Nov 11, 2010

Industrial Control & Networking Trends and Roadmap

Alexandra Dopplinger
Global Industrial Segment Lead, Factory Automation & Drives

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Introduction and Agenda

- Presenter:
  - **Alexandra Dopplinger, Freescale Semiconductor**
    - Global Industrial Segment Lead, Factory Automation & Drives
      - alex.dopplinger@freescale.com
      - +01 613-228-6825 (Ottawa, Canada)
    - Areas of expertise
      - Factory Automation & Drives market
      - Industrial connectivity protocols

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Session Objectives

- After completing this session you will be able to:
  - Describe global trends for industrial control and networking
  - Understand which applications Freescale targets in this market
  - Select the best Freescale solution for your industrial control and networking projects
  - Locate the latest reference designs, enablement and partner support for Freescale industrial control and networking solutions

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Agenda

- Industrial Control and Networking market
  - Target applications
  - Freescale alignment with market trends

- Industrial Control and Networking solutions
  - Application example: Programmable Logic Control
  - 32-bit processor roadmap for industrial control and networking
  - Industrial network protocol solutions

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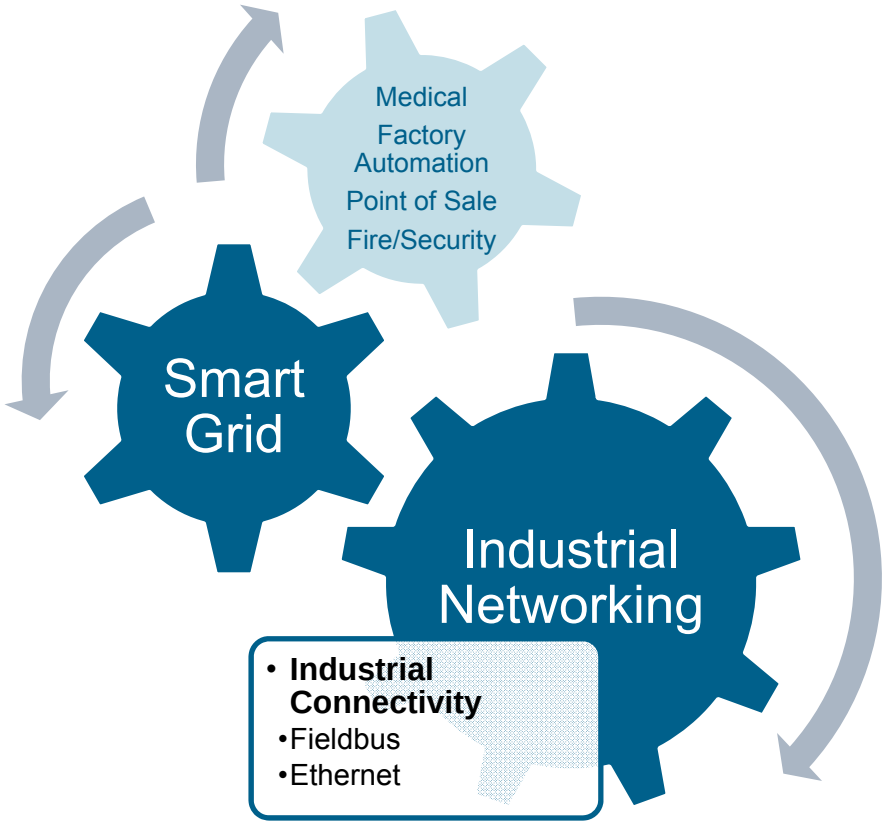
Key Industrial Markets



Going **Green**

Health & **Safety**

Net **Effect**

www.freescale.com/industrial

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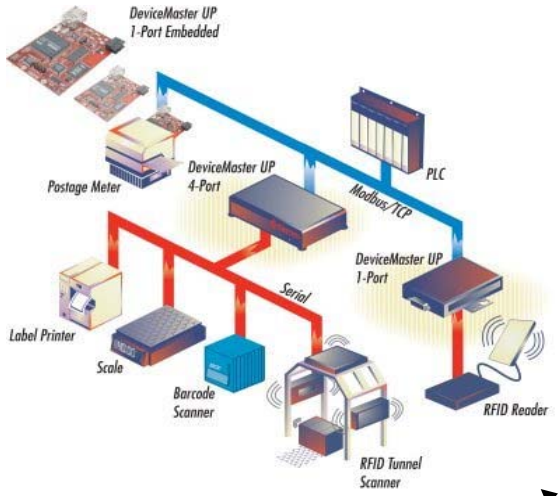
Factory Automation Market

Factory Network



Industrial Control

Industrial Networking

Human Machine Interface (HMI)

Industrial Drives

Industrial Peripherals

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Factory Automation Applications

- Communicate with real-time deterministic protocols
- Ruggedized for harsh environment

- Industrial Control
  - Programmable Logic Control (PLC)
  - Input-Output Control
  - Process, Temperature, Motion, Position Control
- Industrial Networking
  - Gateway, Router, Switch, Converter, Hub
- Human Machine Interface (HMI)
- Industrial Peripherals
  - Robot, Actuator, Power Management

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Freescale Devices are Popular for Industrial Automation

►And many other companies…

- Microcontrollers & Microprocessors
  - 8-bit MCU
  - 32-bit Kinetis ARM MCU
  - 32-bit ColdFire+ MCU
  - 32-bit ColdFire/68K MCU and MPU
  - 32-bit Qorivva Automotive MCU
  - i.MX Application Processor
  - QorIQ Multicore Processor
  - PowerQUICC Communications Processor
  - Power Architecture Host Processor
- Digital Signal Processors
  - Digital Signal Controller
  - StarCore DSP
- Sensors, Analog & Power Management
- Software and Tools

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Factory Automation – Market Trends

Market Trend	Customer Requirements
Reuse software, hardware, and tools across platforms	▶Port software across same platform from 50 to 1500+ DMIPS ▶Use libraries and reference designs for common functions ▶Tools to develop increasingly complex algorithms
Reduce power consumption	▶Fanless operation at -40C to +85C ambient ▶MPU <4 W max at >1000 DMIPS, with power management ▶Intelligent motor control - 2009 was 6th year >10% growth (IMS)
Migrate from fieldbus to standardized Ethernet and wireless	▶Bridge from legacy fieldbus to industrial Ethernet ▶Industrial wireless emerging in process, sensor arrays and automation
Cost-effective safety and security	▶IEC regulatory approval requires single-bit failure detection ▶On-chip security to protect against IP cloning and network data hacking ▶Improve system-level cost and development cycle

