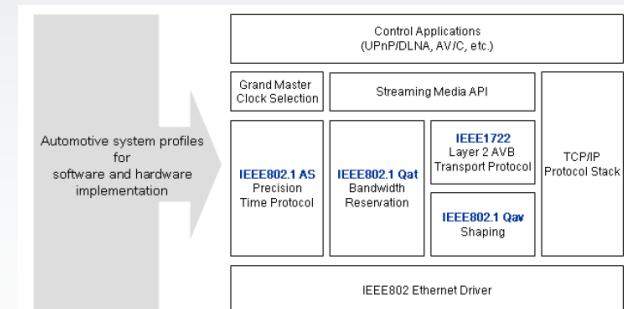


# i.MX Automotive Platform Support

## - Ethernet AVB



*Multiple partners are porting their custom stacks for automotive AVB applications on i.MX 6 Series*



Reference: Understanding IEEE1722 AVB Transport Protocol  
– AVBTP, March 9 2009, Harman International



# i.MX 6 Series Platform Support



i.MX 6Solo



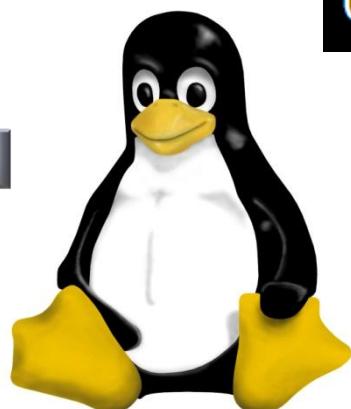
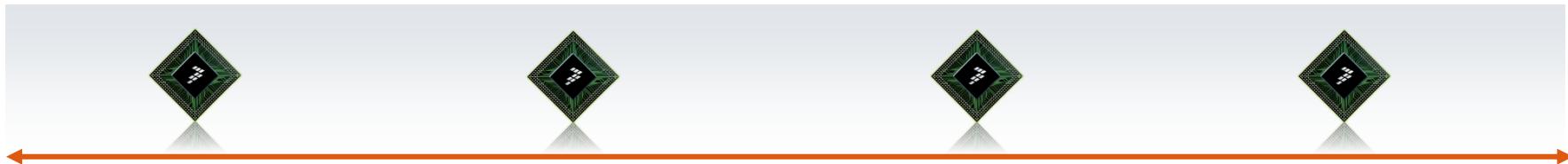
i.MX 6DualLite



