FTF 2016
TECHNOLOGY FORUM

SCALABLE NEXT-GEN MCU FAMILY WITH ADVANCED FEATURES

FTF-AUT-N1794

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AGENDA

- NXP General Purpose and Integrated Systems (GPIS) automotive portfolio
- S32K family introduction
  - Applications, features, and benefits
  - Complete solution offering
- NXP companion SBCs
- Next generation roadmap

One NXP

freescale™

- ✓ **50+** year history
- ✓ **17,300** employees
- ✓ **$4.59b** in revenue
- ✓ **$839m** in R&D

>$10B
IN ANNUAL REVENUE

~45,000
EMPLOYEES

35+
COUNTRIES

11,000+
ENGINEERS

9,000+
PATENT FAMILIES

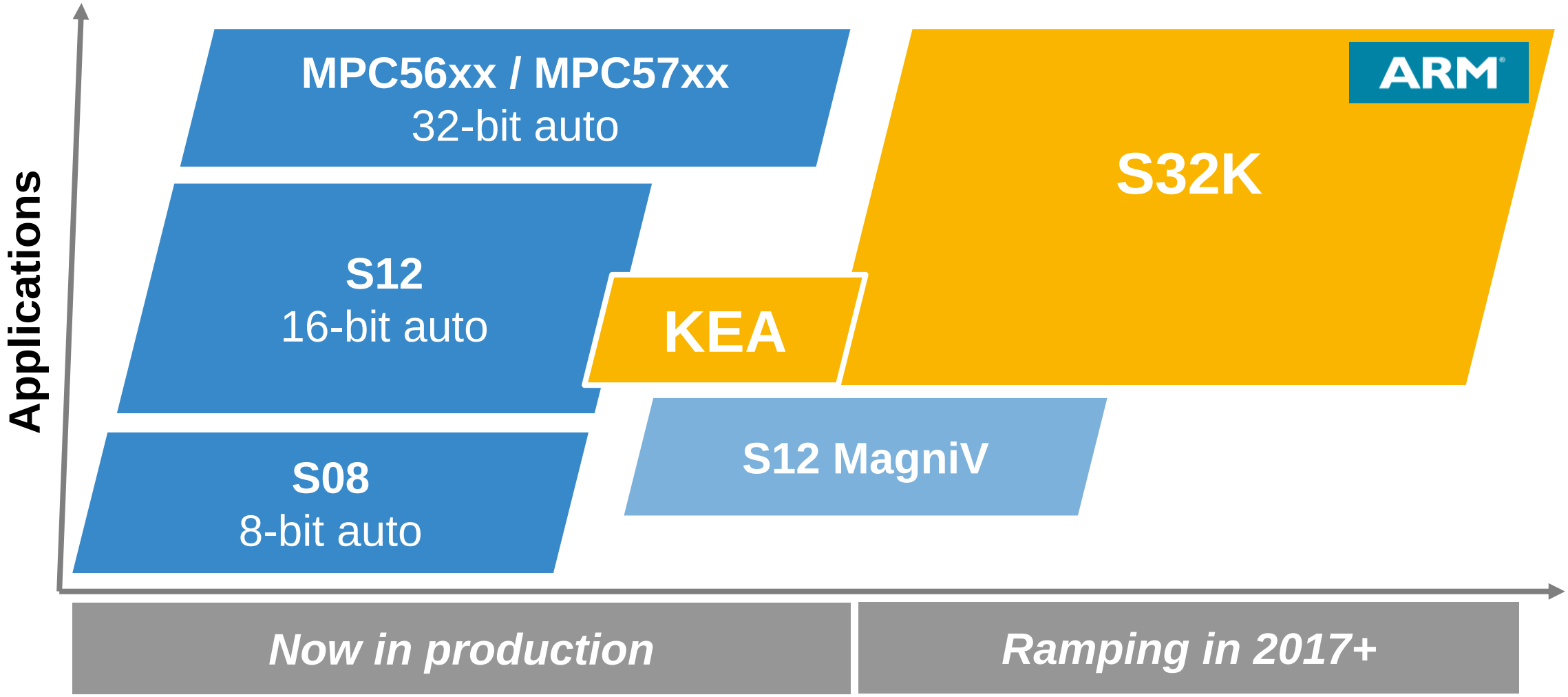
4th Largest
SEMICONDUCTOR COMPANY GLOBALLY[1]

- ✓ **50+** year history
- ✓ **28,000** employees
- ✓ **$6.03b** in revenue
- ✓ **$723m** in R&D

Note:
1. All financial figures are based on trailing twelve month reported information; R&D expense are non-GAAP

Developing Solutions Where Our Customers Operate

NXP Automotive GPIS MCU Portfolio



GPIS Solutions Support Many Applications

NXP is #1

#1 INFOTAINMENT
TUNERS
SOFTWARE-DEFINED DIGITAL RADIO
MULTIMEDIA PROCESSORS
SOUND SYSTEM DSPs & AMPLIFIERS
NFC BT PAIRING
WIRELESS POWER CHARGING
POWER MANAGEMENT

ADAS & SECURITY

POWERTRAIN & CHASSIS
MICROCONTROLLERS
PRESSURE/ MOTION SENSORS
BATTERY MANAGEMENT
DRIVERS

STANDARD PRODUCTS
LOGIC
POWER
DISCRETES

#1 SECURE CAR ACCESS
IMMOBILIZER/ SECURITY
REMOTE KEYLESS ENTRY
PASSIVE KEYLESS ENTRY/ GO
BI-DIRECTIONAL KEYS
NFC
ULTRA WIDE BAND