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Factory Automation – Rugged. Reliable. Reusable

Market Trend	Freescale Alignment with Customer Requirements
Reuse software, hardware, and tools across platforms	▶ Processor performance from 50 to 20,000+ DMIPS in harsh environments, from -40C to 85C ambient ▶ Increasing enablement to leverage ruggedized Power Architecture®, ColdFire® and i.MX processor portfolios ▶ Longevity program www.freescale.com/productlongevity
Reduce power consumption	▶ MPU up to 1600 DMIPS <1 W max, with power management ▶ MPU up to 5500 DMIPS <8 W max, with power management ▶ MCU, 8-bit and DSC for cost-effective and efficient motor control ▶ On-chip memory & peripherals – flash, timers, ADC/DAC, PWM, I/O
Migrate from fieldbus to industrial Ethernet and wireless	▶ Devices support legacy fieldbus, industrial Ethernet and/or wireless ▶ 3rd party protocol support www.freescale.com/connectivity
Cost-effective safety and security	▶ Secure SRAM, on-chip data fusing to protect against IP cloning ▶ Hardware encryption to protect against network data hacking ▶ Parity, watchdog and ECC protection against soft errors

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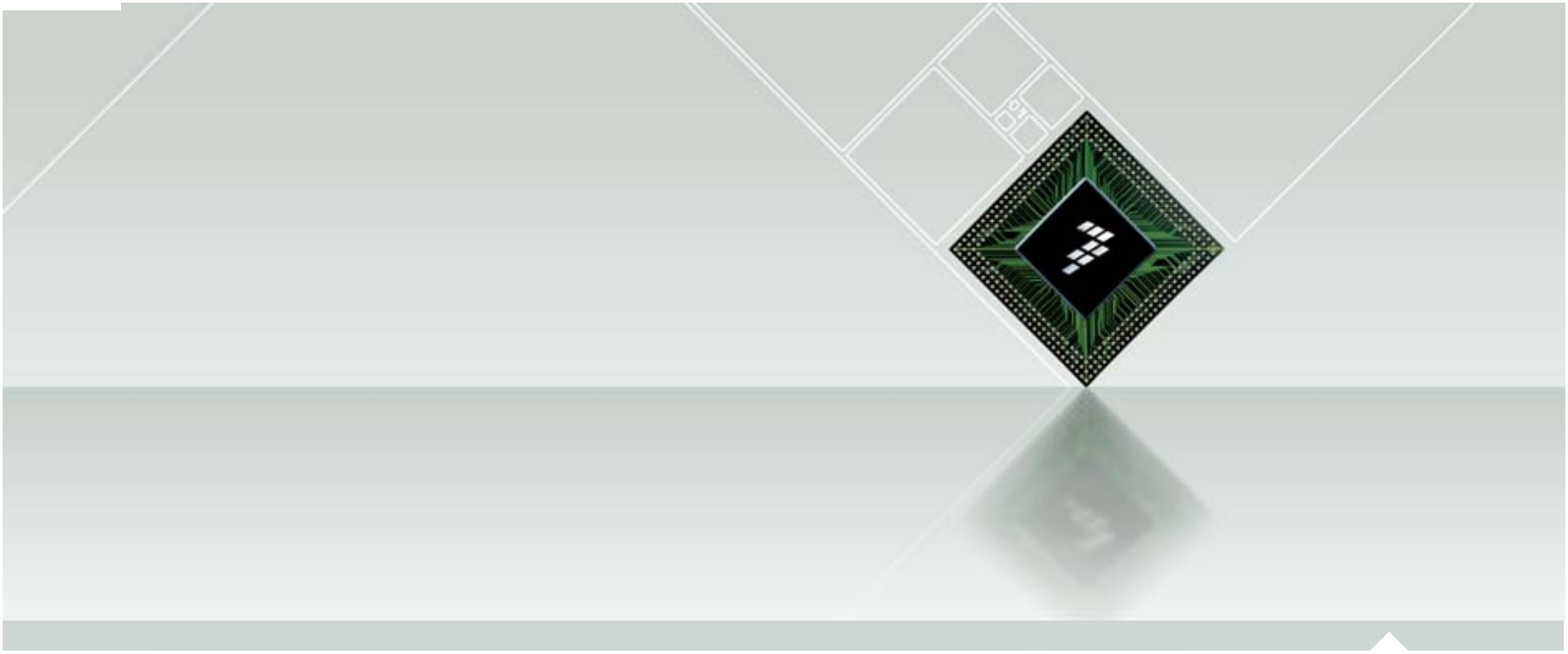

Factory Automation Solutions

Industrial Control Example

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Solutions @ www.freescale.com/FactoryAutomation

Freescale ▸ Industrial ▸ Factory Automation

Factory Automation

Rugged. Reliable. Reusable. Freescale offers industrial control and networking solutions for many wired and wireless industrial communications protocols and human machine interfaces. Our safe and secure systems withstand hacking, cloning, tampering and soft errors in harsh environments typical of a manufacturing or processing facilities.

Featured Applications

- Industrial Control
  - Programmable Logic Control (PLC)
  - Input-Output Control (I/O Control)
  - Process Control, Temperature Control
  - Motor Control with Wireless Sensors
  - Motion Control
  - Single Board Computer
- Industrial Networking
  - Fieldbus-to-Ethernet Gateway
  - Industrial Gateway (Router)
  - Industrial Ethernet Switch
  - Industrial Converter (Bridge)
  - Industrial Hub
- Human Machine Interface (HMI)
- Industrial Peripherals
  - Robotic Arm
  - Robotic Manipulator
  - Network-Enabled High-Performance UPS
  - Digital Power Control

Design Resources

- Getting Started
  - Industrial Control and Networking Roadmap
  - Industrial Network Protocols Training
- Technologies, Standards & Protocols
  - Industrial Network and Fieldbus Protocols
  - IEEE® 802.15.4 Wireless Protocol
  - LCD
  - Motor Control
- Design Partners
  - All Freescale Alliance Members

Related Video

▸ **Robotic Arm Powered by a Flexis™ AC MCU**
Human air hockey competitor can't beat the robotic arm powered by the Flexis AC MCU (Video - 3:32)

▸ **Touch Sensing Introduction**
Enable products for touch sensing in less than 10 minutes.
(Video - 1:01)

▸ **Cool LCD Design**
Using Freescale's 9S08LG32
(Video - 6:15)

Featured Products

▸ **MC9S08MP16**
8-bit BLDC motor control processor

▸ **i.MX51 Applications Processor**
ARM-based and ruggedized for HMI and industrial control applications

