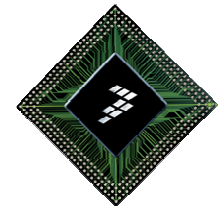




November 10, 2010

Solutions for Body and Comfort Applications

AMF-AUT-T0701

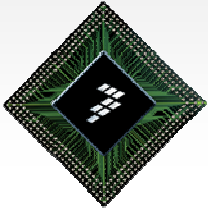


Designing with Freescale Seminars

Toronto

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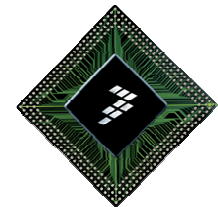
Agenda

- ▶ **Body Systems Market and Challenges**
- ▶ **Freescal Body Systems Solutions**
 - **Microcontroller Overview**
 - **Analog Components Overview**
 - **Intelligent Distributed Control (IDC)**
- ▶ **Review and Wrap-up**





Body Systems Market and Challenges



Body and Comfort Systems Overview

Driver Comfort	Vehicle Networking	Safety Related	Security
▶ Door Module ▶ Window Lift ▶ Seat Module ▶ HVAC ▶ Electric Roof ▶ Tailgate	▶ Central Body Control Module ▶ Central Gateway	▶ Rain Light Sensor ▶ Advanced Front Light Systems ▶ Advanced Rear Light Systems	▶ Immobilizer ▶ Keyless Entry

- ▶ Body systems embrace a broad variety of applications inside the cabin
 - Cost drivers: Comfort, safety, security
 - High user value – look and feel
 - Performance drivers: Vehicle networking
 - Little user value - invisible
- ▶ Body systems cover the widest range of performance requirements
 - Small 8-bit controllers and watchdogs
 - General purpose 16-bit controllers
 - High performance 32-bit compute engines

Fuel Efficiency – Not Exclusive to Engine Management

Weight Reduction

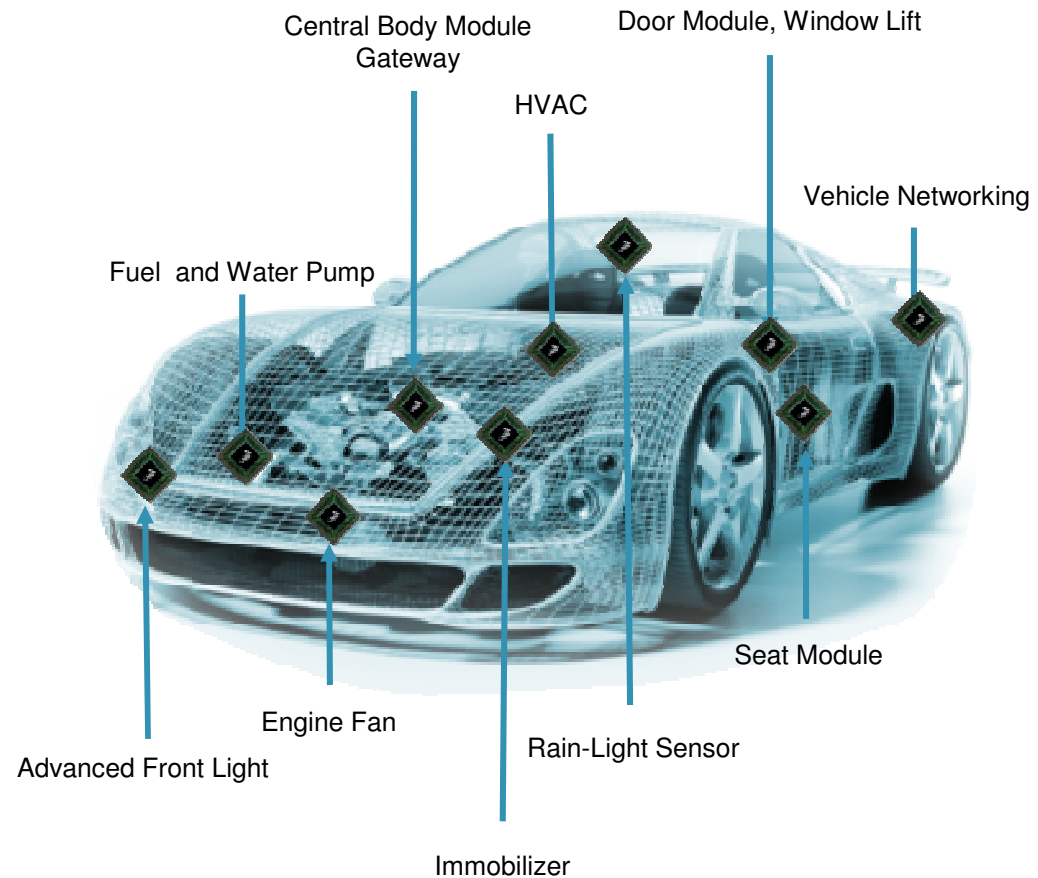
- ▶ Electrification of the car
- ▶ In-vehicle networking
- ▶ Greater integration

50 kg = 0.1 L/100km

Energy Efficiency

- ▶ Efficient engine control
- ▶ System optimization
- ▶ Power reduction

100W = 0.1 L/100km



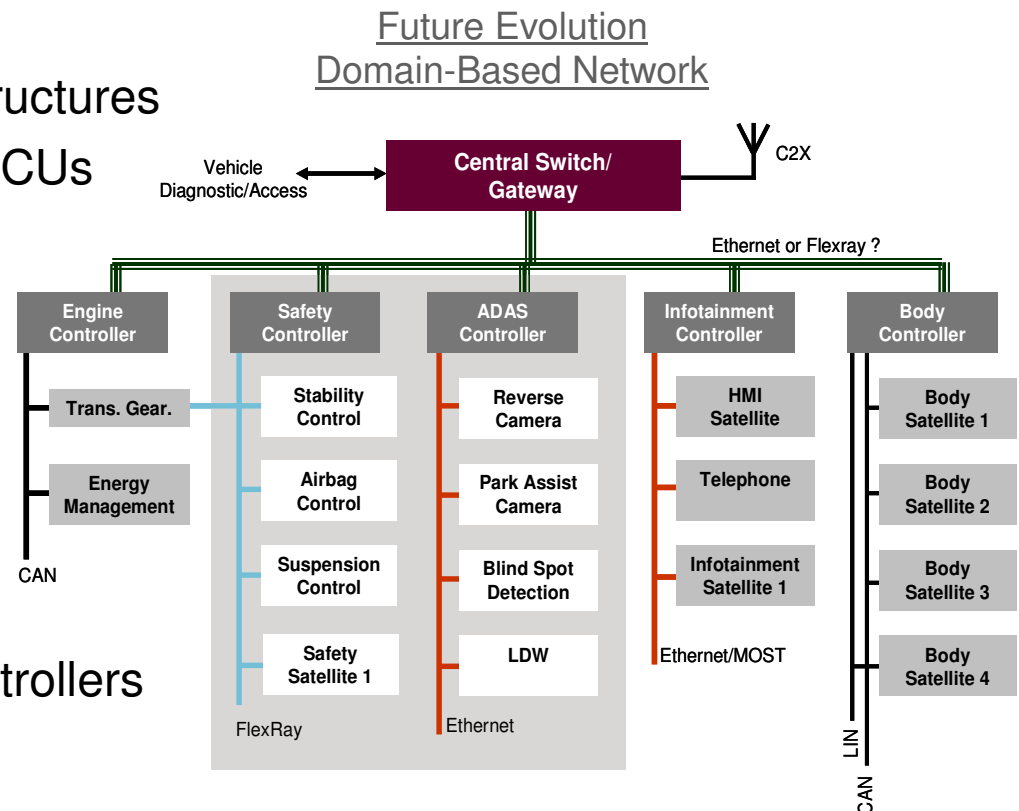
In-Vehicle Networking Evolution

► Today

- Up to 80 individual ECUs
- Local and proprietary network structures
- Increasing interaction between ECUs
- Increasing software complexity
- Increasing cabling weight
- Increasing ... everything

► Tomorrow

- Domain controllers
- Reduced number of ECUs
- High performance multi-core controllers
- Intelligent satellite modules
- Reduced wiring
- Domain specific networking
- Software standardization (Autosar)



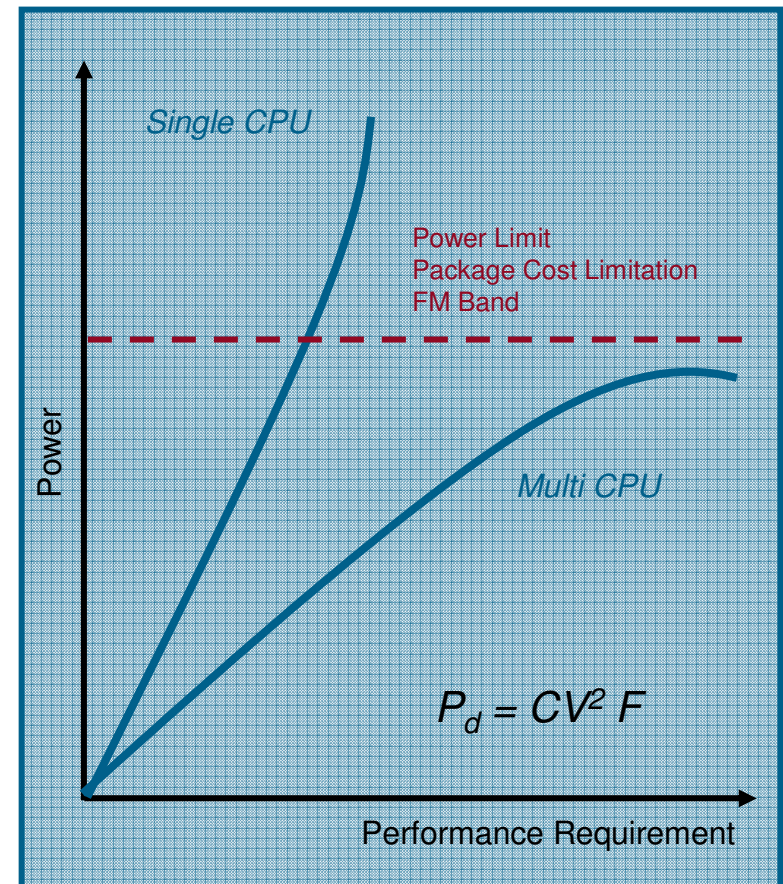
Why Multicore in Embedded Applications?