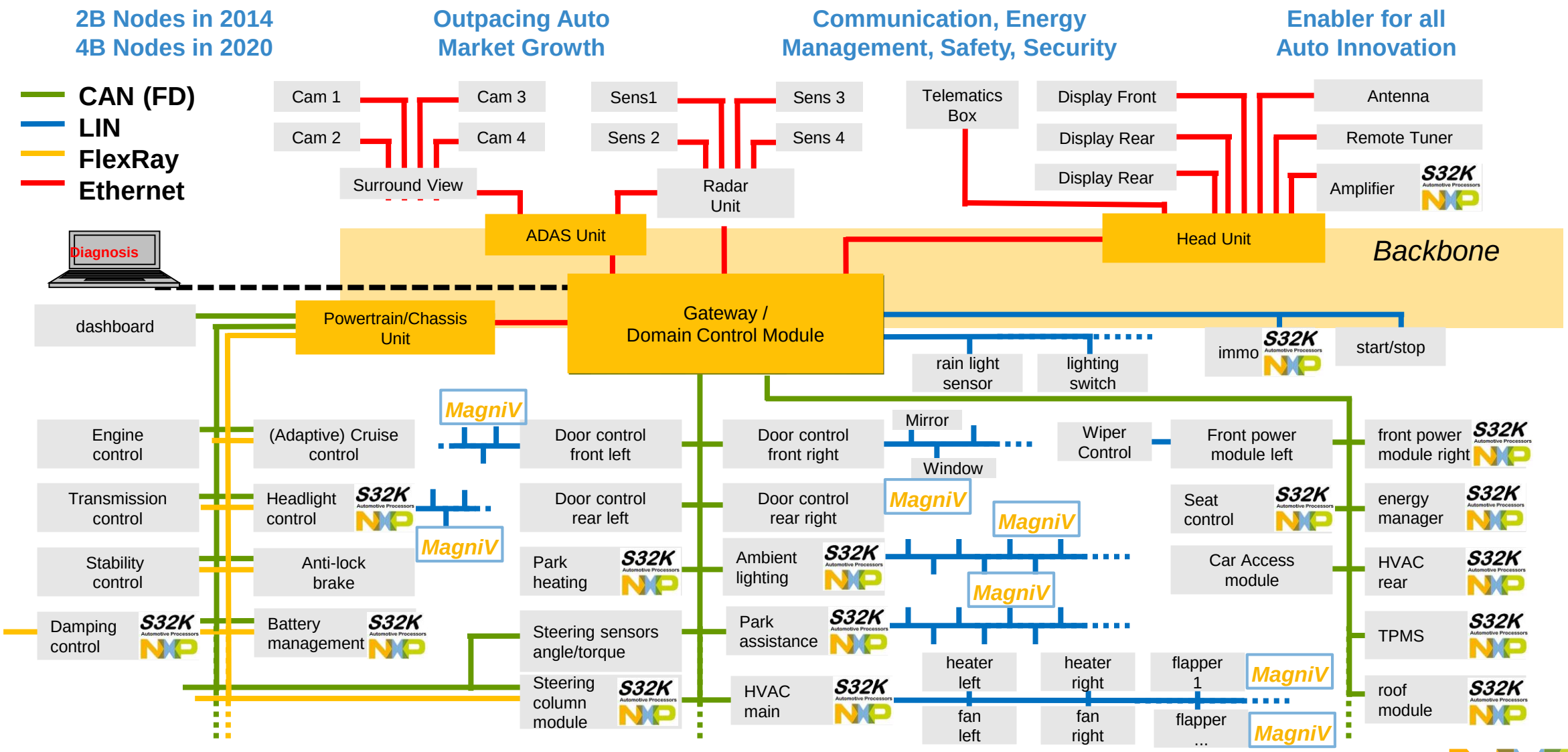
#1 VEHICLE NETWORKING
CAN/LIN/ FLEXRAY
ETHERNET
CENTRAL GATEWAY CONTROLLER
SECURITY
RF

#1 BODY
MICROCONTROLLERS
POSITION/ ANGLE SENSORS
SYSTEM BASIS CHIPS

#1 SAFETY
MICROCONTROLLERS AIRBAG
ANALOG AIRBAG
MICROCONTROLLERS BRAKING
ANALOG BRAKING
SENSORS BRAKING
TIRE PRESSURE MONITORING

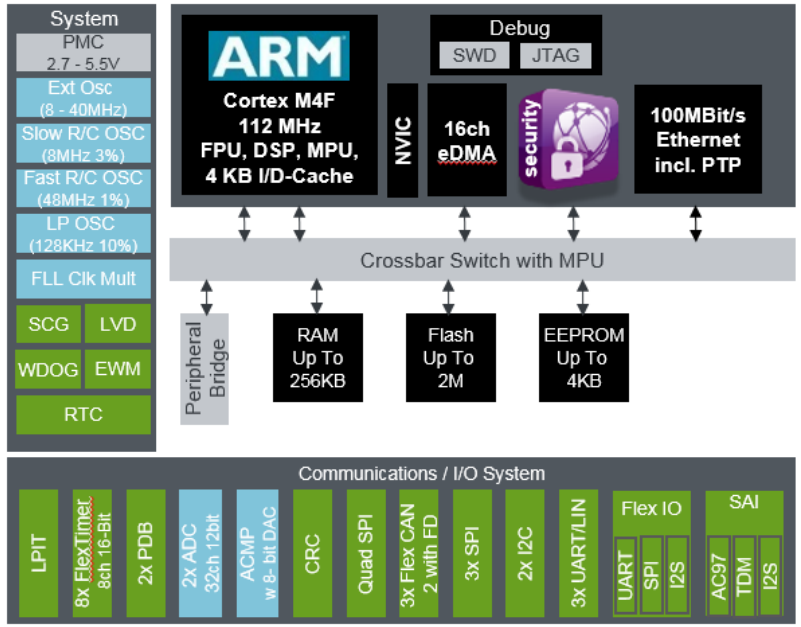
#1 Auto Analog/ RF | **#1 Auto MCU (ex JPN)** | **#1 Auto Merchant MEMS Sensors**

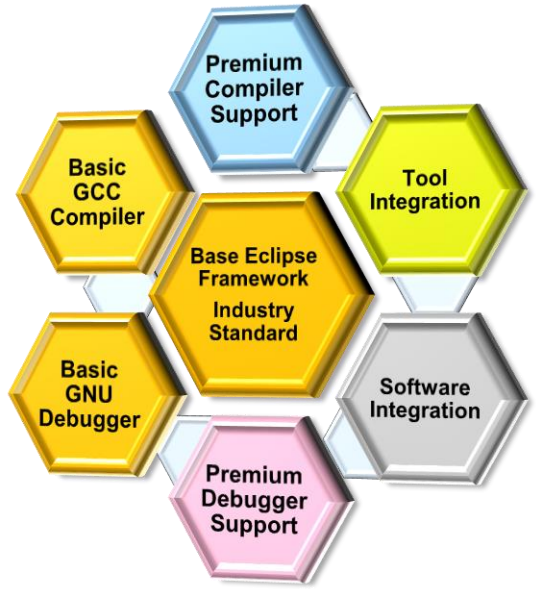
S32K and MagniV Edge Node Solutions



S32K – Fastest Time to Market and Future-Proof Features

Flash	Pin Count								
	16/24	32	48	64	80	100	100 BGA	144	176
2M						S32K148*	S32K148	S32K148	S32K148
1M						S32K146*	S32K146	S32K146	S32K146
512K				S32K144		S32K144	S32K144		
256K			S32K118	S32K142 / S32K118		S32K142			
128K		S32K116	S32K116	KEAZ128	KEA128				
64K		KEAZN64 / S32K114	S32K114	KEAZ(N)64	KEAZ64				
32K		KEAZN32 /		KEAZN32					
16K		KEAZN16		KEAZN16					
8K	KEAZN8								





Most Scalable Portfolio

- 8 K to 2 M+ Flash
- HW and SW compatibility

→ ***Reduce R&D***

Superior Performance and Features

- Cortex M with FPU & DSP
- Lowest Stop Current
- ASIL-B safety
- SHE- Security
- CAN-FD, Ethernet
- FlexIO, Reduced BOM Cost