Training & Events

On-Demand Training

- Industrial Network Protocols Training

Read More

- Industrial Protocol support (PROFINET, EtherNet/IP™, Modbus®, EtherCAT)
- Freescale product longevity program offers up to 15-year availability for selected products

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Programmable Logic Controller

Application Requirements:

- Control machines and processes with fast, deterministic operation
  - Double precision floating point
  - On-chip cache and flash memory
- Manage logic, timing sequencing, counting and arithmetic algorithms
- Connectivity
  - Fieldbus: PROFIBUS, DeviceNet™
  - Industrial Ethernet: PROFINET, EtherNet/IP™, EtherCAT®
  - Binary and analog I/O
- Fanless operation in harsh environment, -40C to +85C ambient

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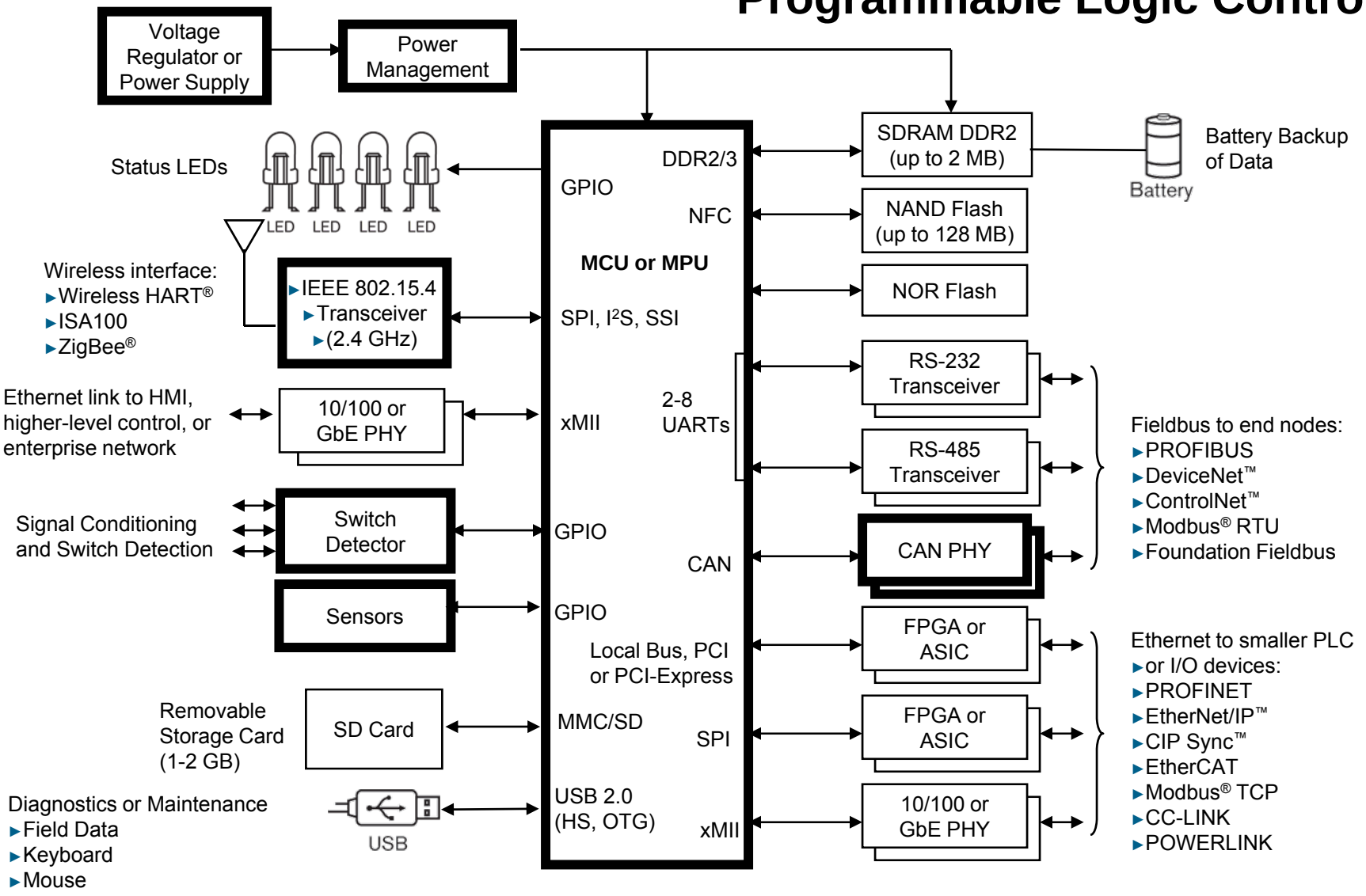
Programmable Logic Controller



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Freescale Solutions for Programmable Logic Controller

- **MCU or MPU**: On-chip Ethernet, CAN, PCI, UART, USB, I/O, local bus
  - P2020, P1011/12 QorIQ™ multicore MPU, highest MIPS/Watt, 5,500 MIPS <8W max
  - MPC8309 PowerQUICC MPU, 650 MIPS <1.5W max
  - i.MX28x, i.MX51x, ARM core, LCD, touch screen, up to 1600 MIPS <1W max
  - MCF5441x ColdFire MPU, extensive connectivity and motor control peripherals <1W max
  - MCF5225X ColdFire MCU, 512K flash, lowest cost, 80-200 MIPS <1W max

-40C to +85C ambient

- **Connectivity:** www.freescale.com/connectivity
  - Industrial protocol support for Ethernet, CAN and serial interfaces
  - Wireless: MC13213, MC13224 integrate MCU with 2.4 GHz IEEE 802.15.4 wireless transceiver
    - Add antenna and oscillator for complete WirelessHART®, ISA100 or ZigBee® wireless network solution

- **Ruggedized Sensors:** www.freescale.com/sensors
  - 3-axis accelerometer: MMA8450Q, MMA736L, MMA7455L, MMA7660 for orientation, motion detection
  - Touch or Proximity: MPR121, MPR03x, MPR084
  - Pressure: MPX5999D, MP3V5004, MPXV5050 pressure sensor for vacuum pump monitor
  - Switch detector: MC33972, MC33975 with signal conditioning for up to 22 contacts

- **Power Management, Voltage Regulator, Power Supply**
  - MC34704 Power Management Unit (PMU) for i.MX25x
  - MC33730 PMU for QorIQ, PowerQUICC, MPC5xxx, ColdFire, 8-bit and DSC products
  - MC13892 PMU operates -30C to +85C with S/W drivers and reference designs for i.MX35x, i.MX51x
  - Voltage Regulator / Power Supply: MC44717, MC34713, MC34726, MC34727, MC33742, MC34700