- ▶ Frequency scaling constraints
 - FM frequency band
 - External component cost
 - Package cost
- ▶ Multicore processors viewed as most viable approach to achieve required performance gains within power budgets

Networking Multicore



Automotive Multicore



- ▶ New challenge: Software for multicore processors

Body and Comfort Challenges

Market Dynamics

Cost pressure and globalisation force platform designs

Going Green: the dominating theme

Standardization vs. diverging OEM car network architectures

Designers' Challenges

Scalability of hardware and software

Reduced time to market

Increasing MIPS while saving energy requires architectural changes

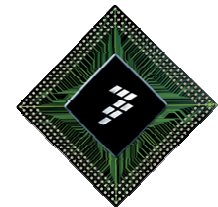
Multicore MCU architecture and software enablement

Increasing network complexity: CAN, LIN, FlexRay, Ethernet, MOST ...

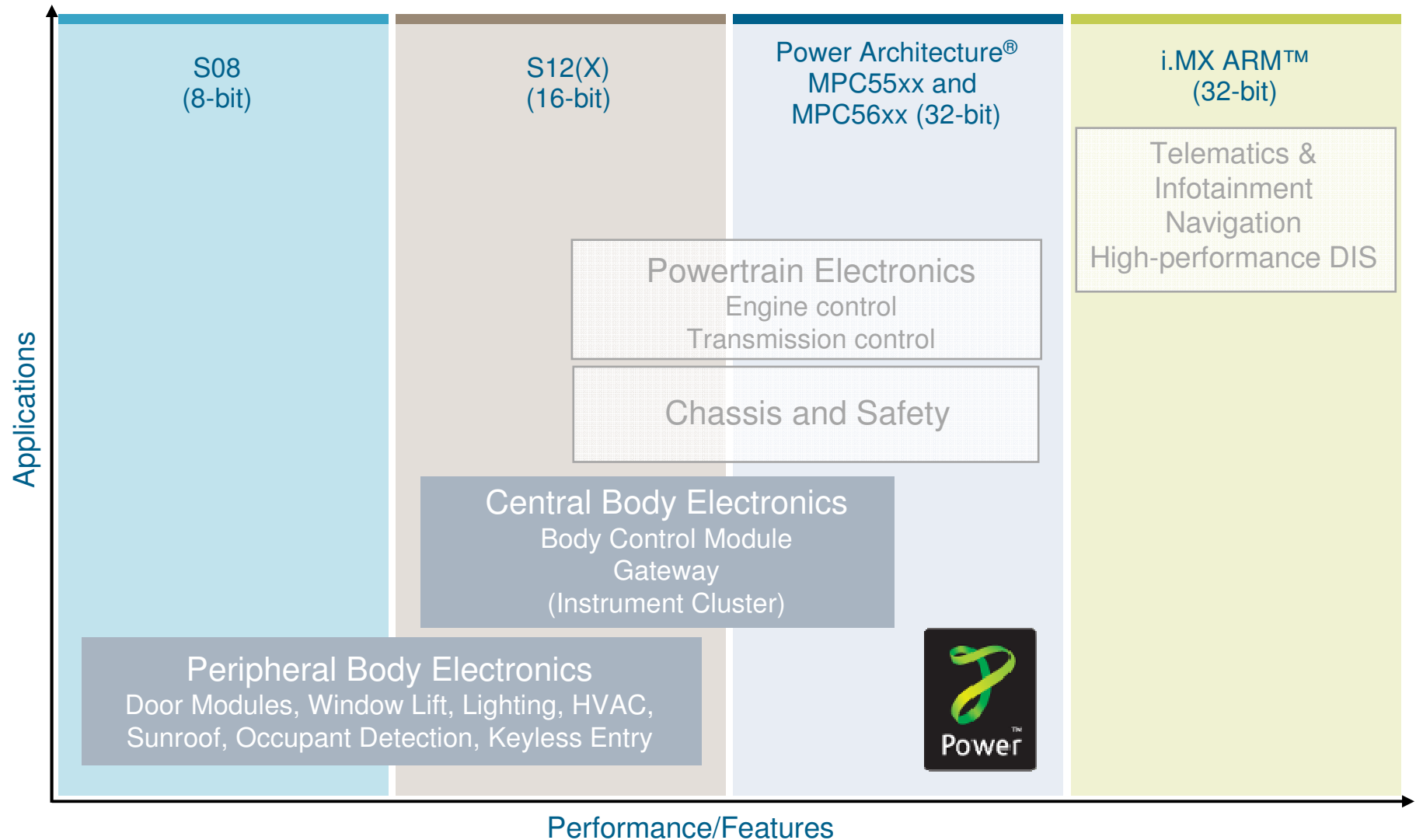


Freescal^e Body Systems Solutions

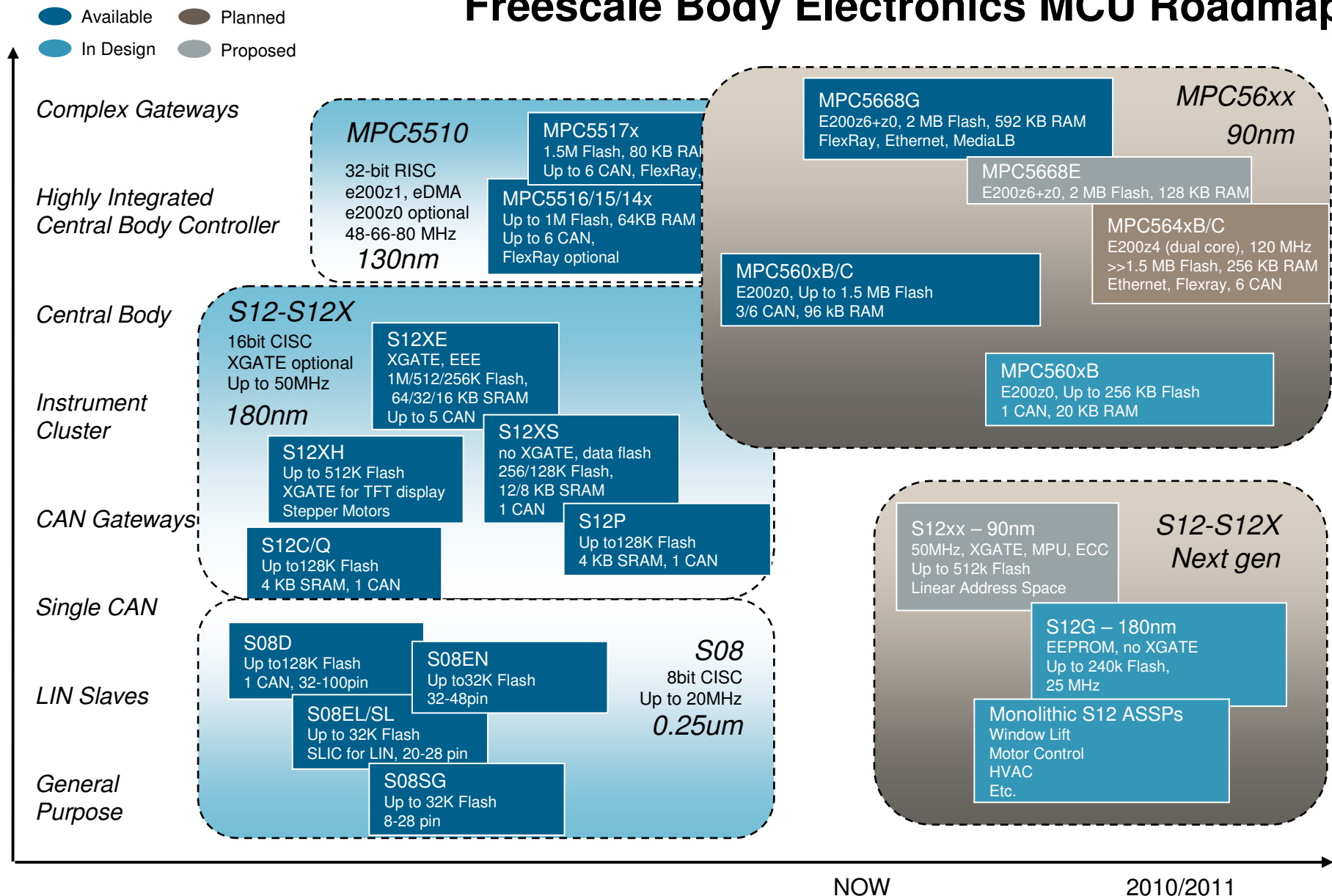
Microcontroller Overview



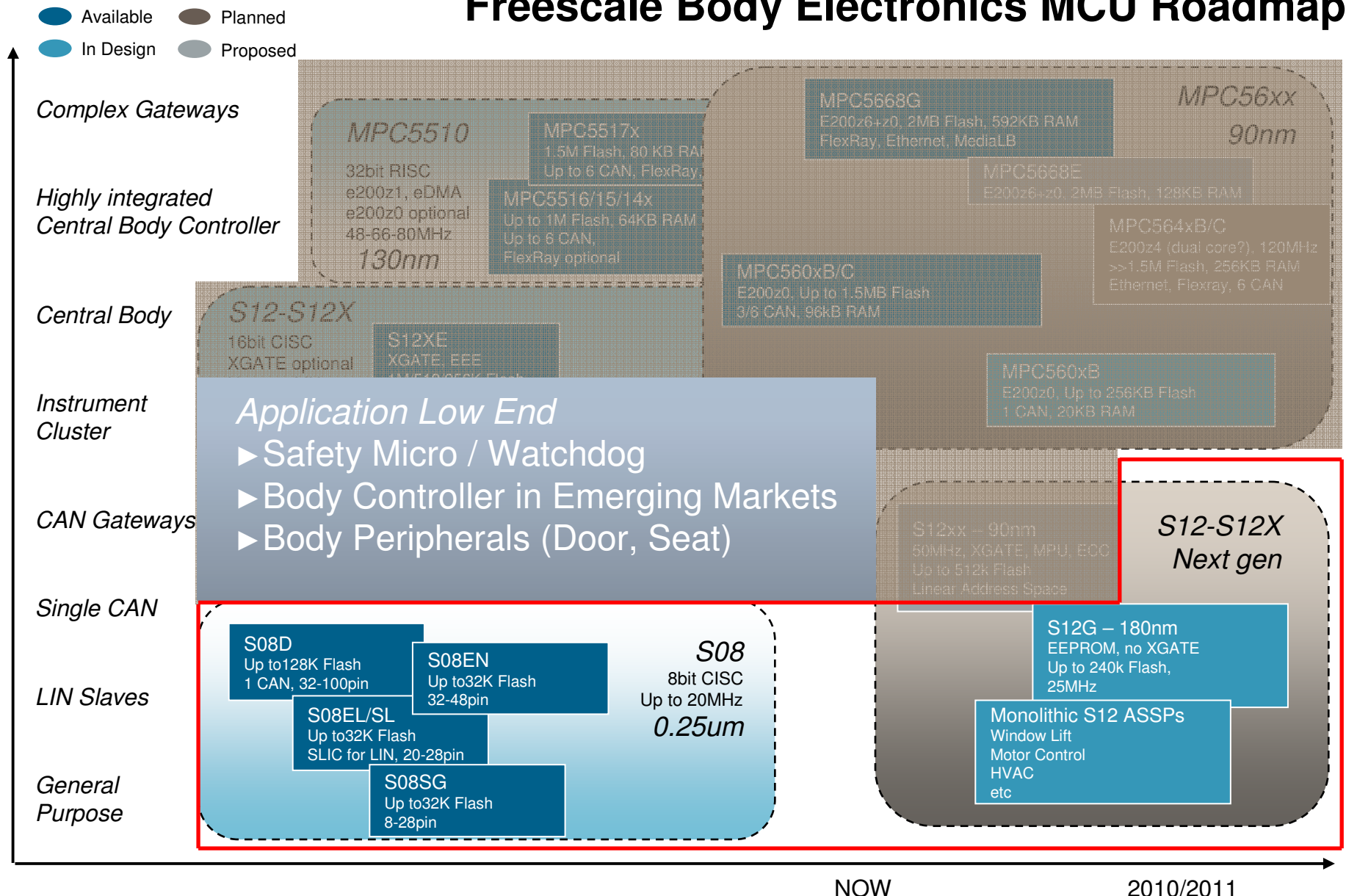
Automotive Core Architectures



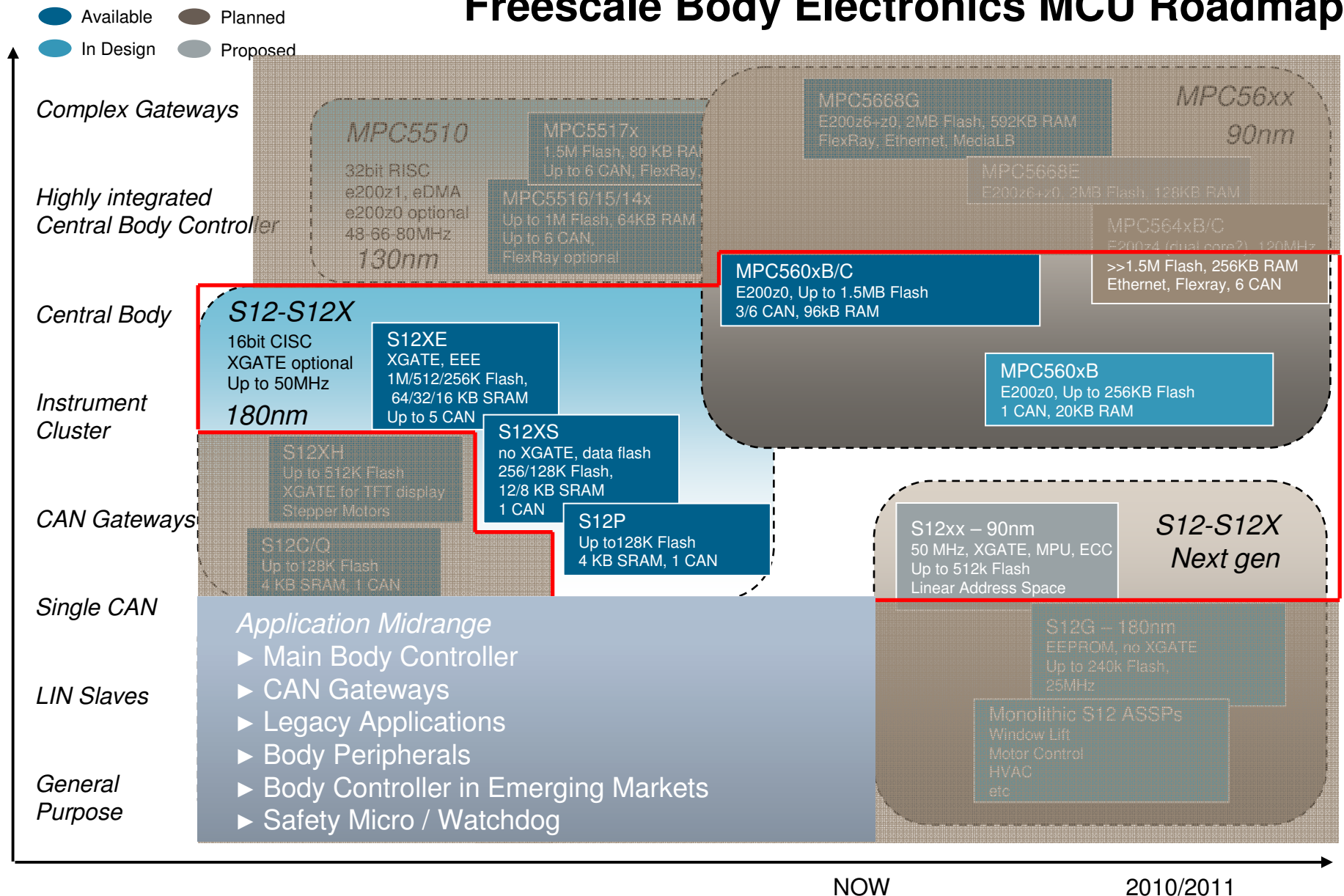