→ ***Future proof designs***

Complete Software Solution

- S32 Design Studio
- Software Devt Kit (SDK)
- Autosar MCAL + OS

→ ***Reduce Time-to-Market***

S32K14X Reduces System Cost

* For 64LQFP 3 C's
** @ Tamb 105°C

Function	Other	S32K144	$ Savings
Decoupling / Buffer	9 C's	**4 C's (100nF)**	**$0.05**
ADC Supply Filter	Optional	Optional	
Ext. Osc	2 x C's + optional Rs	2 x C's + optional Rs	
RESETB	1nF + 4k7	1nF + 4k7	
Mode Select	FAB: 4k7 pull-down	**N/A**	**$0.01**
JTAG	TMS: 4k7 pull-up	TMS: 4k7 pull-up**	
JTAG	TDO: 4k7 pull-up	**N/A**	**$0.01**
SBC / Vreg / Thermal mgmt	BCP52 on MC33903P 200mA (MCU Iddmax = 140mA)	**No BCP52 / smaller Vreg 100mA (MCU Iddmax 43mA)**	**$0.05**

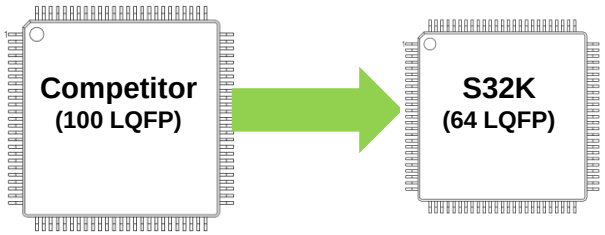
BOM Cost Savings: ~ $0.12

S32K14x I/O Efficiency

Package	Competitor GPIO count	S32K14x GPIO count	Additional GPIO‘s
64 LQFP	45	58	13
100 LQFP	79	89	10
144 LQFP	123	128	5
176 LQFP	149	152	3

Potential savings : ~ $0.10

Smaller package / less PCB space / less external mux



S32K FlexIO Module

- FlexIO = Flexible Input and Output peripheral
- Programmable logic for complex waveform generation
- Emulation of standard communication interfaces:
  - UART, SPI, I2C, I2S, LCD RGB, PWM, etc.
- Low CPU overhead
- DMA support
- Drivers available

S32K SafeAssure Program

Safety Hardware
Common safe hardware platform for application software:

- Voltage/clocks monitoring
- Memories w/ error correction (ECC)
- Window Watchdog...

Safety Process

- ISO 26262 development process for all products
- Safety Element out of Context

Safety Support

- FIT rates
- Safety manual
- Technical support as required

Safety Software
S32K core self-test available to complement the built-in hardware safety features

Product	Development Process	FMEDA Report Availability	Dependant Failure Analysis	Safety Manual	Core Self-Test and User Guide
S32K	ISO 26262	Upon request	Yes	Yes	Yes

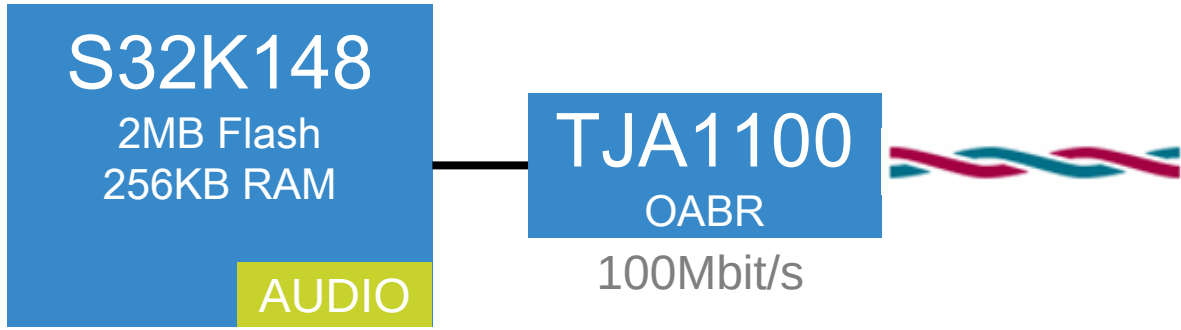
Ethernet Solutions

S32K148 High Performance MCU

- 100 MBPS Ethernet with AVB and IEEE-1588 timestamping support
- 32 TDM channel audio streaming
- Production Grade Software Developement Kit (SDK) incl. Audio SW and TCP/IP stack

TJA1100 100 MBPS PHY

- Open Alliance BroadR-Reach Compliant
- Fully automotive qualified
- Robust automotive grade EMC and ESD
- Minimal external component count
- Enhanced Power Management to save battery life
- Samples, Evaluation Board Available

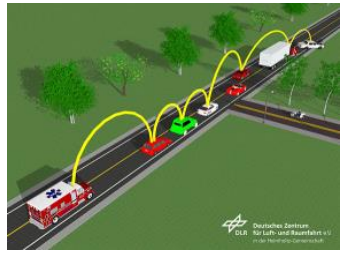


Security Use Cases

In-Vehicle Security

- Secure Communication
- Component Protection
- Mileage Protection
- Secure Boot and Chain of Trust