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32-bit Processor Roadmap for Industrial Control and Networking

QorIQ, PowerQUICC, ColdFire, ColdFire+, i.MX and Kinetis

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Freescale 32-bit Processor Families

QorIQ Multicore MPU
PowerQUICC MPU
Power Architecture® MCU

Multicore with broadest scalability from 100 to 20,000+ MIPS, leading on-chip connectivity

- Networking
- Automotive
- Industrial

ColdFire MPU
ColdFire MCU
ColdFire+ MCU

NEW 90nm

Up to 200 MIPS with flash memory, extensive peripherals, free MQX or Linux® OS

- Consumer
- Industrial

i.MX MPU
Kinetis MCU

NEW 90nm

<1W for battery-operated applications up to 1600 MIPS, LCD, graphics, extensive connectivity

- Consumer
- Automotive
- Industrial

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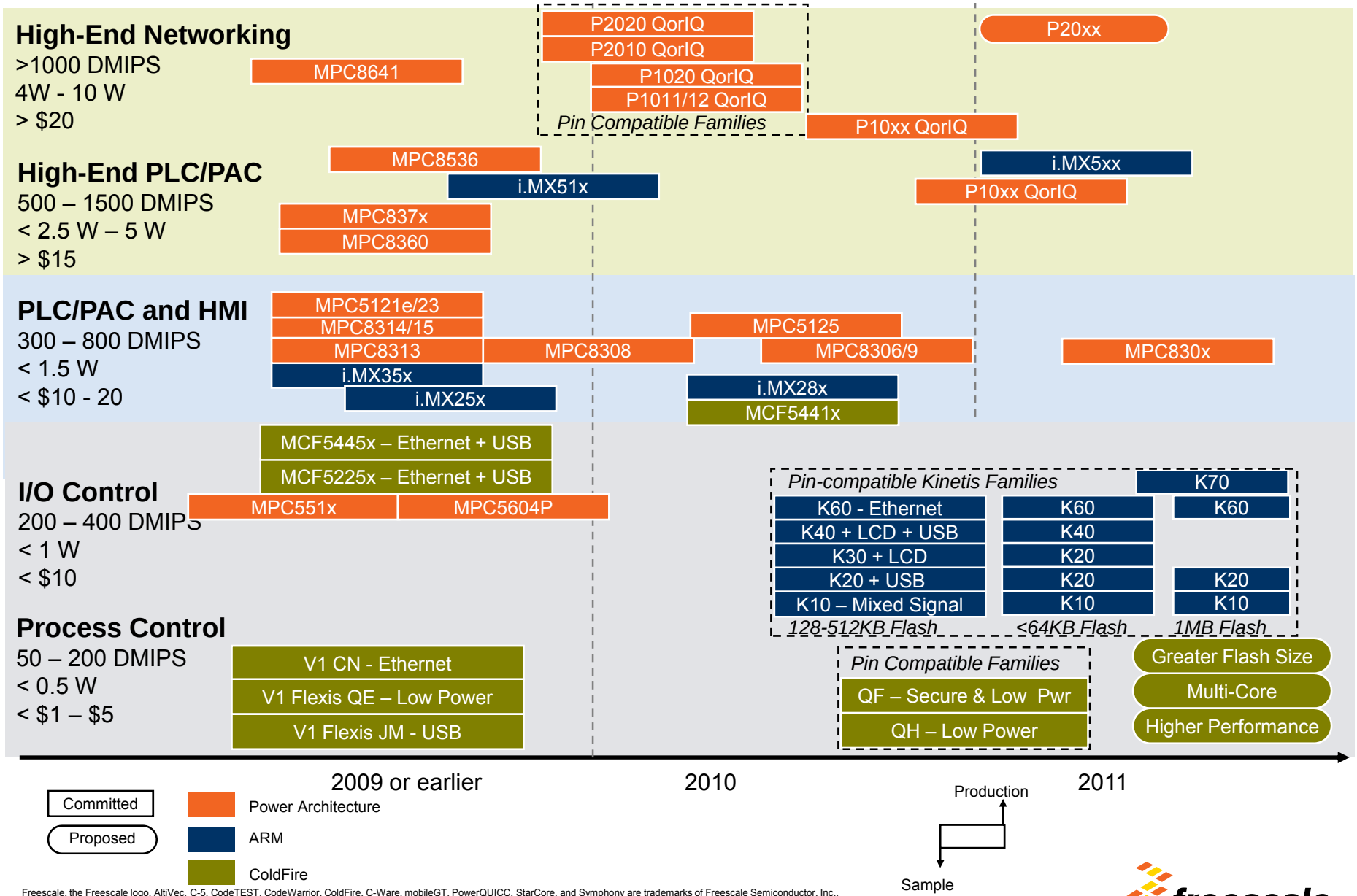
Processors for Industrial Control, Networking and HMI



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Newest 32-bit Solutions for Industrial Control

freescale semiconductor ColdFire

ARM

Power Architecture	ColdFire	ARM
QorIQ Multicore MPU **P2020/10, P1011/12** Pin-compatible across 1000-3500 MIPS <5W, Extensive connectivity PowerQUICC MPU **MPC8306/9, MPC5125** 400-800 MIPS <2W, Extensive connectivity Power Architecture MCU **MPC5604P** Automotive 100-400+ MIPS	ColdFire MCU **MCF5441x** – 375 MIPS, 2x10/100 Ethernet, USB, CAN, 5xUART **MCF5225x** – 76 MIPS, 512K Flash, Ethernet, USB, CAN, 3 x UART ColdFire+ MCU **MCF51QF** – Secure, 50-200 MIPS <1W **MCF51QH** – Low Power	i.MX MPU **i.MX51x** – 1600 MIPS <1W, Ethernet, USB, LCD, graphics, touch screen **i.MX28x** – 500 MIPS <0.5W, 2x10/100 Ethernet, USB, LCD, touch screen Kinetis MCU Pin-compatible across 50-200 MIPS <1W **K60** – Ethernet **K40** – LCD, USB **K30** – LCD **K20** – USB **K10** – Mixed Signal

Included in Product Longevity Program

Freescale Product Longevity Program

- The embedded market needs **long-term product support**
  - Freescale has a longstanding track record of providing long-term production support for our products
- Freescale offers a **formal product longevity program**
  - A broad range of devices are made available for a minimum of **10 or 15 years from the time of launch**
  - Participating Freescale products are listed at www.freescale.com/productlongevity