Freescal Body Electronics MCU Roadmap



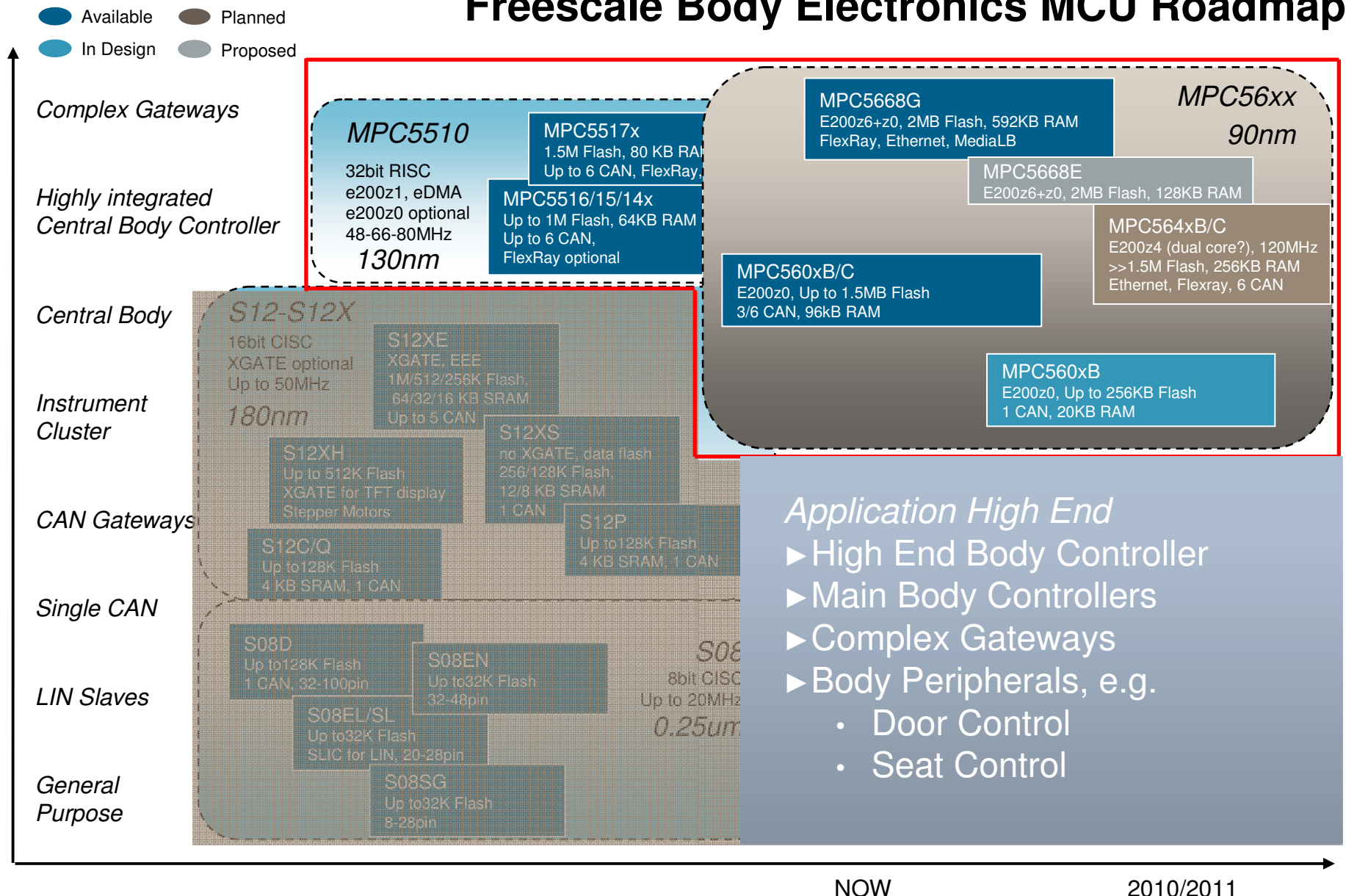
Freescal Body Electronics MCU Roadmap



Freescal MCU Roadmap



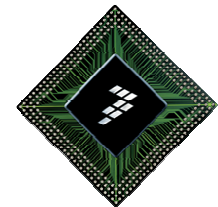
Freescal Body Electronics MCU Roadmap



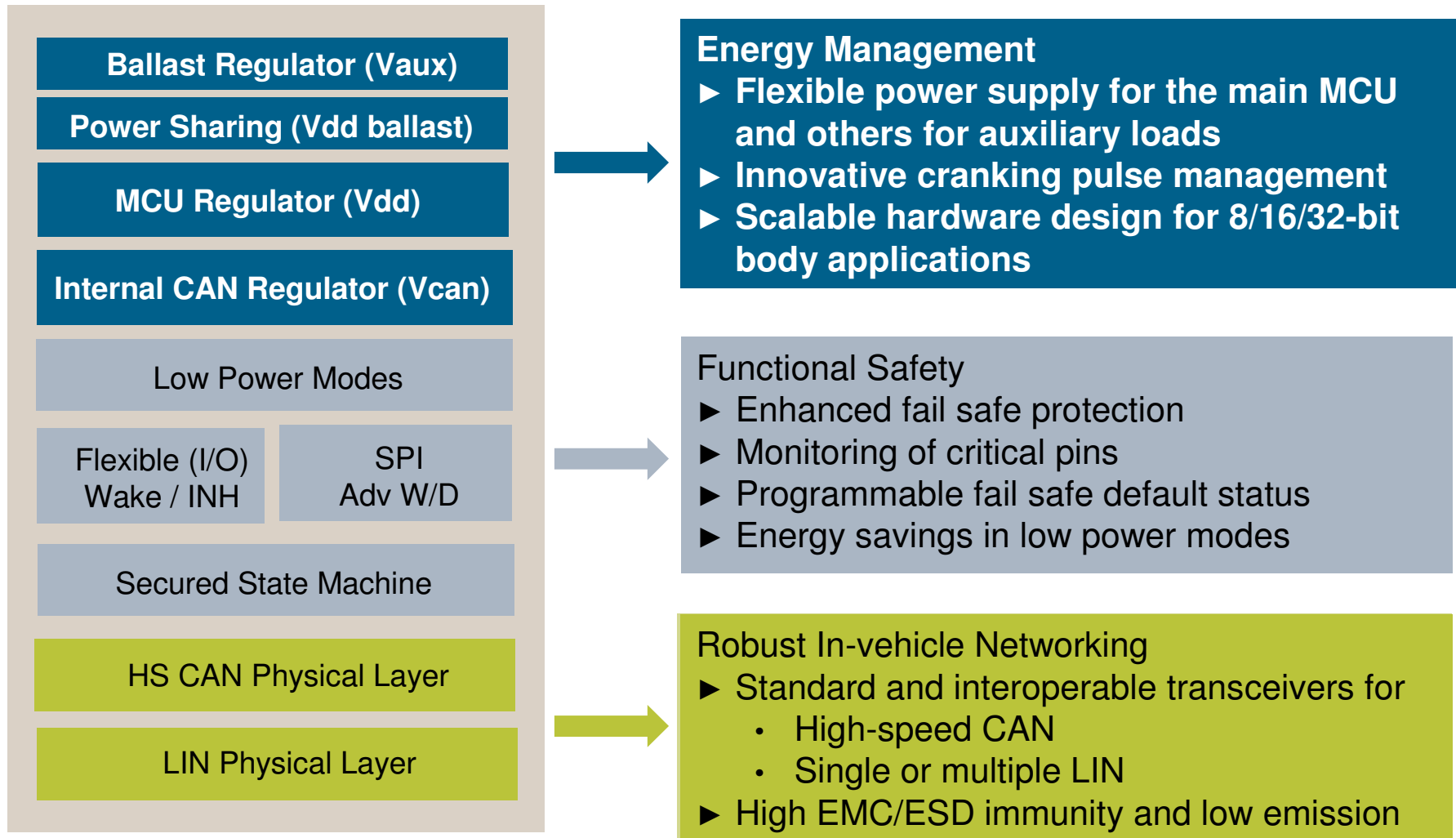


Freescal^e Body Systems Solutions

Analog Components Overview - SBCs



System Basis Chip – SBC

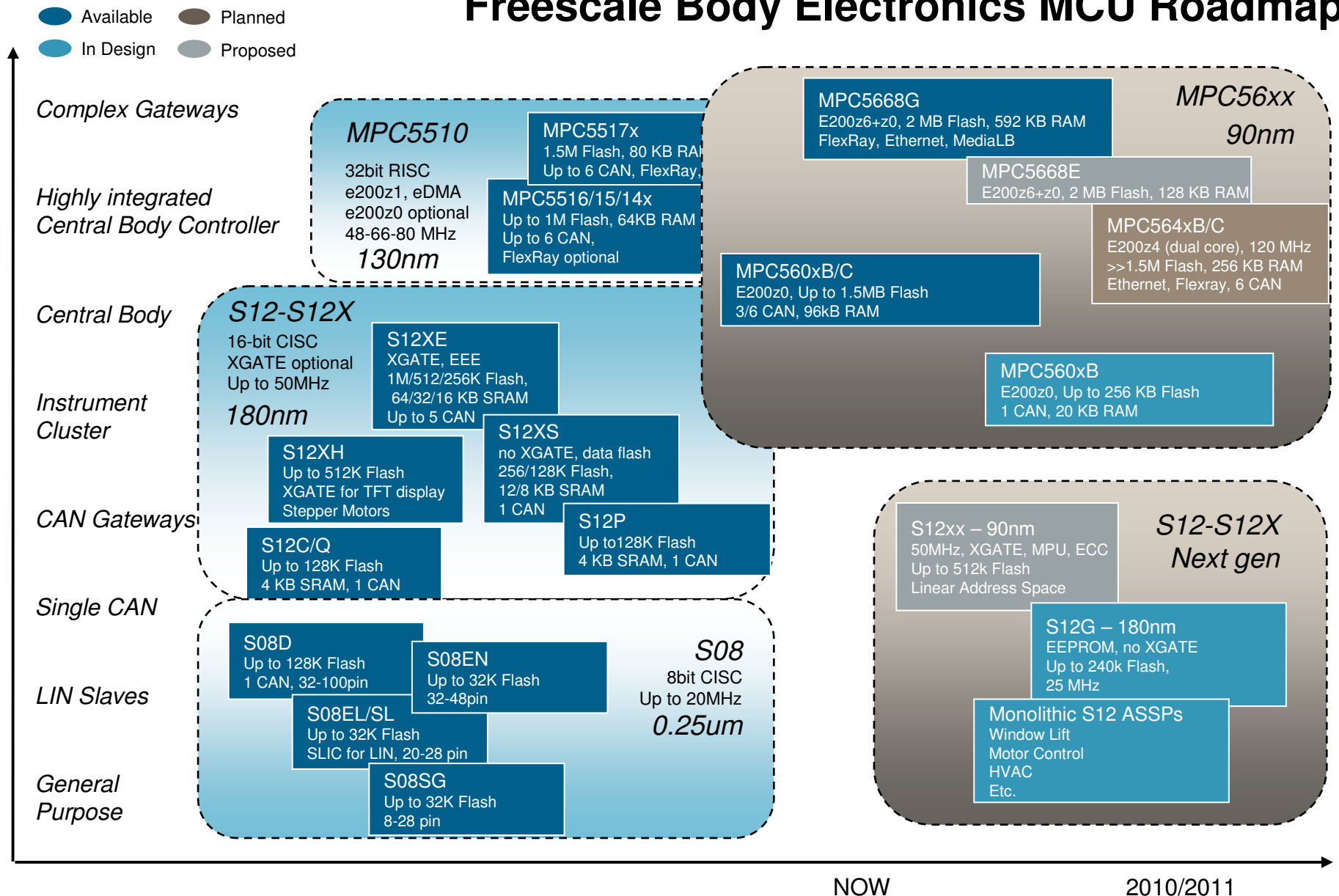


Customer Concerns and Freescale Solutions

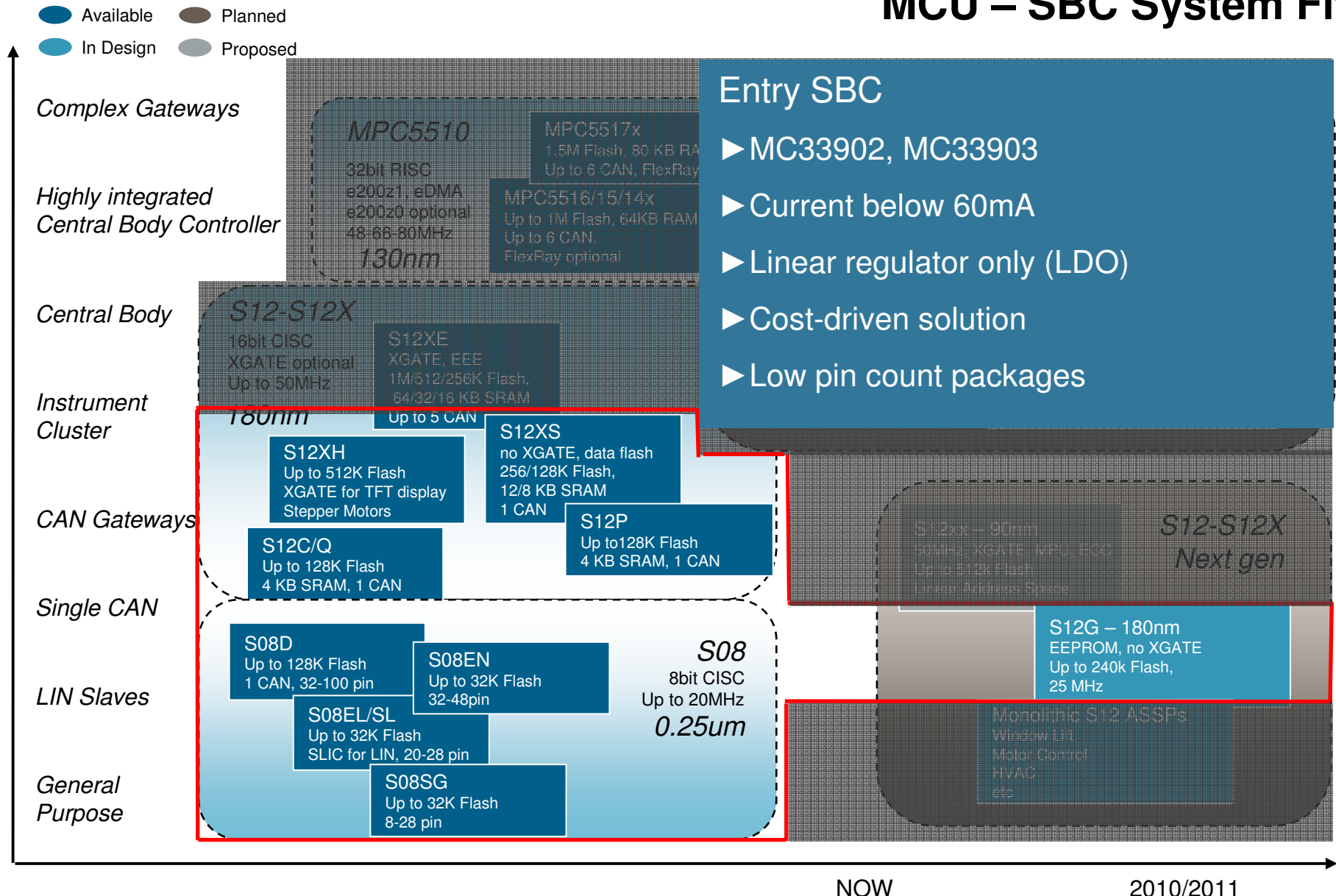
- Help customers meet their design challenges by providing associated benefits