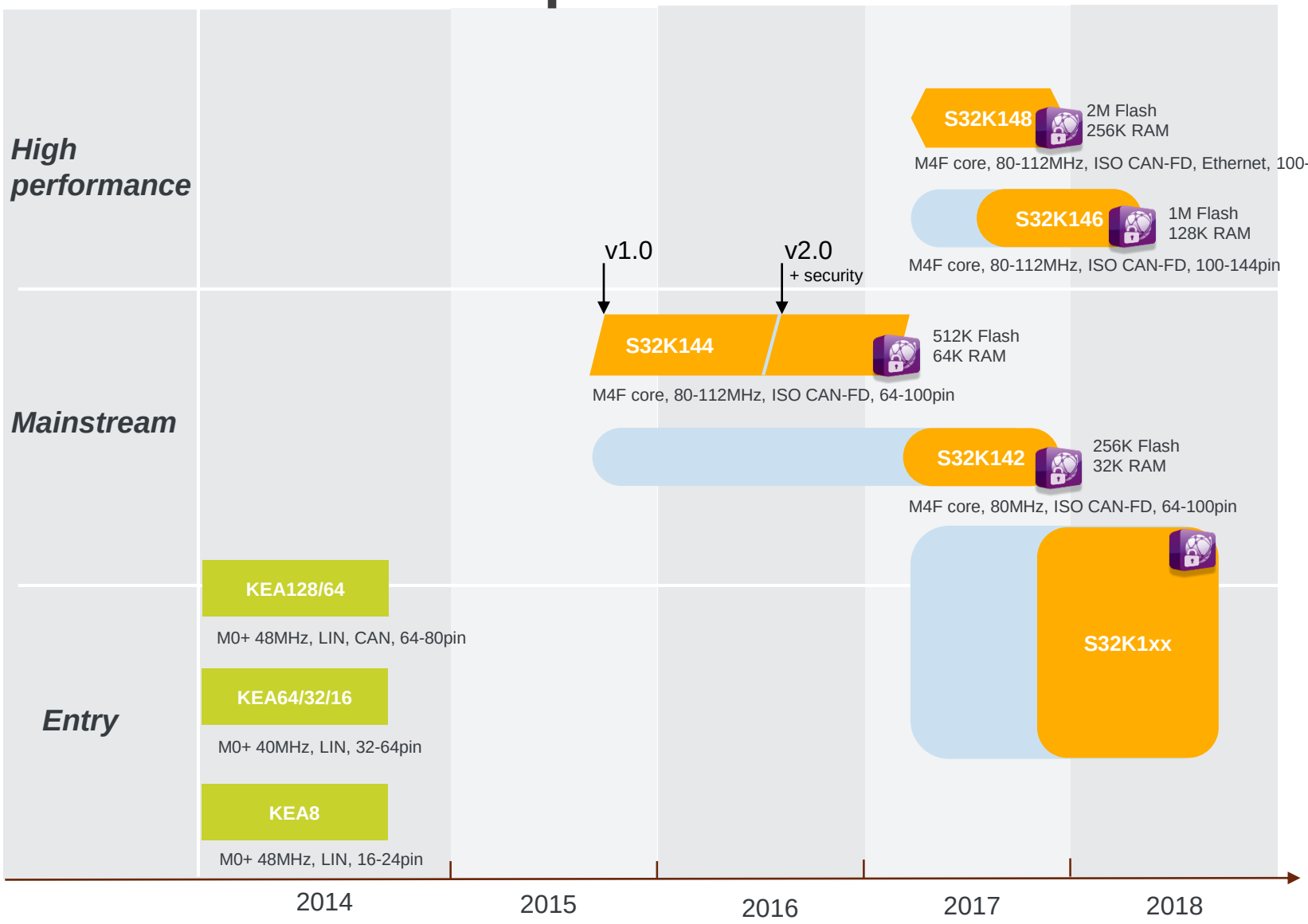
NXP is the #1 solution provider HW + SW



Connected Vehicle Security

- Application download
- DRM for content download/streaming
- Remote ECU firmware update
- Black-box for government or insurance

S32K14x Product Roadmap



ARM

Proposal

Planning

Execution

Production

First Sample Date (left edge)

Product Qualification (right edge)

90 nm

180 nm

Start design with super sets

SHE+ HW security

S32K148 Block Diagram

High Performance
- ARM® Cortex ® M4F up to 112 MHz w FPU
- eDMA from 57xxx family

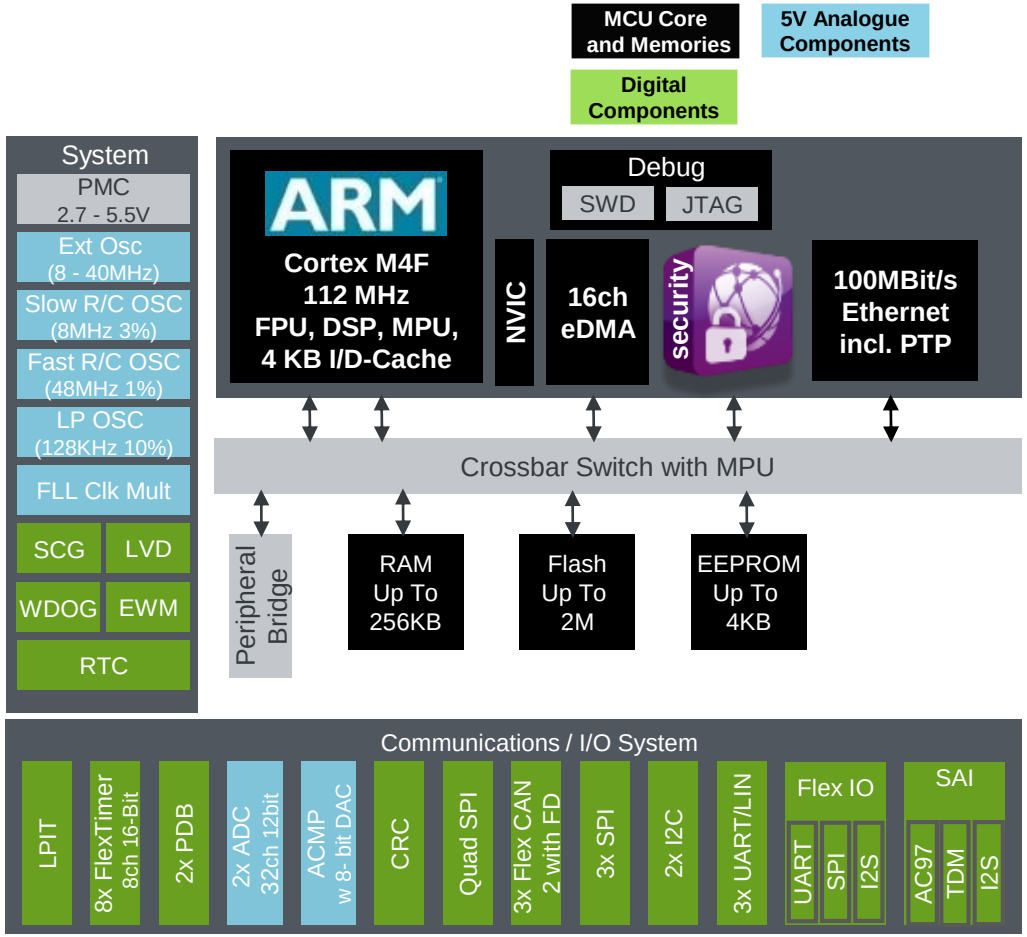
Software Friendly Architecture
- High RAM to Flash ratio
- Independent CPU and peripheral clocking
- 48 MHz 1% IRC – no PLL init required in LP
- Registers maintained in all modes
- Programmable triggers for ADC → no SW delay counters or extra interrupts

Functional safety
- ISO26262 support for ASIL B or higher
- Memory Protection Unit
- ECC on Flash/Dataflash and RAM
- Independent internal OSC for Watchdog
- Diversity between ADC and ACMP
- Diversity between SPI/SCI and FlexIO
- Core self test libraries
- Scalable LVD protection
- CRC

Low power
- Low leakage technology
- Multiple VLP modes and IRC combos
- Wake-up on analog thresholds

Security
- CSEc (SHE-spec)

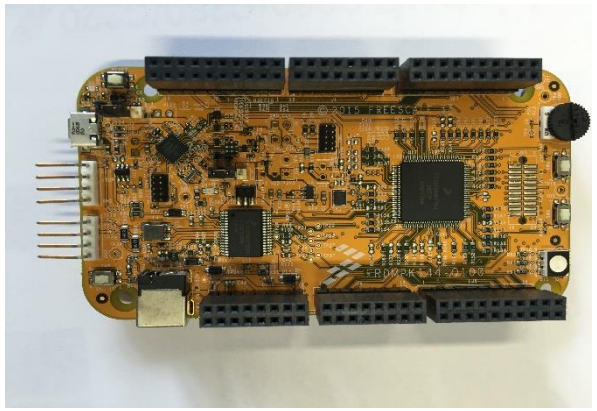
Operating Characteristics
- Voltage range: 2.7 V to 5.5 V
- Temperature (ambient): -40°C to +125°C



Packages & IO
- Open-drain for 3.3 V and hi-drive pins
- Powered ESD protection
- Packages: 100 BGA, 144 LQFP, 176 LQFP