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QorIQ and PowerQUICC High-Performance Processors

► Evolved from industry-leading PowerQUICC communications processors

- Single core @ 800 MHz <3 Watts
- Eight cores @ 1.5 GHz/core <30 Watts
- 10/100/1000 Ethernet, CAN®, UART, SPI, USB, GPIO
- Integrated security processors

BUILT ON Power™

Starts <$15! (SRP)

► Hybrid software simulation and debug tools

- CodeWarrior multicore development environment
- VortiQa gives production-ready security software

► Industrial qualification and long product life

- Operation in harsh environments from -40C to +85C
- Included in Product Longevity program

Pin-compatible solutions up to 20,000+ MIPS with leading MIPS/Watt

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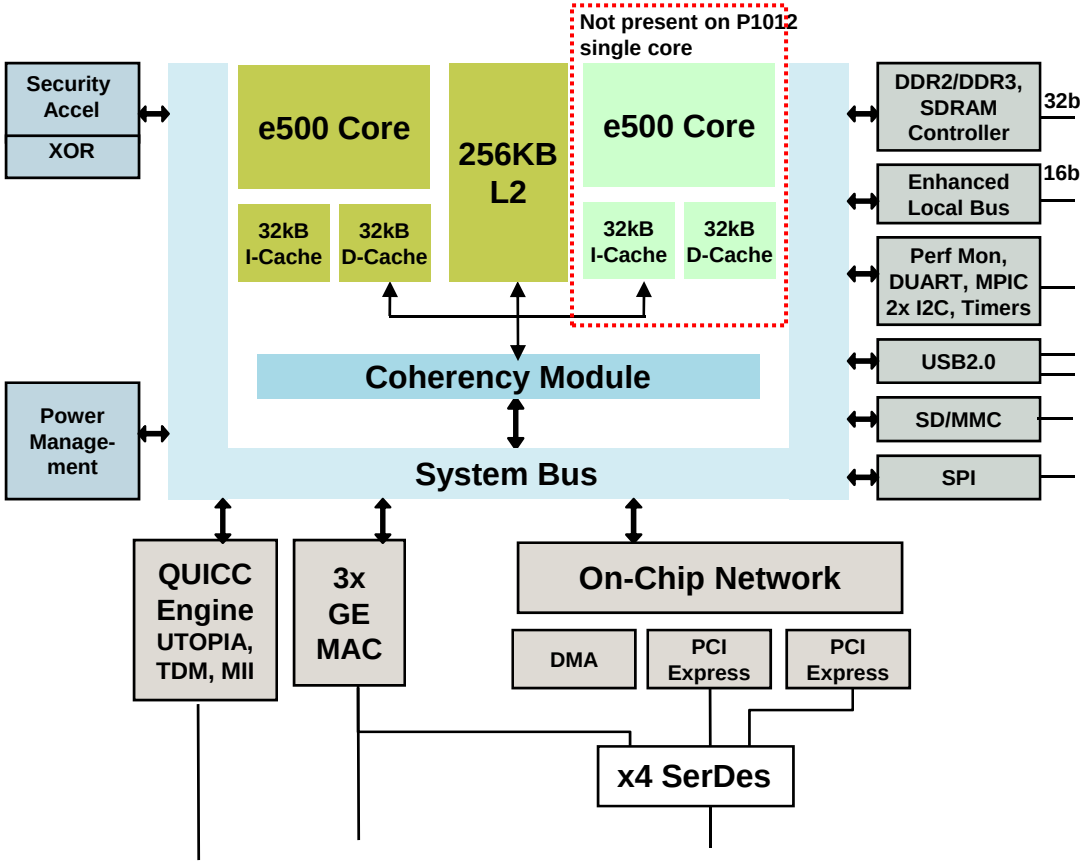
P1012/P1021 QorIQ Processor



- **Single or Dual e500 Power Architecture™ core**
  - 533 – 800 MHz (up to 1800 MIPS) per core
  - 256KB frontside L2 cache with ECC
  - 36 bit physical addressing, DP-FPU
- **System Unit**
  - 32-bit DDR2/DDR3, 667 MHz data rate with ECC
  - Integrated SEC 3.3 Security Engine
  - Open-PIC Interrupt Controller, Performance Monitor
  - 2x I^2C, Timers, 16 GPIO, 2x UART
  - USB 2.0 Controller Host/Device
  - 16-bit Local Bus can boot from NAND Flash
  - SPI controller can boot from SPI serial Flash
  - SD/MMC card controller can boot from Flash cards
  - Three 10/100/1000 Ethernet Controllers (eTSEC) with Jumbo Frame support, SGMII interface
    - IEEE® 1588v2 Support
  - QUICC Engine® for protocols and legacy interfaces
    - 4 x TDM interfaces with HDLC support
    - 4 x UCC for Serial Protocols, e.g. PROFIBUS
  - Two PCI Express 1.0a Controllers up to 2.5Gbps
  - Power Management
- **Process & Package**
  - 45nm SOI, 0.95V+/-50mV, -40C to 125C Tj
  - 689-pin TePBGAII

Supports Industrial Ethernet and PROFIBUS, low power consumption

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Introducing the MPC830x PowerQUICC II Pro Portfolio

For less than $10, MPC830x PowerQUICC II Pro processors offer 770 DMIPS performance, extensive on-chip connectivity, and fanless operation for industrial and commercial networking applications.

- MPC8308 – 266 to 400 MHz
  - Performance/price optimized MPC8308 combines 16/32-bit DDR2 memory controller with ECC, 2 x Gigabit Ethernet, PCI Express, USB and eSDHC targeting smart metering gateways, wireless media gateways, factory automation & test/measurement equipment. In mass production today.
- MPC8306/S – 133 to 266 MHz
  - MPC8306 integrates QUICC Engine, CAN, USB, SDHC and IEEE® 1588 support ideal for industrial control, factory automation and test/measurement equipment
  - MPC8306S features QUICC Engine (HDLC/TDM, 10/100) and USB targeting networking equipment such as low-end base station line cards and branch access gateways
- MPC8309 – 266 to 400 MHz
  - Richly featured with QUICC Engine, CAN, USB, SDHC, PCI and IEEE® 1588 support for networking, industrial control, factory automation and test/measurement equipment