Customer Concerns	SBC Benefits
Increased electrical content can increase battery discharge in parked mode or increase CO2 emission	Freescale SBCs save energy by minimizing current consumption and optimizing wake up events
Customer platforms can require multiple semiconductors or increase bill of materials	Freescale SBCs offer an ideal scalable (pin-to-pin compatible) power management solution for our MCUs to address multiple applications
Need ability to improve determinism during failure modes	Freescale SBCs offer flexible safety solutions and documentation to support application safety integrity level (SIL) assessment
A wide range of networked electronic systems mean car environments need to be less sensitive to external noise and highly robust (less sensitive to power injection)	Freescale SBCs integrate fully certified CAN and LIN according to latest electrical/ESD/EMC market requirements

Freescal Body Electronics MCU Roadmap



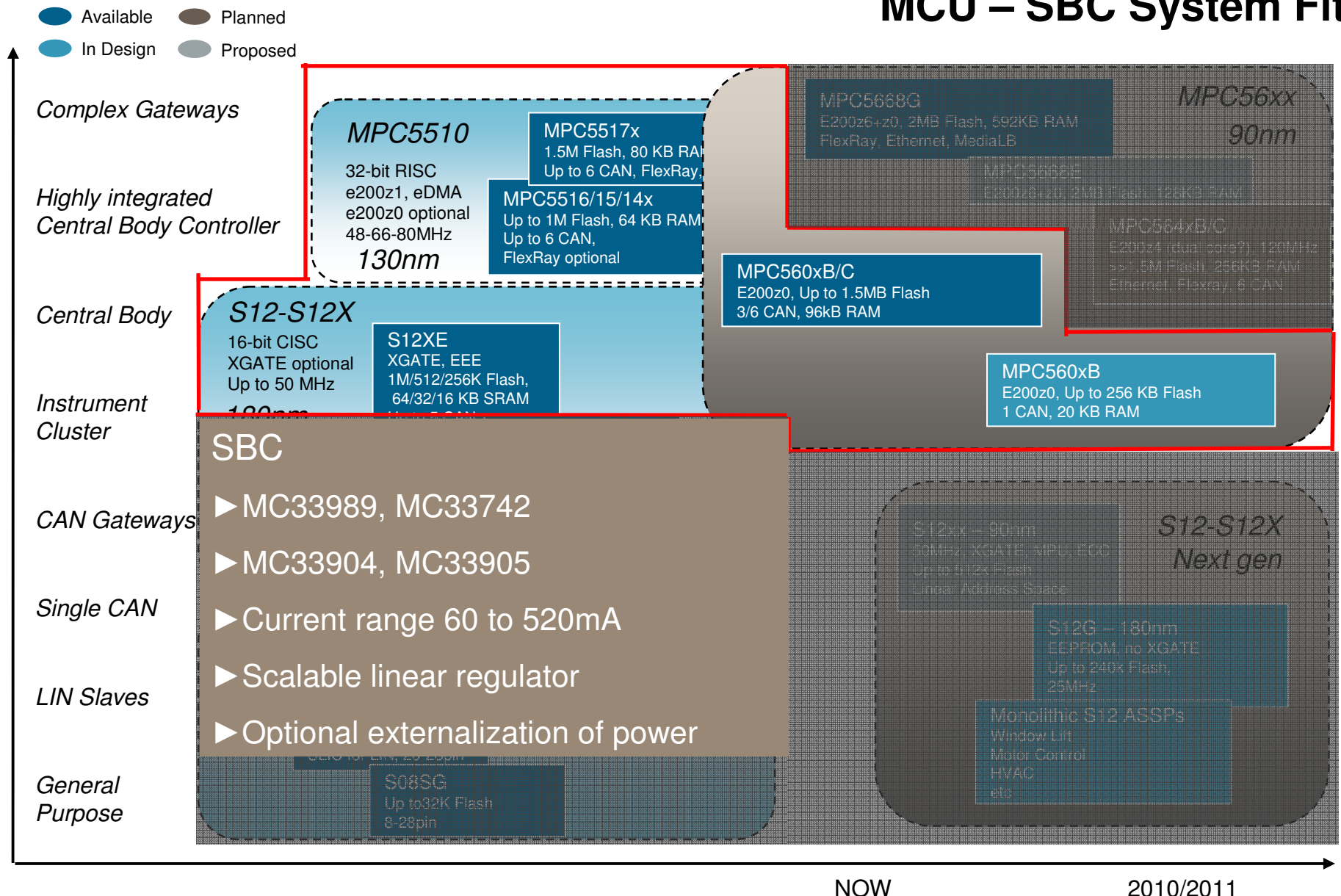
MCU – SBC System Fit



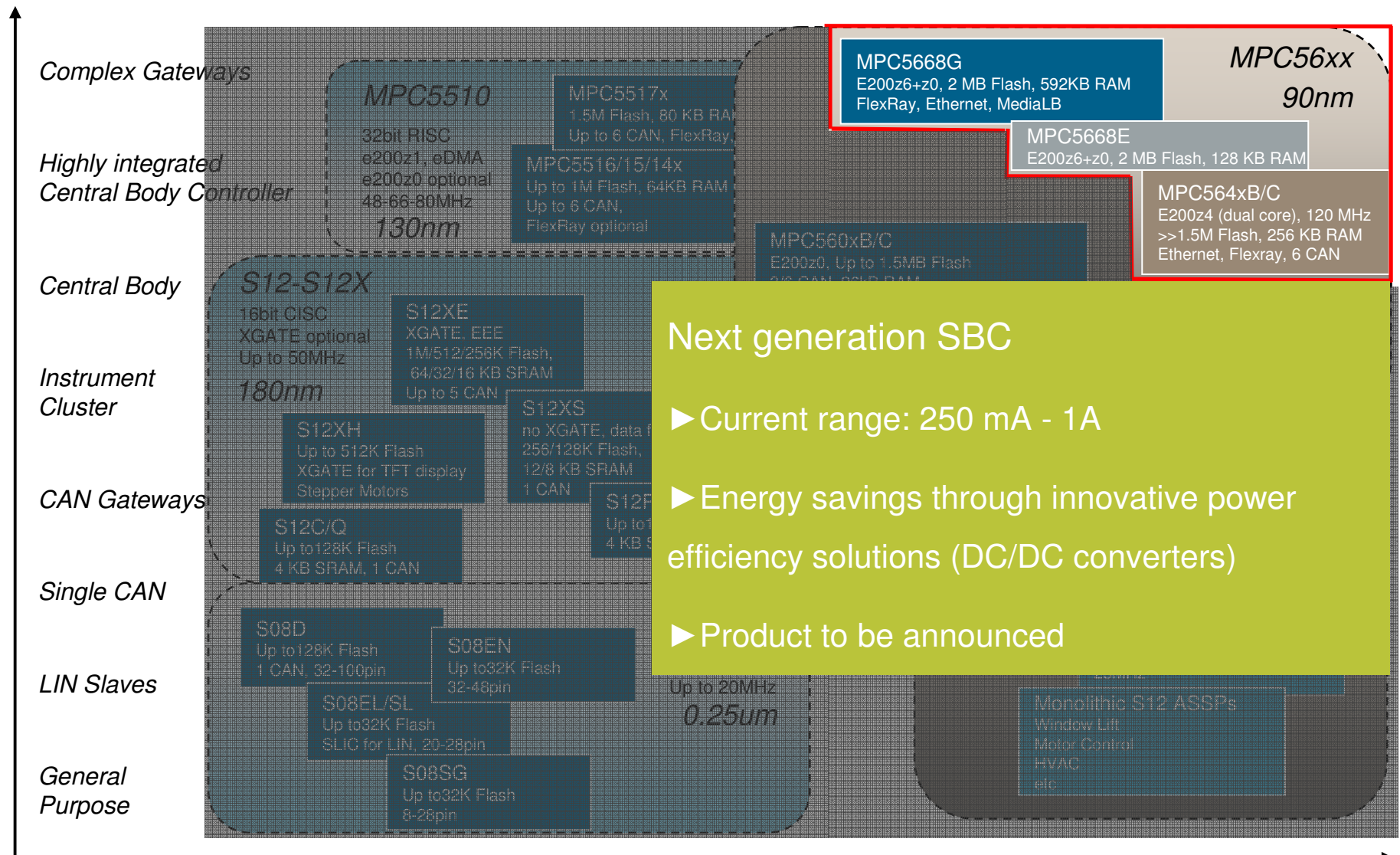
Entry SBC

- ▶ MC33902, MC33903
- ▶ Current below 60mA
- ▶ Linear regulator only (LDO)
- ▶ Cost-driven solution
- ▶ Low pin count packages