S32K – Complete Solution Offering

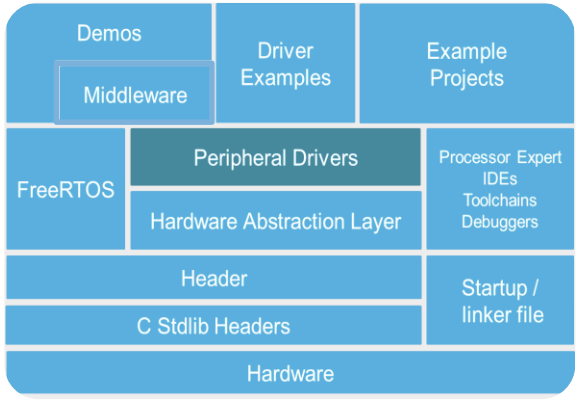
Hardware Platform



- Low cost development board compatible to Arduino shields
- Onboard debugger and system basis chip

Full Hardware evaluation and Development Platforms

+ Software



- Full-featured, no cost development platform (S32 DS)
- Production grade Freescale Software Development Kit (SDK)
- NXP Middleware e.g. Core Self Test, LIN Stack, Automotive Math and Motor Control Library
- Autosar 4.0 and 4.2 MCAL

Complete software package to streamline software development

+ Ecosystem

- IAR and Cosmic toolchains, more to follow
- Including community software – FreeRTOS
- Design services
- Training
- Arduino shields

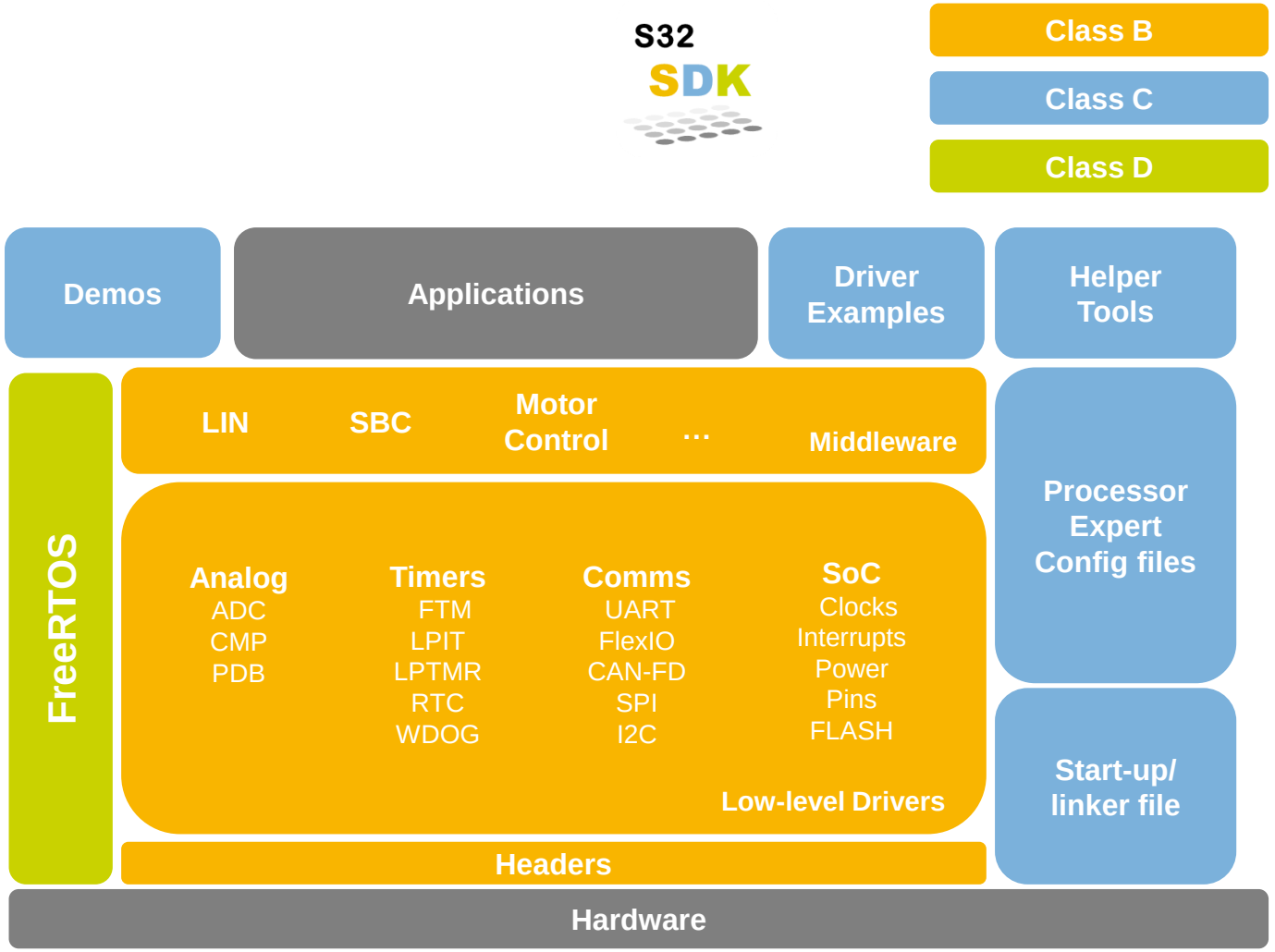
Technology alliances for building smarter, better connected solutions

Middleware is sold separately

S32 SDK Overview

Features

- Integrated Non-Autosar SW package
- Graphical-based configuration
- Layered SW architecture
- Documented Source code and examples
- Integrated with S32 Design Studio and other IDEs
- Featuring various Middleware (sold separately, demo as binary)
- FreeRTOS integration
- Multiple toolchains supported
- Several examples and demos



NXP Auto Software Quality Classifications

S32 SDK

Class A

- Functional Safety Products ISO26262 Compliant
- Examples: Safety MCAL, Core Self Test

Automotive Qualified

Class B

- SPICE Compliant Products
- Examples: Low Level Drivers + HAL, LIN Stack, SBC, Autosar OS, eNVM drivers, Autosar OS

Automotive Qualified

Class C

- Minimum quality compliance (ISO/TS16949)
- Examples: IDE and Configuration tools, ICC

General Availability

Class D

- Open Source software, No standard compliance
- Examples: FreeRTOS

General Availability

S32 Design Studio and SDK

subject to change

Design Studio

IDE: Luna Eclipse CDT
Compiler:
-GCC 4.9 Cortex M0+/M4/A5/A53
- IAR
- GHS
Debug:
- P&E GDB
- Segger GDB
- Lauterbach
- iSystem

Device support:
- KEA, S32K144
- S32V, MAC57xx

Integration:
- Processor Expert for SDK
- SDK S32K, SDK KEA
- FreeRTOS S32K
- FreeMaster/Bootloader
- AMMCLib
- Core Self Test S32K

Host: Windows, Linux
Licensing: Activation (Flexera)