i.MX 6Dual



i.MX 6Quad



QNX CAR Application Platform



# Infotainment Platform Roadmap

High-End Navigation  
Natural Language  
HD Video Decode  
Multiple Displays



## i.MX53 family



Windows Embedded  
Automotive 7



## i.MX51 family



Microsoft Auto 4.1



High-Premium

Entry to Mid-Tier Nav  
Advanced Audio  
Entry Speech Rec  
Sophisticated GUI

## i.MX 6 Solo



Windows Embedded  
Automotive 7



Mid-Tier

Audio Connectivity  
GUI Support  
Segment to TFT LCD  
PDIMs

## i.MX35 family



Microsoft Auto 4.1

## Next-gen



MQX

## i.MX25 / i.MX28 family



MQX



Windows  
CE6



Connected Radio

# i.MX Ecosystem



# Introducing the i.MX 6 Series

Industry's Most Scalable Family of Multimedia Applications Processors

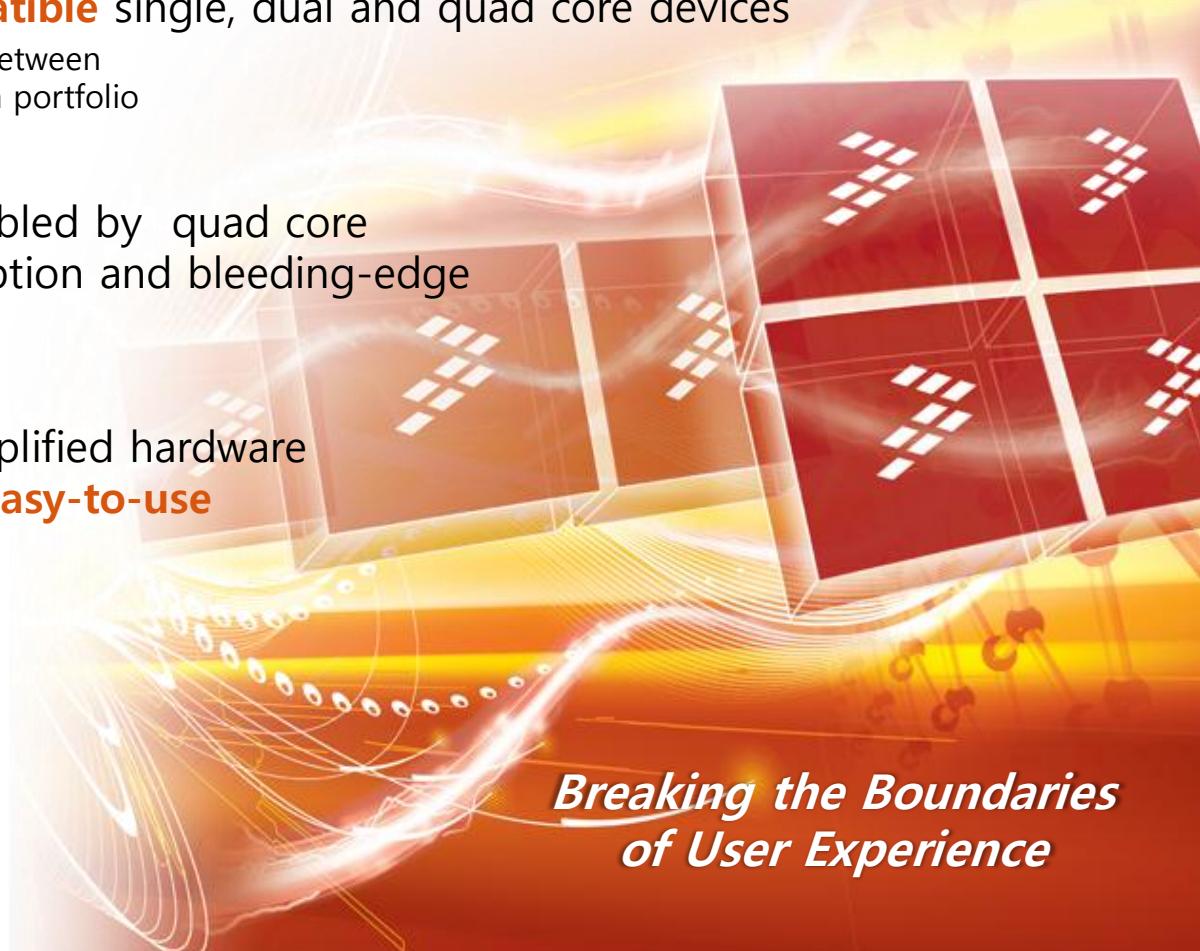
Build **scalable product lines** with the new i.MX 6 series —

**ultimate versatility** with **compatible** single, dual and quad core devices

- Software and hardware compatibility between families makes it even easier to build a portfolio of products quickly

**Best-in-class performance** enabled by quad core processing, low power consumption and bleeding-edge multimedia and graphics

**Fast development** through simplified hardware design, flexible interfaces and **easy-to-use** development kits



# i.MX 6 Series



## i.MX 6Solo

- Single ARM Cortex A9 at 1.2GHz
- 256KB L2 cache, Neon, VFPv16, Trustzone
- Next generation 3D graphics
- External memory support up to 3 2bit DDR3 and LPDDR2
- Integrated EPD controller



## i.MX 6Dual

- Dual ARM Cortex A9 up to 1.2GHz
- 1 MB L2 cache, Neon, VFPv16, Trustzone
- 3D graphics with 4 shaders up to 200MT/s
- External memory support up to 6 4-bit DDR3 and 2-channel 32-bit LPDDR2
- Integrated SATA-II