MCU – SBC System Fit



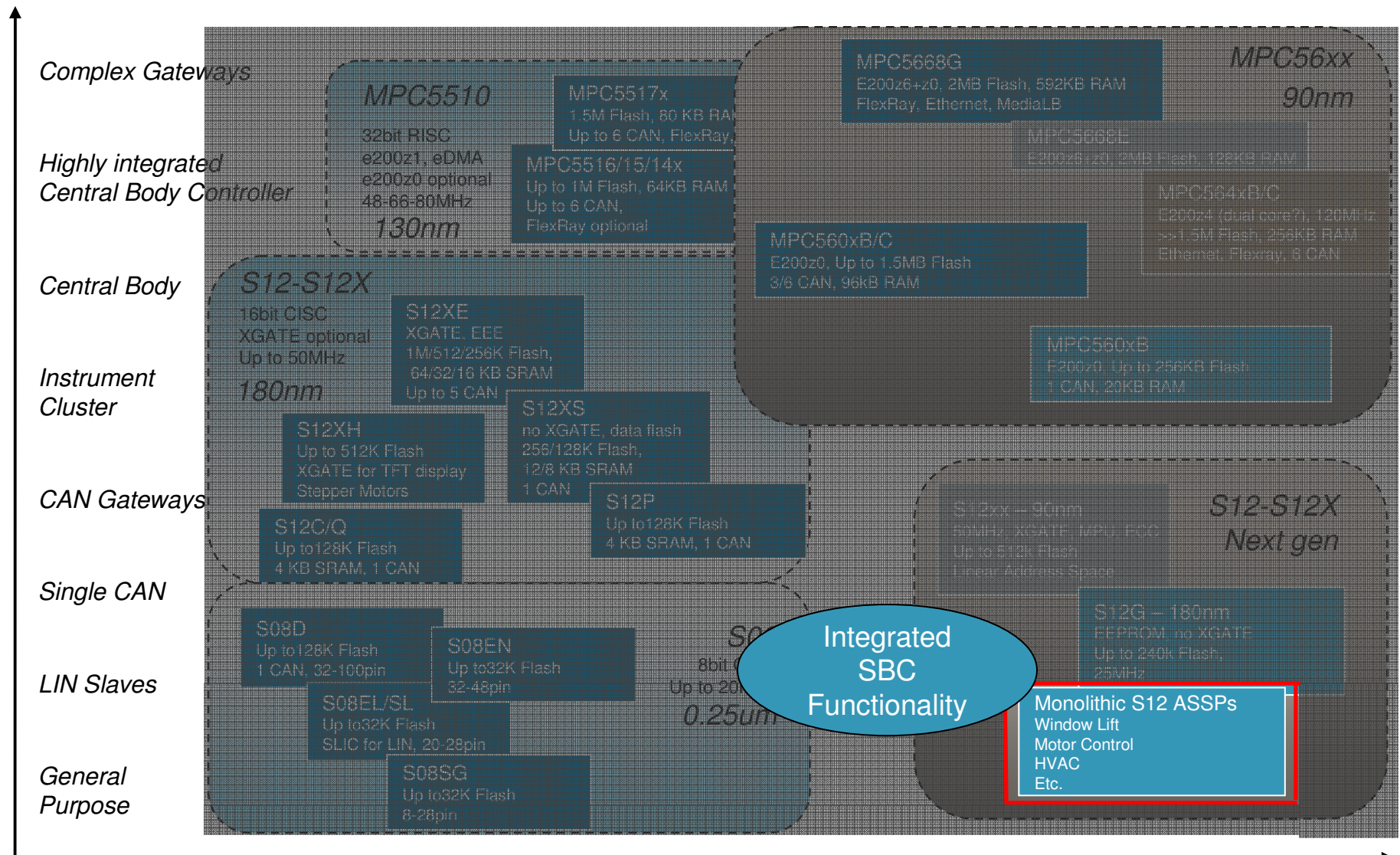
MCU – SBC System Fit



NOW

2010/2011

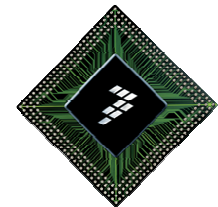
MCU – SBC System Fit





Freescal^e Body Systems Solutions

Analog Components Overview – Power Switches



Energy Distribution in Automotive

► Today

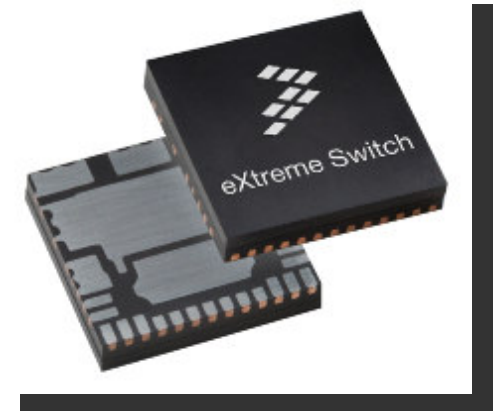
- Traditional BCM modules use fuses and relays



► Tomorrow (SOP2012 and beyond)

- Regulation: CO2 emission, weight
- Warranty extension: Robust design
- Comfort: No changing of fuses
- Fuse box no longer accessible to the driver
- Solid state switches replace fuses and relays

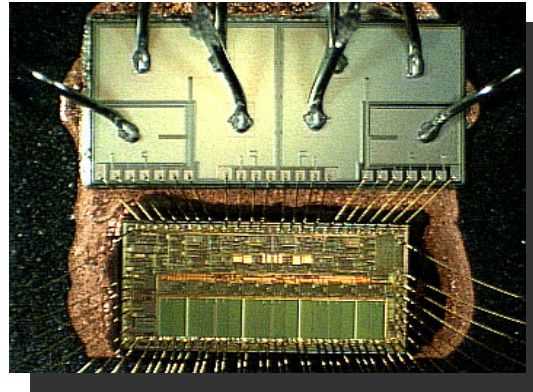
Freescal solution: eXtreme Switch



eXtreme Switch: Three Innovations in One Product

► SMARTMOS

- Protection and diagnostic
 - Over temperature
 - Over current
 - Over/under voltage
 - Short circuit
 - Reverse battery
 - Loss of ground/Vbat
 - Energy discharge protection
- SPI Interface
 - Easy connection to the μC
 - Programmability
 - Daisy chain using SPI
 - Programmable over current trip level
 - Watchdog

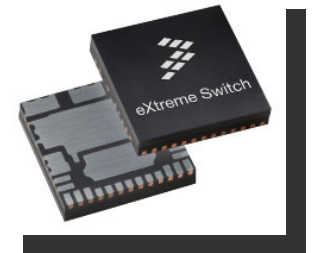


► Power MOSFETs

- Low $R_{ds(on)}$ MOSFETs
 - 1.7mOhm typ. at 25°C
 - 3.4mOhm typ at 150°C
- Protection in the power stage
 - Temperature sensor
 - Current sensor

► PQFN

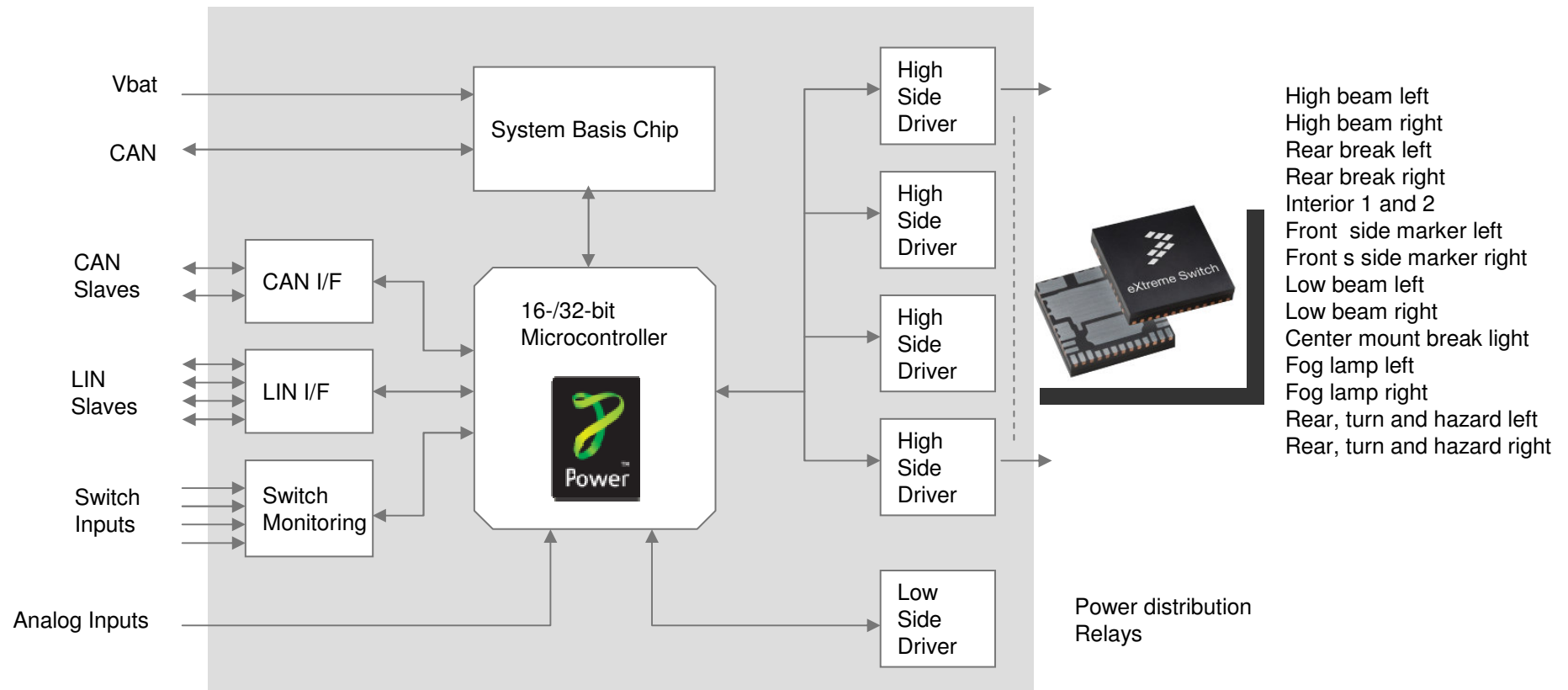
- Design flexibility
- AI power wirebonds
 - Low series resistance
- Low cost power package
 - 0.5 mm thick leadframe
 - Solder die attach
 - $R_{thj-c} < 0.5^\circ\text{C/W}$
 - Current capability > 200A
- High reliability



eXtreme Switch
Intelligence - Power - Protection

14 patents filed since 2003

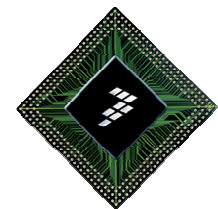
eXtreme Switch Application: Lighting Module