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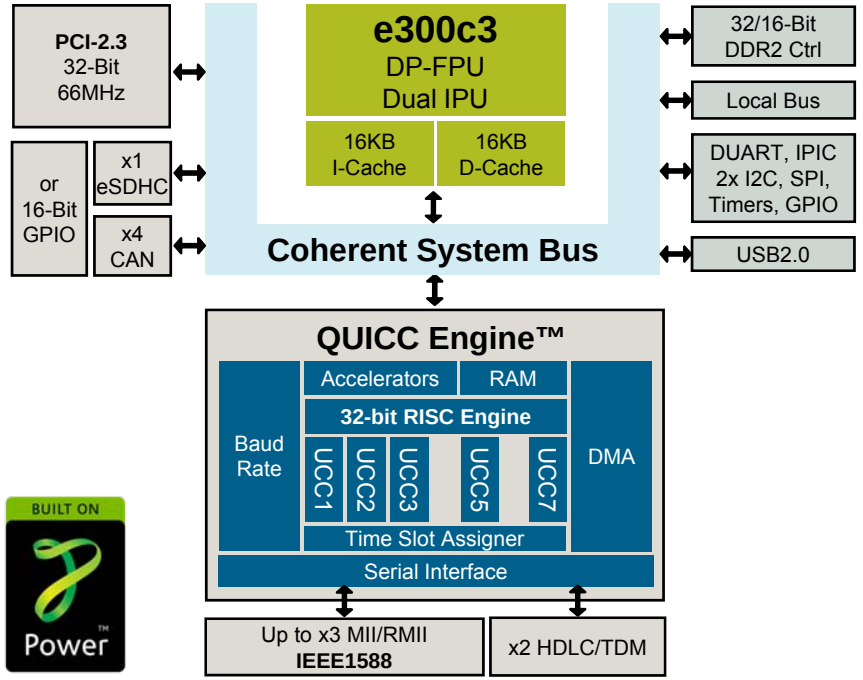
MPC8309 PowerQUICC Processor

- e300c3 up to 400 MHz
  - 16K I/D 4-way L1 cache
  - Double Precision FPU + Dual IU
- DDR2 up to 333MHz
  - 32/16-bit, with ECC Support
- Local Bus
  - Both NAND / NOR flash boot support
- x3 10/100Mbps Ethernet
  - MII / RMII
  - IEEE1588 Support
- PCI-2.3, 32-bit @ 66 MHz
- x2 HDLC/TDM
  - Up to 128 channels
- USB 2.0 - Host / Device / OTG
- eSDHC (host controller)
- 4x CAN 2.0B Controllers
- 4x UART, 2x I2C, SPI, GTM, RTC
- 64 Muxed GPIO
  - MUX'd 16 GPIO with eSDHC / x4 CAN
- Multi-channel DMA controller



- **Power:** Sub-1.6W @ 333MHz CPU, 200MHz QE
- **Package:** 489 MAPBGA, 19x19mm, 0.8mm pitch

Sampling Now, Qualification Feb 2011
10Ku Pricing Starting at **$8.55**

Low-cost Networking / Industrial Control with PCI-2.3 & 16/32-bit DDR2 w/ ECC

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i.MX Applications Processors for Industrial Control and HMI

ARM

▶ Evolved from handheld battery-operated devices

- Single core @ 800 MHz <1 Watt
- 10/100 Ethernet, CAN, UART, SPI, SDIO, USB, GPIO
- Integrated video and graphics processors offload CPU
- On-chip power management to increase battery life

Starts <$10! (SRP)

▶ Market-leading human machine interface

- High resolution color LCD controller with touch screen
- Hardware accelerated video processing and graphics rendering
- Camera interface

▶ Industrial qualification and long product life

- Operation in harsh environments from -40C to +85C
- Included in Product Longevity program

Pin-compatible solutions up to 1600 MIPS <1W

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i.MX51 Application Processor

- Specifications:
  - CPU: Cortex A8, up to 1GHz
  - Process: 65nm, LP/GP
  - Core Voltage: 0.7-1.1V
  - Package: 13x13 0.5mm, 19x19 0.8mm
  - Temp Range: -20 to 85C, -40 to 85C
- Camera
  - Camera and Display I/F (legacy
  - Image Sensor Processor (ISP)
  - Up to 8Mpixel @ 15fps, Up 133Mpixel/sec
  - Resizing, Inversion, Rotation
  - Color Space conversion, video/graphics combining
- Display
  - Display I/F (legacy and MIPI DSI)
  - Up to WXGA display - 24 bit @ 60fps
  - Secondary Display Support
- Connectivity
  - High speed USB OTG w/ embedded Phy, Host HS x3
  - Up to 400Mbps MobileDDR, DDR2
  - SLC/MLC NAND Flash 8/16-bit, NAND/NOR
  - High speed MMC\SDIO, UART, I2C, SPI
  - ATA-6
  - 3.3V support on HD, SDIO, and SIM I/F
- Security
  - TrustZone
  - AES, DES/3DES, SHA-1, SHA-224, SHA-256
  - Run time integrity checker (RTICv3)
  - Secure High Assurance Boot
  - Security Controller (SCC), including Secure RAM and Security Monitor
  - Random Number Generator Accelerator
  - Secure JTAG Controller
  - Secure real-time clock
  - Universal Unique Identification
  - Tamper Detection

1600 MIPS
<1W

Energy Efficient Solutions by Freescale

i.MX515

System Control
- Secure JTAG
- Power Mgmt
- PLL x 3
- Clock Reset

Timers
- Timer x3
- PWM x2
- Watch Dog x2

Memory
- ROM 32KB
- RAM 96KB

Security
- Sahara v4
- Trust Zone
- RTIC
- SCC v2
- SRTC

CPU Platform
- Cortex A8
- 32KB i-cache
- 32KB d-cache
- 256KB L2-cache
- Neon
- ETM
- Vector Floating Point Unit

Multimedia
- OpenGL ES 2.0 + VG1.1
- HW Video Codecs
- HD720 TV-Out

Imaging Processing Unit
- Display Controller
- Image Signal Processor
- Resizing & Blending
- Inversion / Rotation
- Image Enhancement
- Camera