SDK

FlexCAN, DMAMUX, DMA

Middleware: LIN, SBC, MC
OS: FreeRTOS full integration

IDE: DS full integration

Compiler: GCC, IAR, GHS, Cosmic

All examples

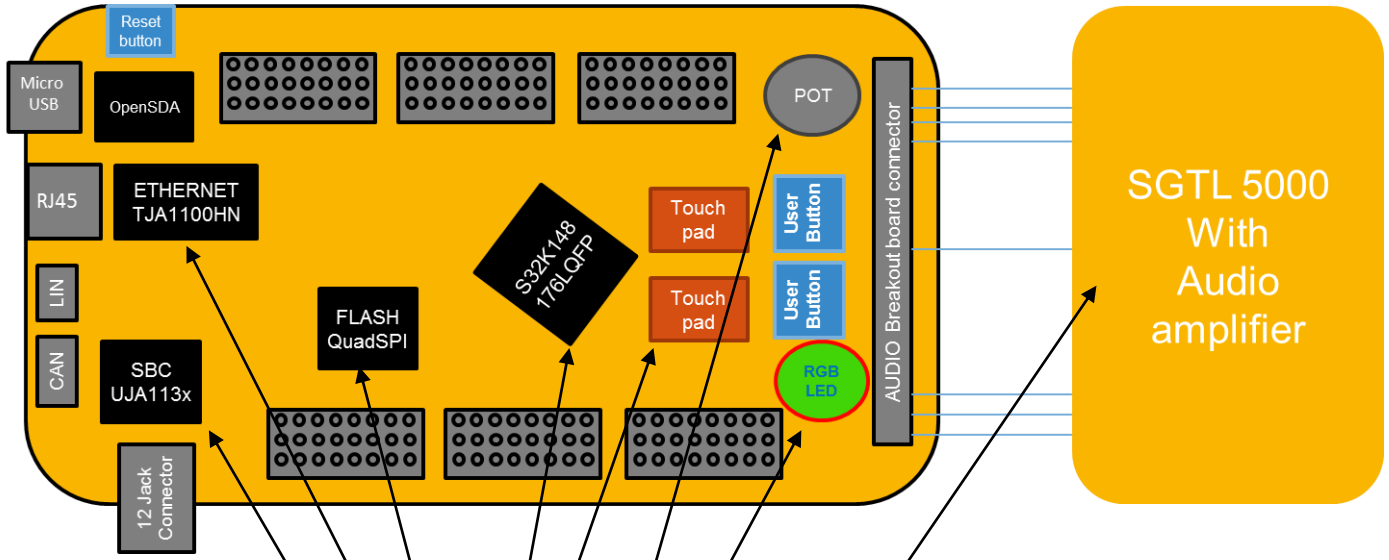
Documentation: Full

Licensing: Flexera

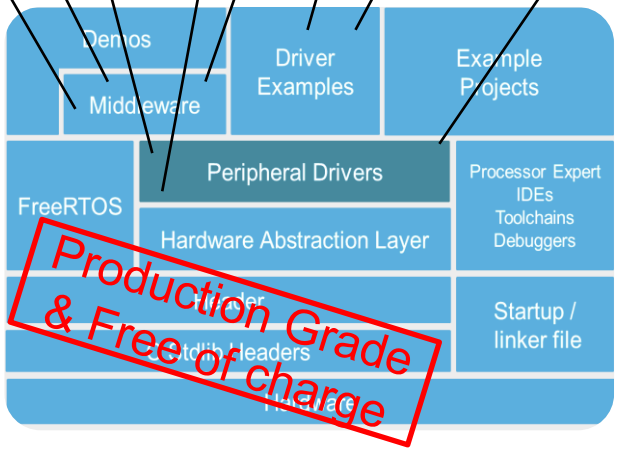
Quality level: BETA, quality package, no S1s, full verification on silicon

EVB + SDK = Reduced Development Time

S32K148/146 EVB



S32 SDK

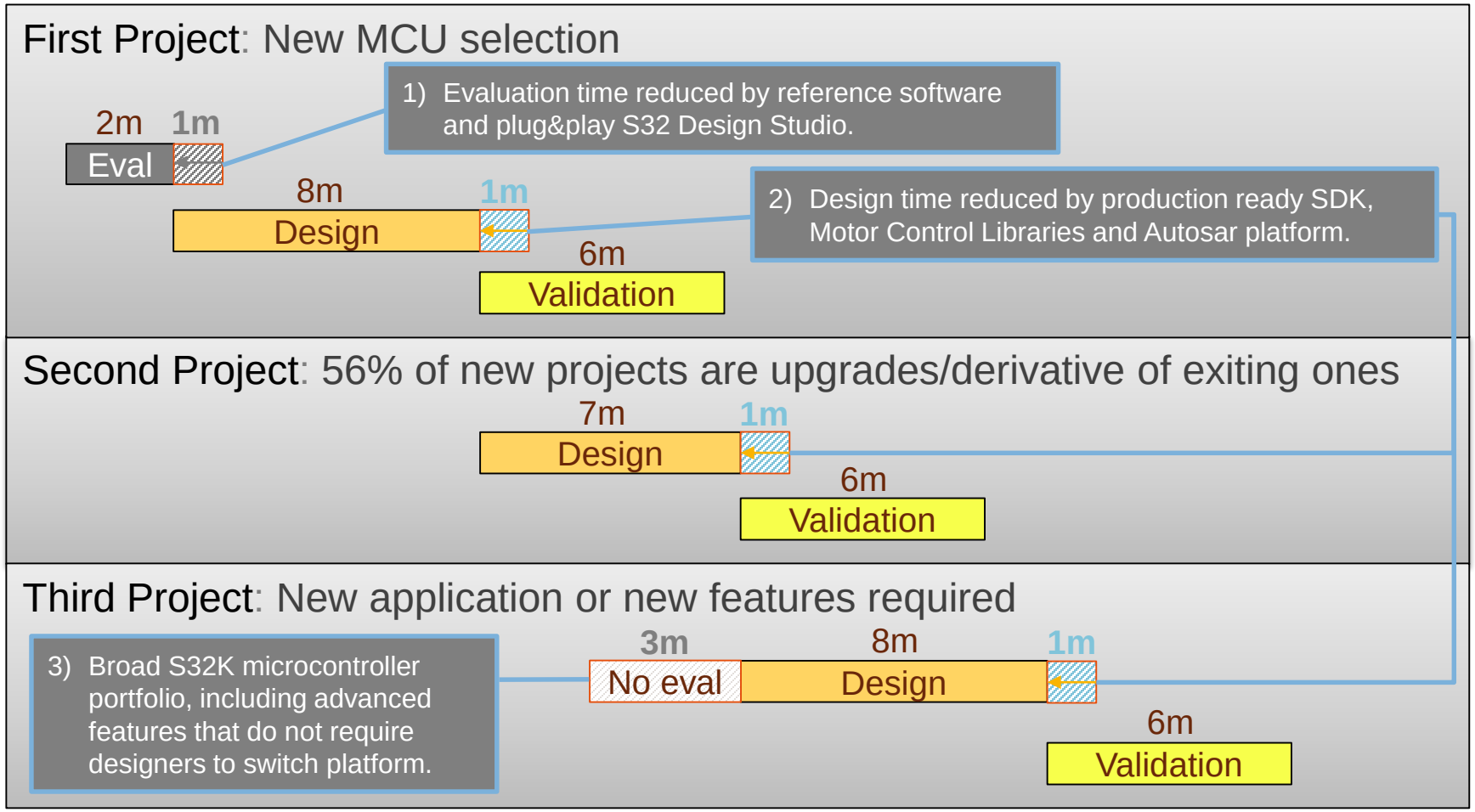


Benefits

1) Evaluate devices all at once
2) Confirmed interoperability
3) Faster prototyping
4) Reduced time to production