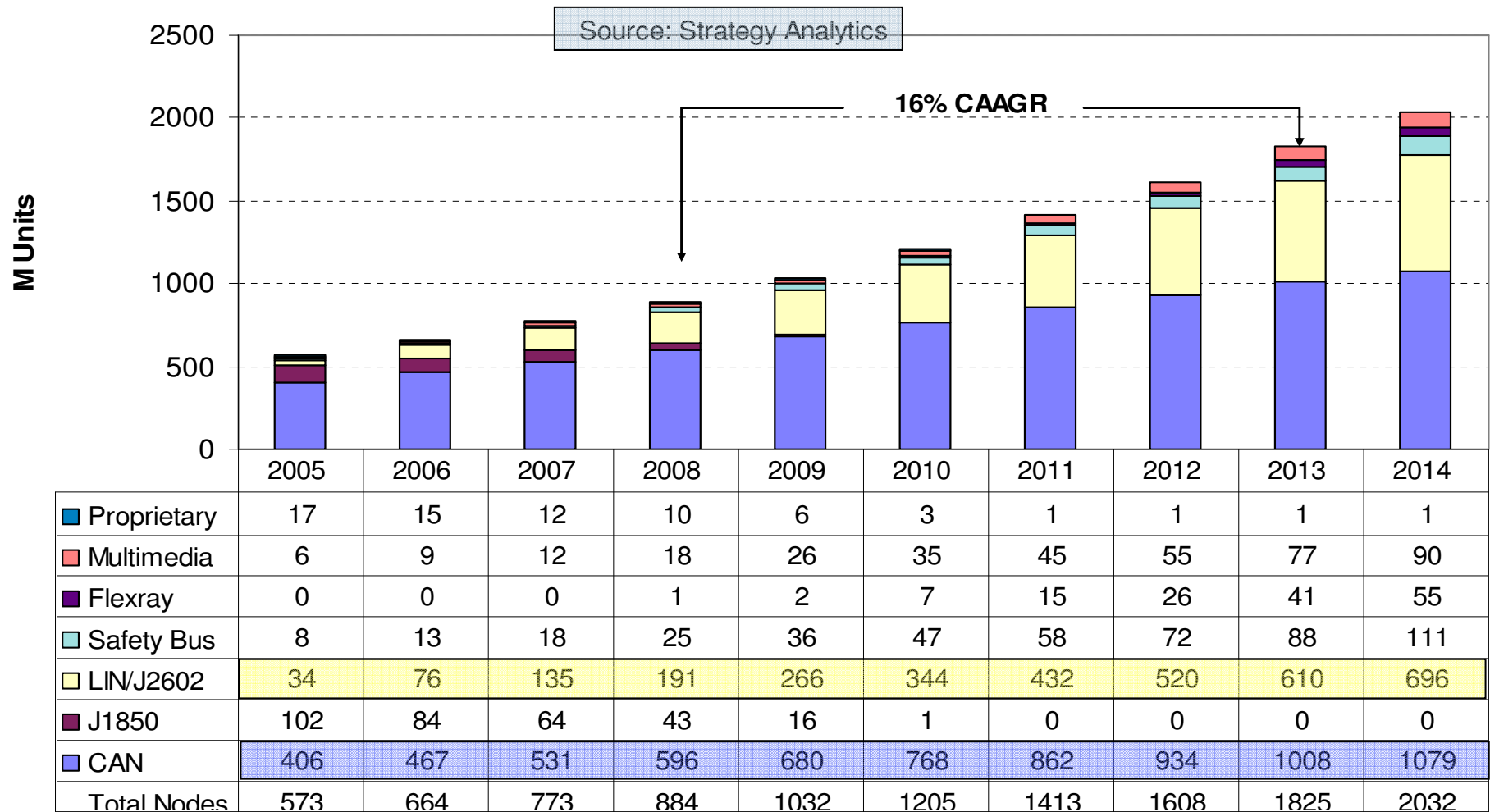


Freescal^e Body Systems Solutions

Intelligent Distributed Control (IDC)



Market Trend: CAN/LIN Modes



Includes NAFTA, Europe, Japan, S.Korea, China, India

What Is IDC?

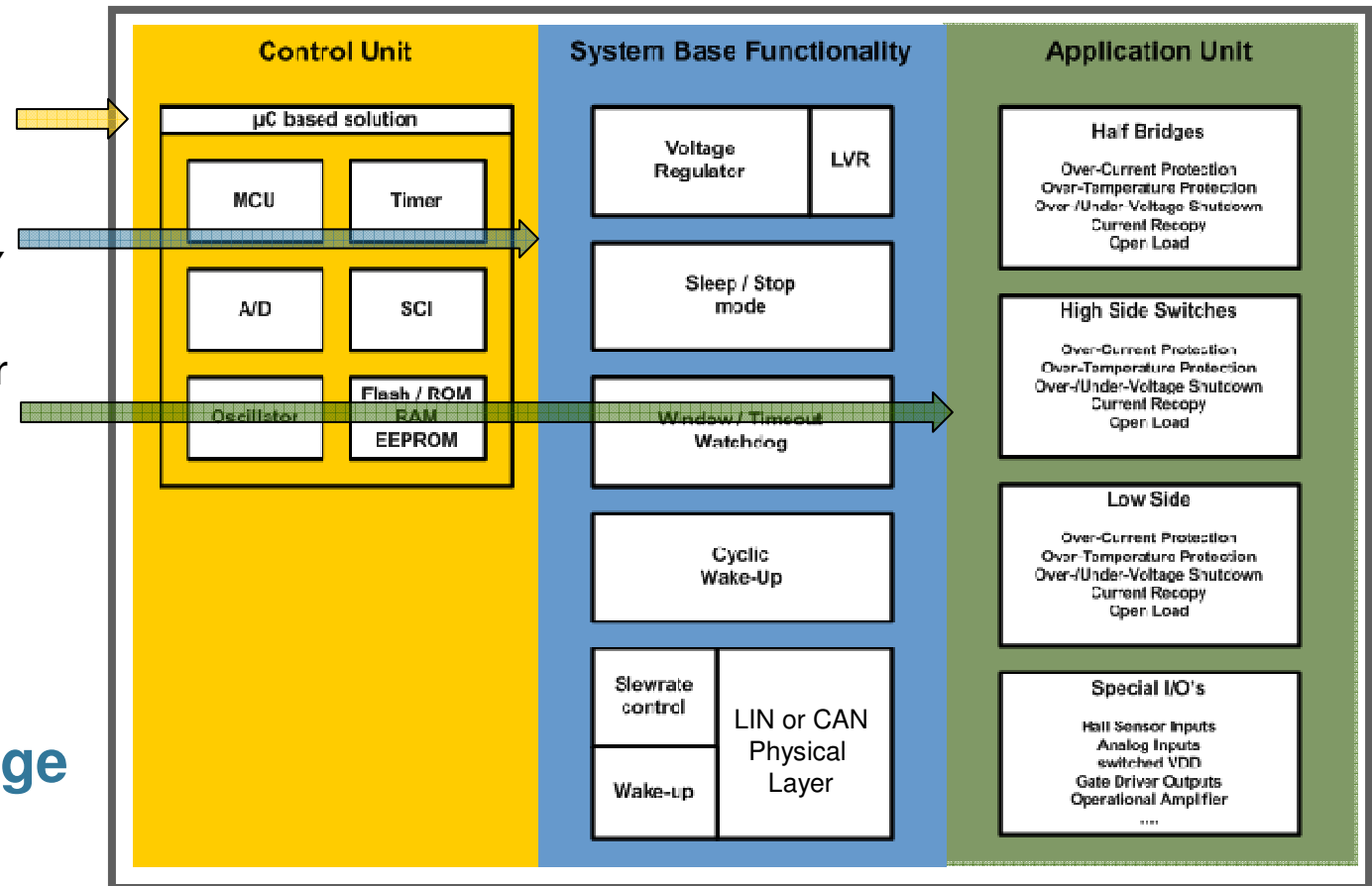
Intelligent Distributed Control

► The Ingredients

- Microcontroller
- System basis chip
 - LIN / CAN PHY
- Analog application layer