Connectivity
- Fast IrDA
- HS MMC/SDIO x4
- CSPI HS x2 / LS x1
- UART x3
- HS I²C x1
- I²C x2
- SSI/I²S x3
- 1-Wire
- ATA-6
- USB OTG HS+PHY
- USB HS x3
- SPDIF Tx
- GPIO
- Keypad
- Ethernet
- Ext Memory I/F
  mDDR 200 MHz
  DDR2 200 MHz

eFUSES

Smart DMA

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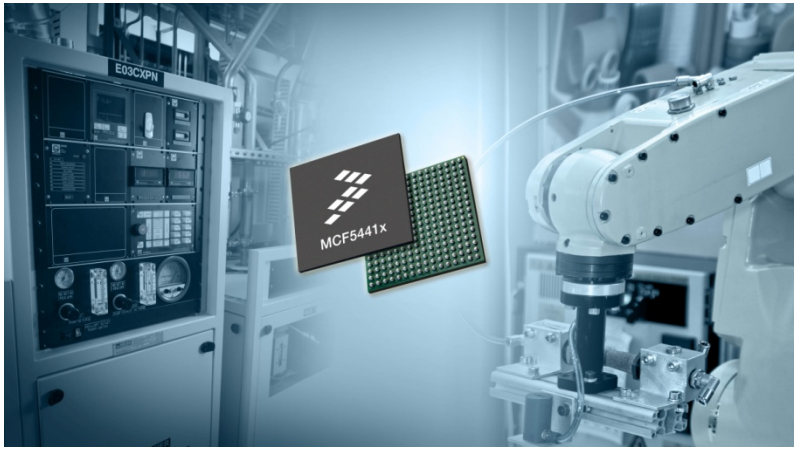
Introducing the Newest Freescale Industrial MPUs



i.MX28x

- ARM9™ architecture
- <0.5 W for hand-held and battery-powered applications
- On-chip power management
- Graphical display controller
- Secure boot
- Linux® OS and Windows® Embedded CE OS

Shared features:

- Extensive connectivity
- Dual 10/100 Ethernet with IEEE® 1588 time-stamping
- 3-port Layer 2 Ethernet switch (L2 Switch)
- <0.5 W for fanless operation
- Industrial Qualification
- Product Longevity –15 years

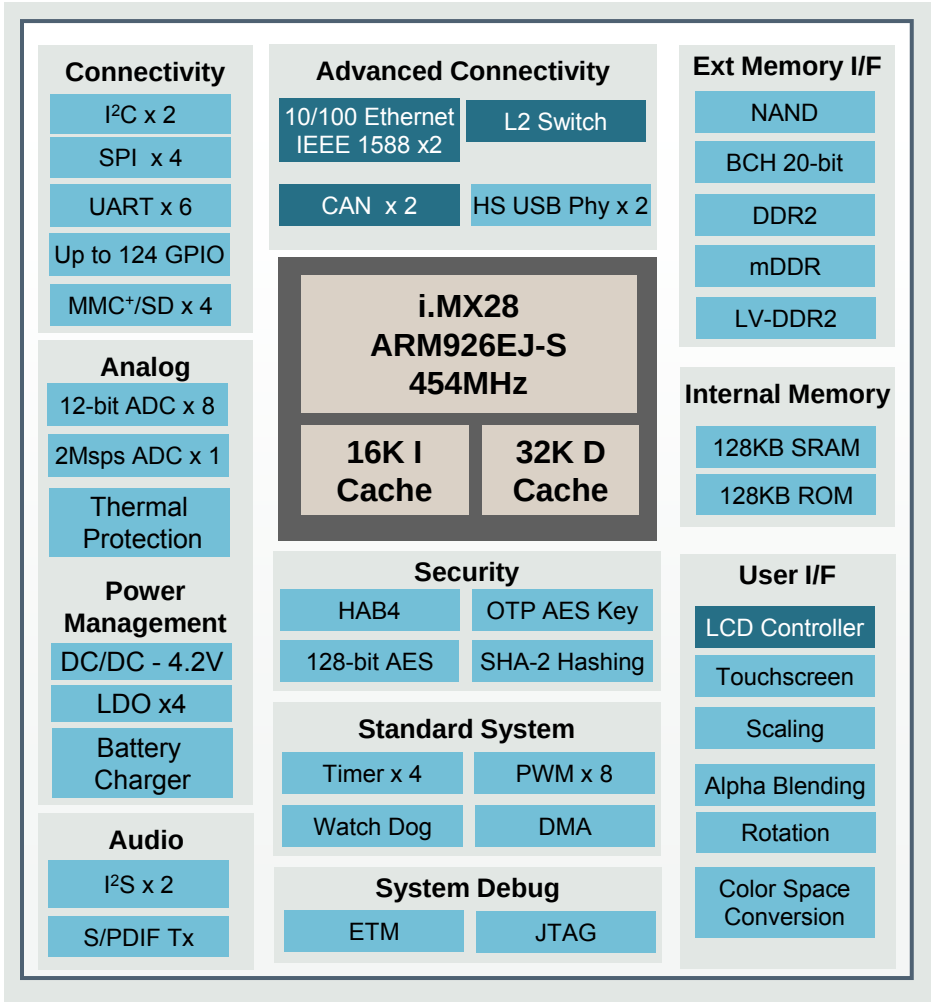
MCF5441x

- ColdFire™ V4 architecture
- Motor control integration - PWM Timers, DACs, ADCs
- 10 serial ports
- DACs for sensors and audio interface
- True Random Number Generator (RNG) for enhanced data security
- MQX™ RTOS, Linux OS, and CodeWarrior™ v10

i.MX28x Applications Processor

► Key Features and Advantages

- ARM9 Core with 454 MHz performance
- <0.5 W maximum power
  - On-chip Power Management for device and external components
  - Freescale Energy Efficiency Mark
- Display interface with touch screen
  - Rich user experience
- Extensive connectivity
  - Dual 10/100 Ethernet with IEEE 1588 hardware timestamp and L2 Ethernet switch
  - Dual CAN controllers
  - Dual USB with integrated PHY
  - Many other IO peripherals
- Real-time control
  - Integrated ADC and PWM
- Secure boot
- Industrial qualification
  - Product longevity – 15 years
  - -40C to +85C ambient operating temperature
- Packaged to reduce manufacturing cost
  - 0.8 mm pitch (289 BGA)
  - Product variants for a range of applications
- Linux and Windows Embedded CE



Pricing: 10K units MSRP from $5.27 - $9.90

Not available on all variants

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i.MX28x Development Platform

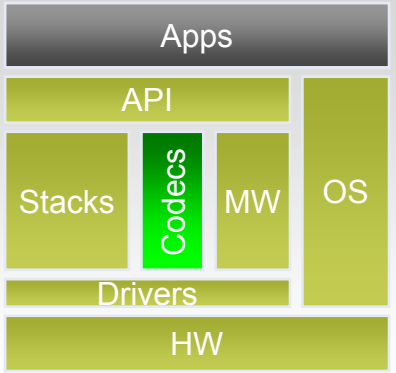
Hardware Platform

- Ease of Use – BSP and demo images, development environment build demonstration, video tutorials, schematic and layout, documentation
- Small, single-board design with optional add-on LCD module
- MCIMX28EVK – $399
- MCIMX28LCD – $199

Software

Linux and Microsoft Windows Embedded CE Operating Systems

- Full-featured, scalable, optimized and proven OS
- Product-worthy software for reference designs and product development
- Simplifies hardware management
- Streamlines software development



- Use EVK to differentiate and accelerate product development
- Broad multimedia codec library
- IEEE 1588 stack from IXXAT
- Growing developer community

www.imxcommunity.org

Full Hardware Evaluation and Development Platform

Complete software package
Simple download at no cost

Price. Performance. Personality.