## i.MX 6Quad

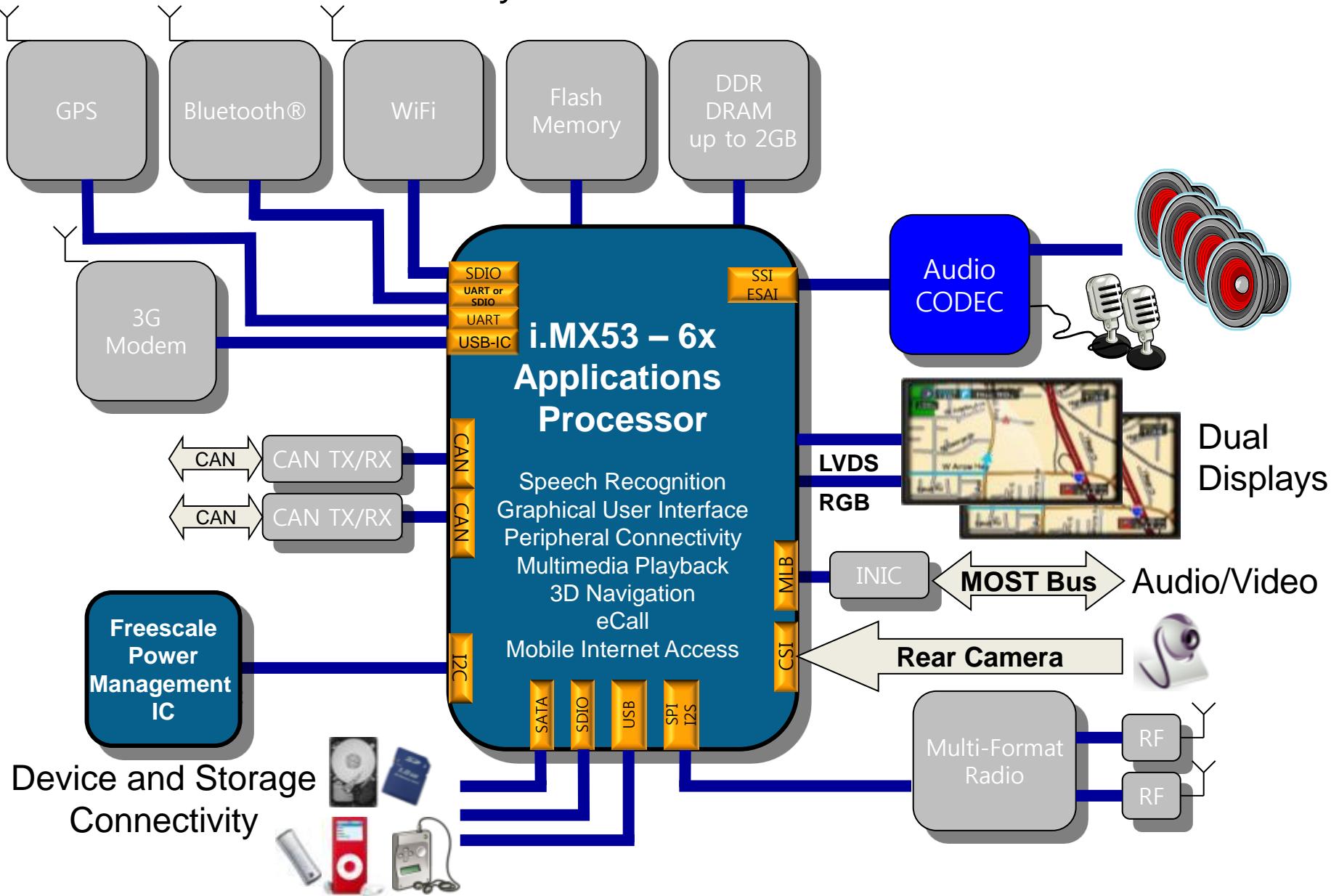
- Quad ARM Cortex A9 up to 1.2GHz
- 1 MB L2 cache, Neon, VFPv16, Trustzone
- 3D graphics with 4 shaders up to 200MT/s
- External memory support up to 6 4-bit DDR3 and 2-channel 32-bit LPDDR2
- Integrated SATA-II



## Common Features of the i.MX 6 Series Platform

- ARM Cortex A9 based solutions up to 1.2GHz
- HD 1080p encode and decode
- 3D video playback in High definition
- Low power 1080p playback at 350mW Integrated IO's that include HDMI v1.4, MIPI and LVDS display ports, MIPI camera, Gigabit Ethernet, multiple USB 2.0, PCI-Express, CAN controller, MLB bus
- Consumer, Industrial and Automotive temperature range qualifications
- SW support: Google Android, Microsoft Windows Embedded CE, Ubuntu, Linux, Linaro, Adobe Flash, Skype

# Platform Flexibility: i.MX SABRE for Automotive Infotainment

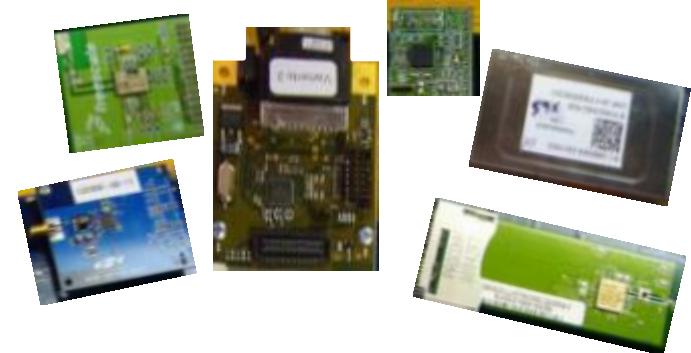


# i.MX SABRE for Automotive Infotainment

## Modular Reference Design Concept



- Main Board
  - Expanded connectivity options (CAN, MOST, USB, dual displays, SDIO)
  - Connectors for Processor Module and Wireless Modules



- Wireless Modules
  - GPS Module
  - Bluetooth/WiFi Module
  - 3G Modem Module
  - Radio Tuners
  - IAP