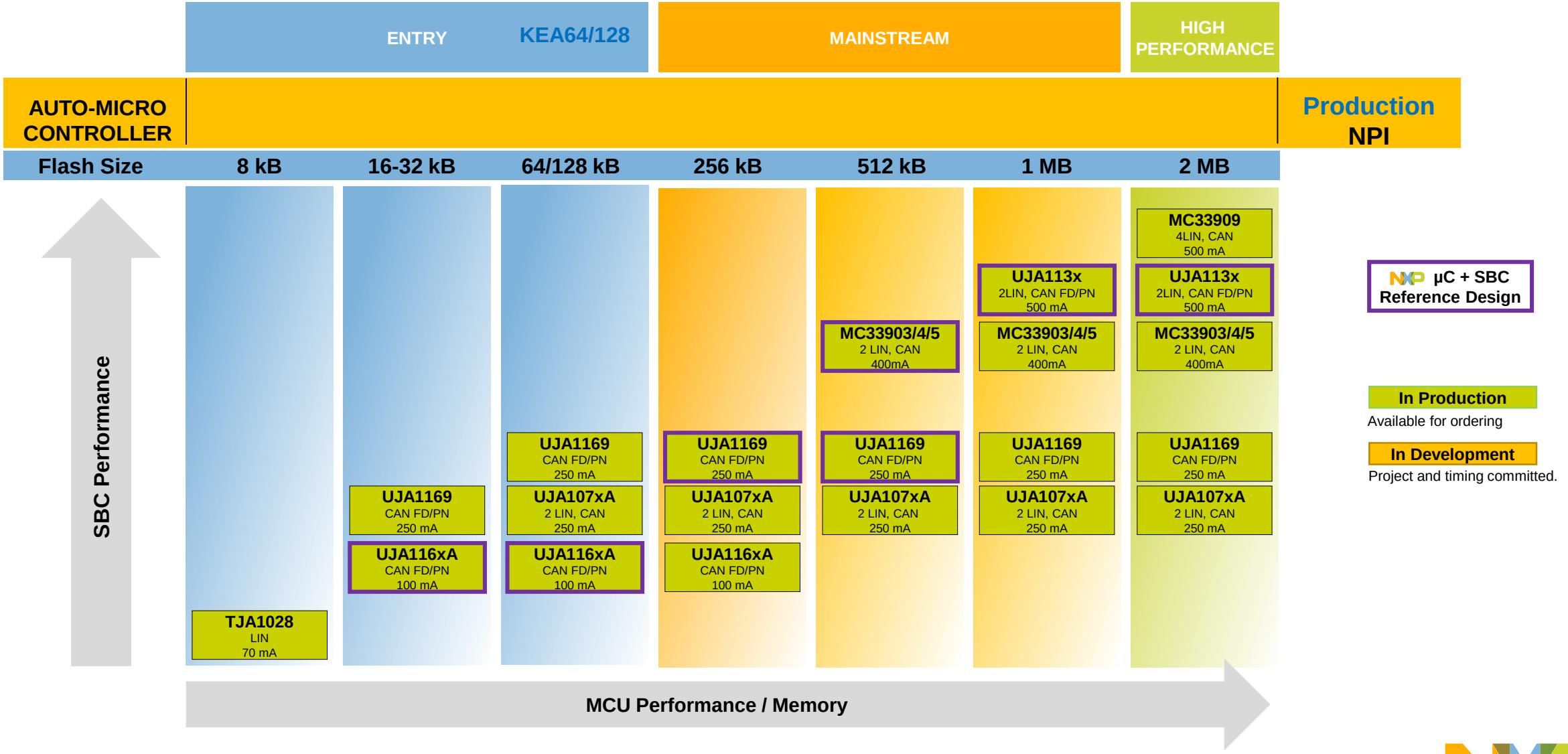
Middleware is sold separately

Reduced Project Cycle Time with S32K

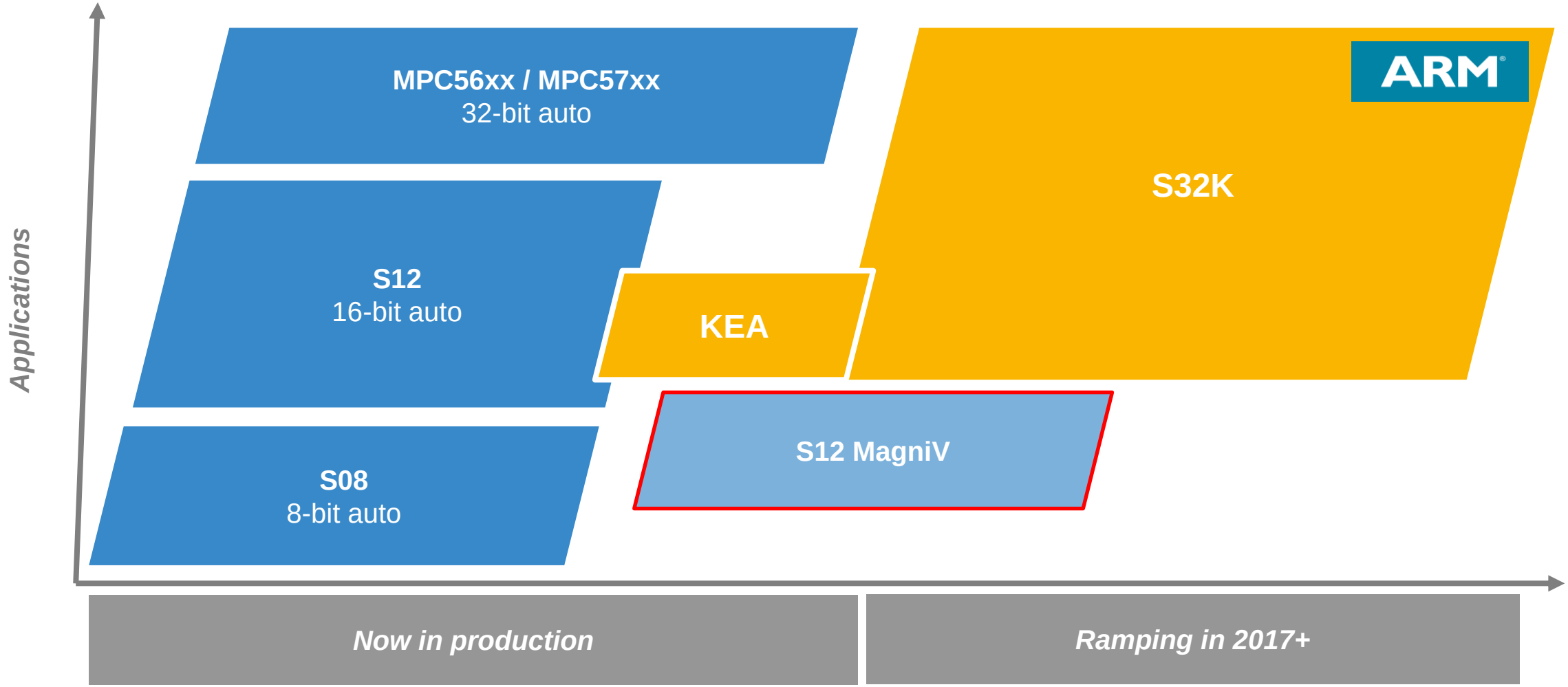


Save 20% time over 3 projects with S32K! (7/35months)