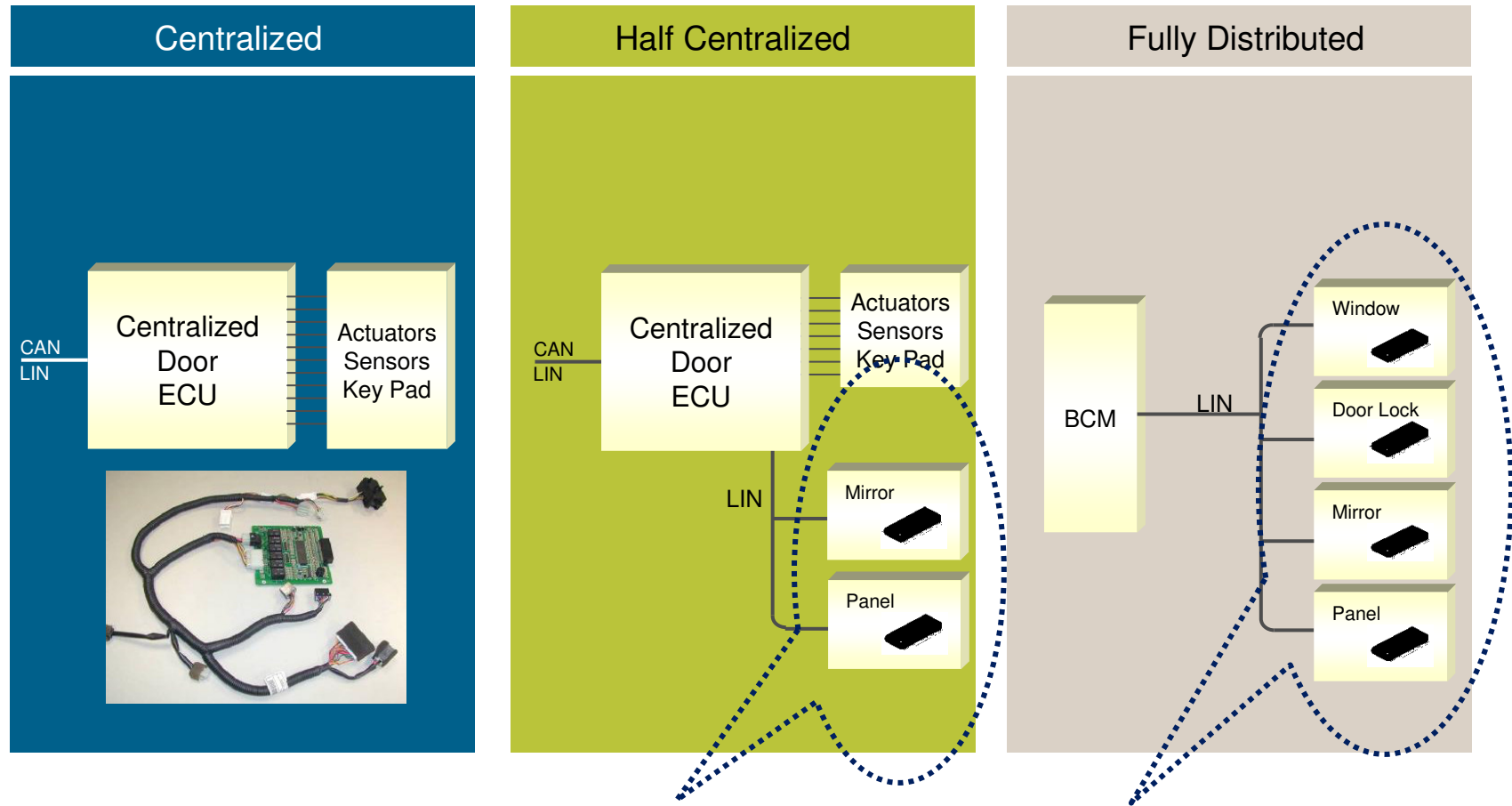


System In Package Solution



IDC Products: Destined for Distributed Systems

Example: Door Architecture



Typical IDC Use Cases: Half Centralized and Distributed Systems

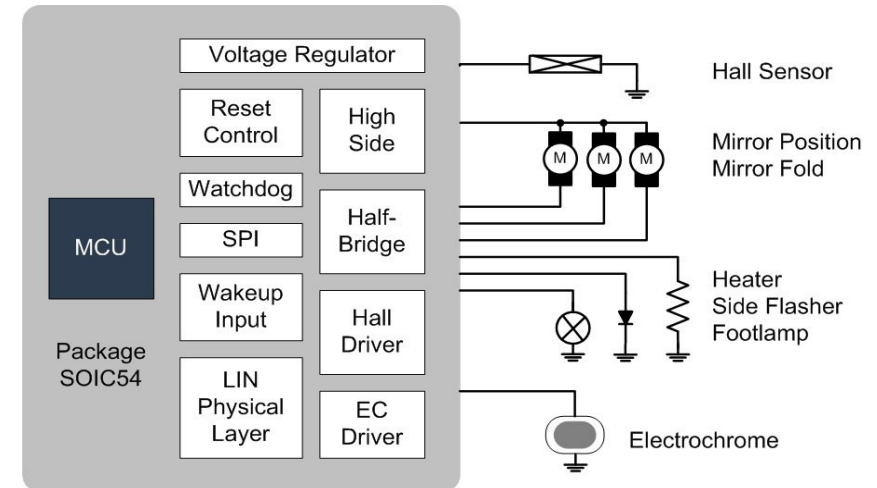
IDC Summary

- ▶ Integration of standard microcontroller, analog function and network interface
- ▶ System In Package solution: Two dies in one package or monolithic integration
- ▶ Utilization of most optimized technology node
- ▶ ASSPs for set of applications, e.g. window lift, sunroof, light leveling, EC mirror, keypad, steering wheel, HVAC, motor control, etc.
- ▶ Designed for distributed LIN/CAN systems

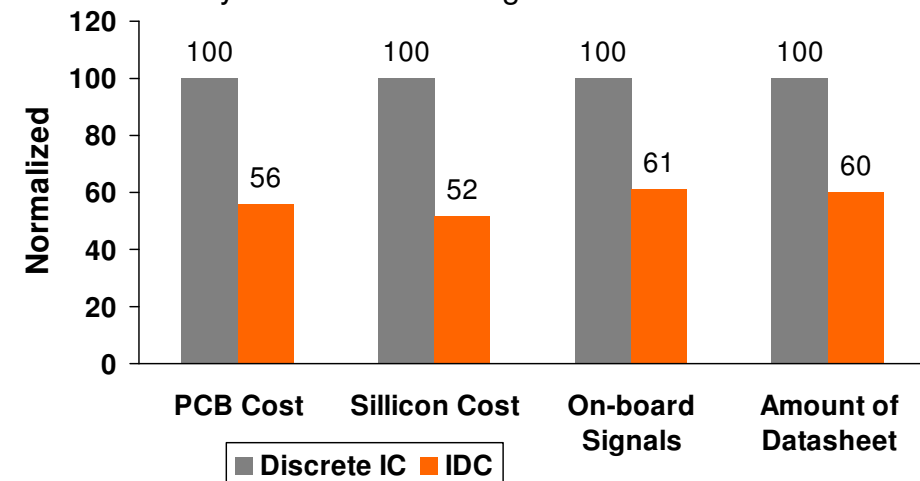
Customer Benefits

- ▶ Space and weight saving
- ▶ Fewer external components
- ▶ 100% MCU-analog compatibility
- ▶ Improved system level reliability
- ▶ Reduced development cycles
- ▶ Reduced logistic costs

Example: High-end EC mirror application



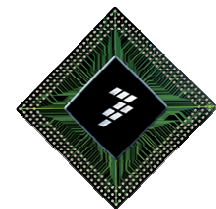
IDC system level advantage vs. discrete IC solution



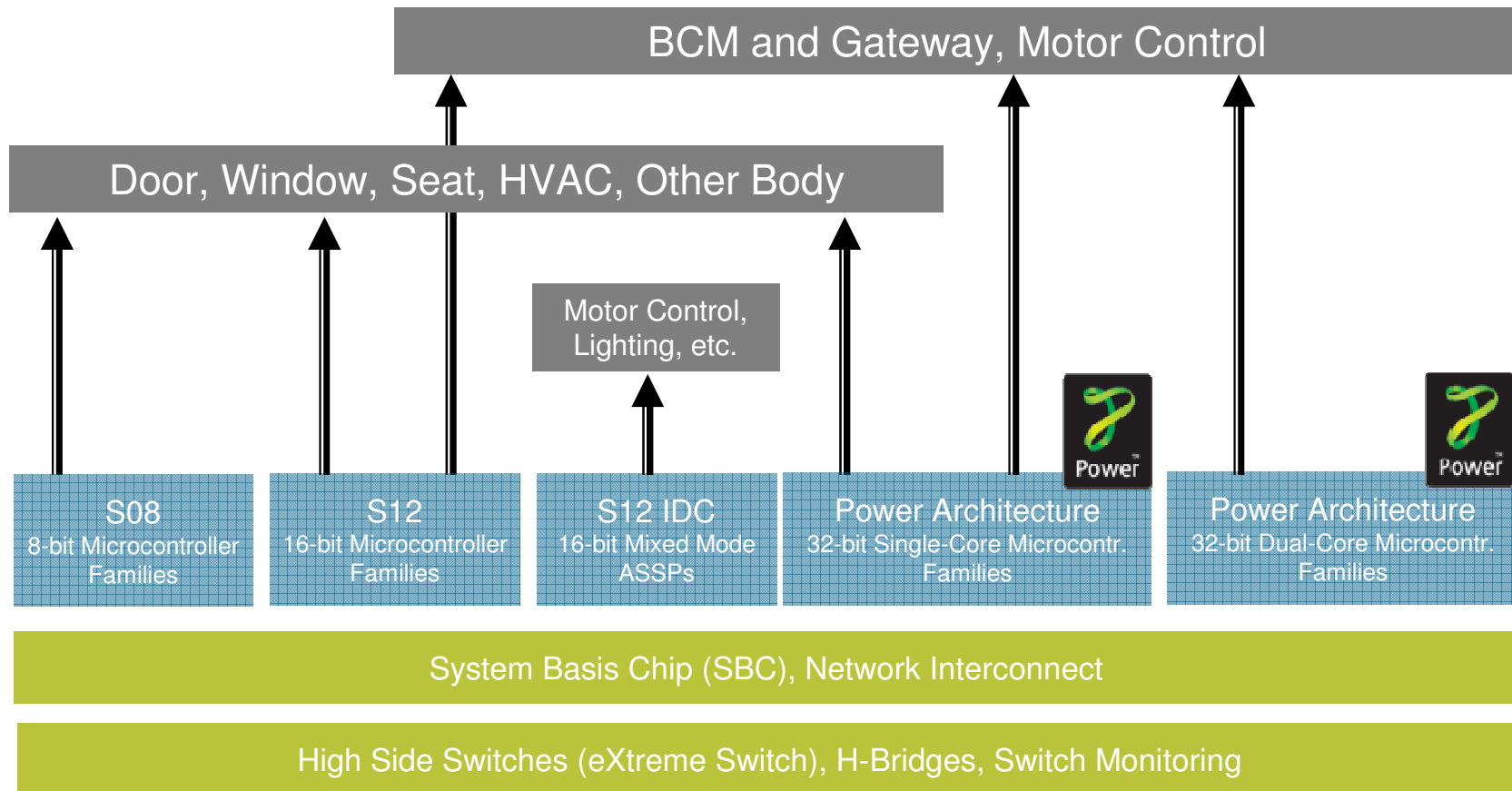
Source: EC mirror application, discrete devices are sampled from various major vendors (anonymous)



Review and Wrap-up



Body Systems Solutions – Freescale Portfolio Overview



Body Systems – Freescale Solutions

FSL Solutions

- ▶ Wide portfolio of 8, 16 and 32 bit microcontrollers
 - S08 – S12 – MPC56xx
- ▶ Wide portfolio of standard analog devices
 - SBC, power switches, network interfaces, H-Bridge, etc.
- ▶ Growing portfolio of System-In-Package solutions
 - Door module, lighting, motor control, interior lighting, etc.
- ▶ AutoSar for 16-bit and 32-bit microcontrollers

Key Differentiators

- ▶ S12 microcontroller family is established de-facto 16-bit automotive standard
 - Shipping >130M units per year
- ▶ System-in-package solutions based on S12 controller architecture
 - Software and tool re-use
- ▶ Standardizing 32-bit solutions on Power Architecture
 - Body, powertrain, chassis and safety, infotainment
- ▶ Joint Development Program (JDP) with STMicroelectronics

Dedicated Product Sessions at FTF

Session ID	Title	Content	Day	Time	Duration	Room
FTF-AUT-F0408	Low Power System Techniques	MCUs	Tuesday	15:00	1 hr	Palazzo Salon H
FTF-AUT-F0730	Automotive Network Protocol Overview	LIN, CAN, FR, MOST, etc	Tuesday	16:15	1 hr	Palazzo Salon H
FTF-AUT-F0746	Hands-on Part 1: MPC560xx Features	32bit MPC560xx MCUs	Tuesday	16:15	2 hrs	Siena I & II
FTF-AUT-F0687	Hands-on Part 2: MPC560xx Low Power	32bit MPC560xx MCUs	Wednesday	10:15	2 hrs	Siena I & II
FTF-AUT-F0814	Microcontrollers for Automotive Applications	8/16/32 bitMCUs	Wednesday	10:15	1 hr	Palazzo Salon B
FTF-AUT-F0728	Automotive Runtime Software	Software Roadmap and QA	Wednesday	11:15	1 hr	Palazzo Salon B
FTF-AUT-F0556	Analog Mixed Signal and Power products for Automotive	Analog and Power	Wednesday	14:00	1 hr	Palazzo Salon B
FTF-AUT-F0556	Automotive MCU architecture for the future	32bit MCUs	Wednesday	15:00	1 hr	Palazzo Salon E
FTF-AUT-F0452	thermal Modeling for the real World	Analog & Power Mangement	Wednesday	16:15	2 hrs	Palazzo Salon E
FTF-AUT-F0732	SBCs: Power Management for 16 & 32 bit MCUs	SBCs	Thursday	9:00	1 hr	Palazzo Salon E
FTF-AUT-F0423	PWM & Diagnosis for BCM Modules	32bit MPC560x MCUs	Thursday	10:00	1 hr	Palazzo Salon C
FTF-AUT-F0741	Speed up SBC product selection cycle	Analog & Power Mangement	Thursday	10:00	1 hr	Palazzo Salon E
FTF-AUT-F0692	Technical deep dive: MC3391x family	LIN SBCs	Thursday	11:00	1 hr	Palazzo Salon E