S32K + SBC Solutions



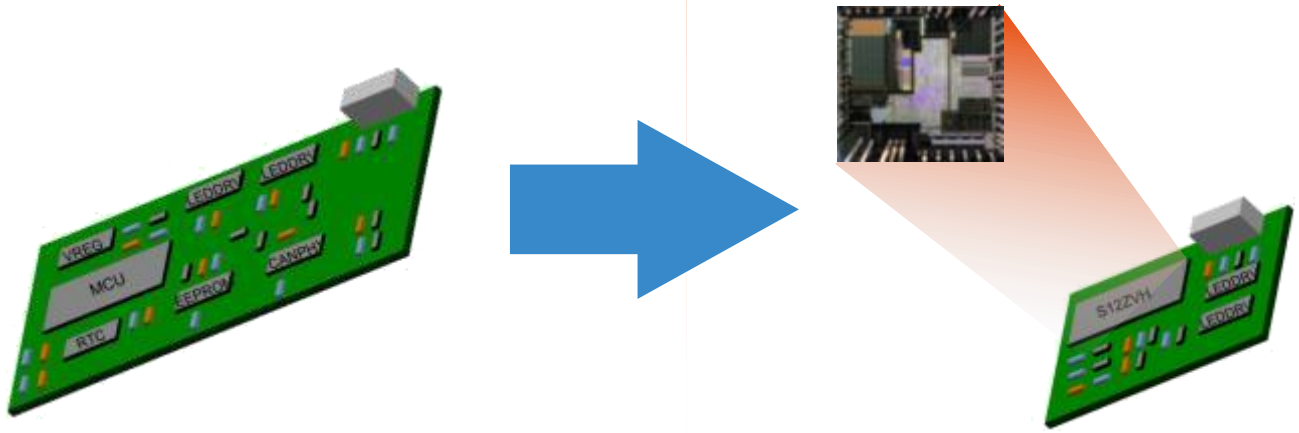
NXP Automotive Body MCU Portfolio



MagniV Concept: Shrink Your Application

Integration of High-Voltage (HV) analog features into a standard automotive MCU

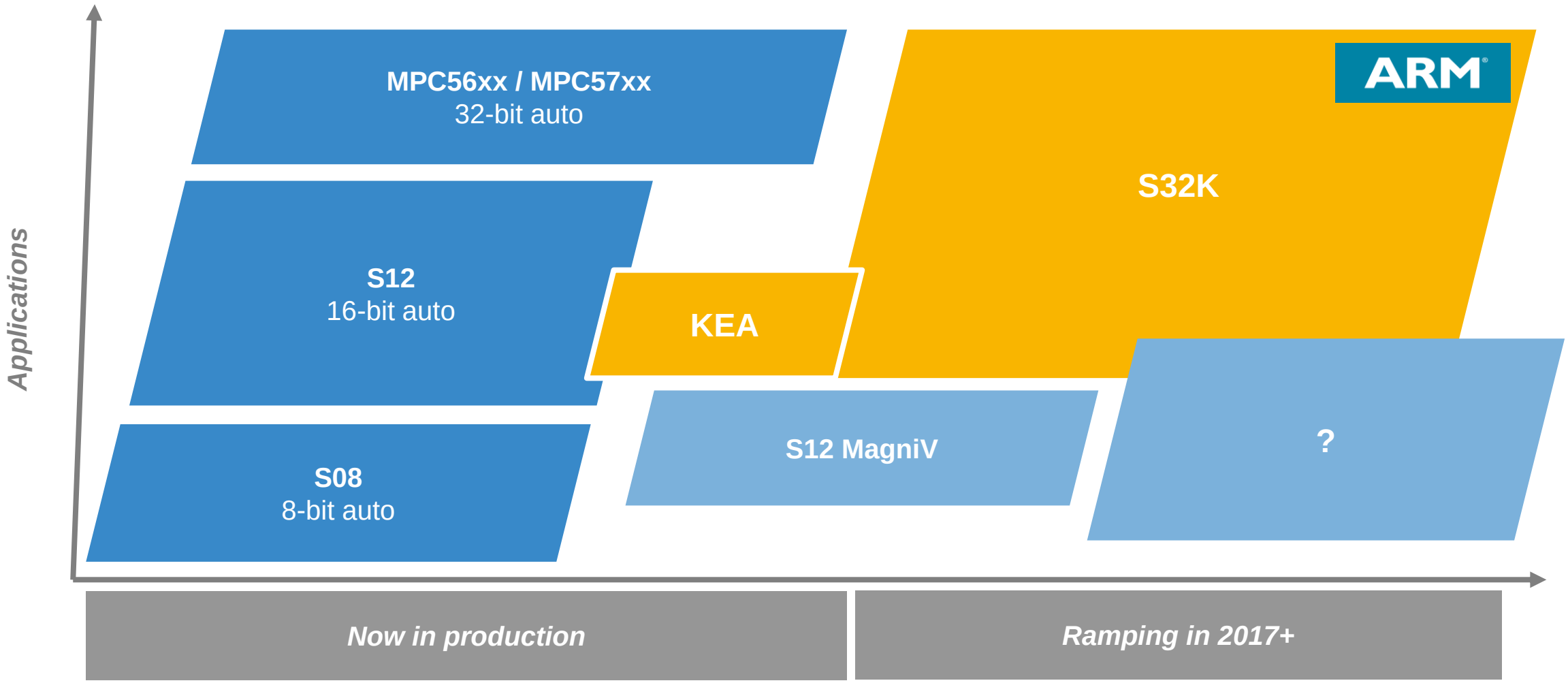
Traditional Solution	MagniV
• Standard MCU • Multiple analog ICs	• Single device • Reduced space



MagniV: Integration Benefits

- Reduced size
  - Smaller PCB
  - Smaller housing
  - Increased design flexibility
- Fewer components
  - Fewer devices to pick and place
  - Fewer solder joints
- Fewer test points
  - Integration offers a pre-tested subsystem
- Quality
  - Fewer points of failure
- Simplified Logistics
  - Fewer parts to qualify, source, store, track

Next Gen MagniV



SECURE CONNECTIONS
FOR A SMARTER WORLD

ATTRIBUTION STATEMENT