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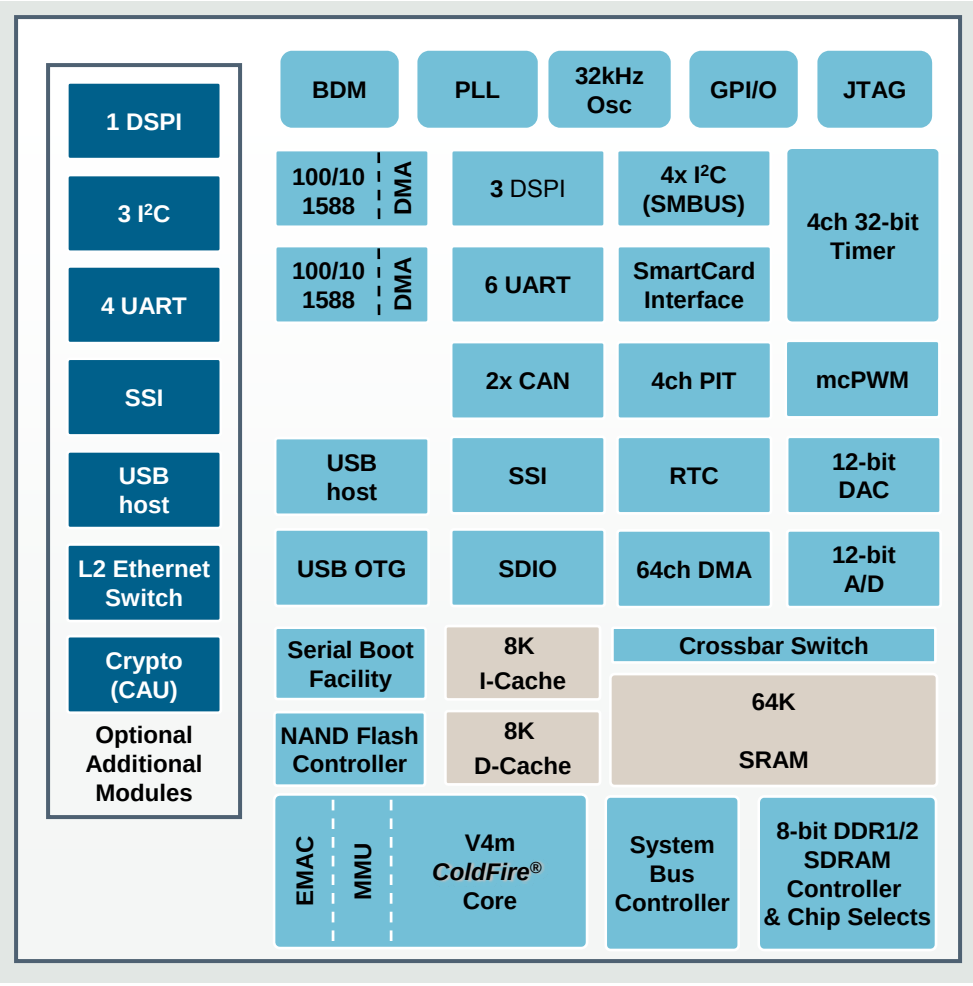
MCF5441x ColdFire Microprocessor

► Key Features and Advantages

- V4m Core, Up to 385 Dhrystone 2.1 MIPS @ 250 MHz
- < 0.5 W Power
- Extensive connectivity
  - Dual 10/100 Ethernet with IEEE 1588 hardware timestamp and L2 Ethernet switch
  - Dual CAN controllers
  - Up to 10 serial ports
  - Many other IO peripherals
- Real-time control
  - 2x 4 ch. 12-bit ADC with simultaneous / parallel sampling
  - 2x 12-bit DAC
- True Random Number Generator (RNG) for enhanced data security
- Industrial Qualification
  - Product longevity – 15 years
  - -40° C to 85° C temperature range
- Packaged to reduce manufacturing cost
  - Product variants for a range of applications
- MQX RTOS, Linux OS, and CodeWarrior v10



Pricing: 10K units MSRP from $4.99 - $9.49

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MCF5441x Development Platform

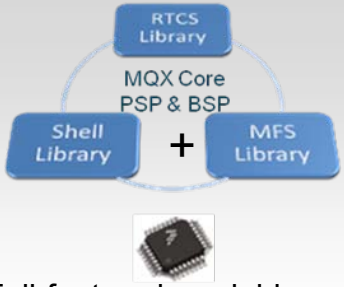
Hardware Platform

Tower System

- Modular, expandable development platform for 8/16/32-bit MCUs/ MPUs
- Rapid eval, prototyping with maximum hardware reuse
- Supported by range of MCU and peripheral plug-in boards and growing web community www.towergeeks.org

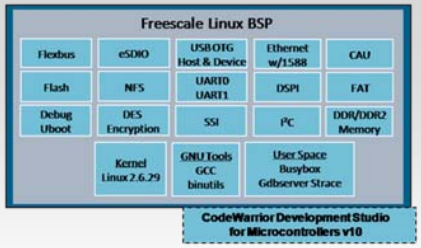
Complimentary Operating Systems

Freescale MQX



- Full-featured, scalable, optimized and proven RTOS
- Simplifies hardware management
- Streamlines software development
- Reduces development cost while speeding time to market

Linux



- Support for 2.6.29 Linux kernel
- u-boot with ColdFire patches
- GNU tools: gcc, eglibc, & binutils.
- GDB debugger
- Wide range of BSP drivers offering broad application scope

Software

CodeWarrior *IDE*

- Eclipse environment
- Processor Expert code generation wizard
- Build, debug and flash tools
- Software analysis
- Kernel-aware debug
- Host platform support

Enables prototyping application development

Comprehensive OS solutions for embedded control and connectivity

Accelerates development time

Extensive. Enabled. Easy.

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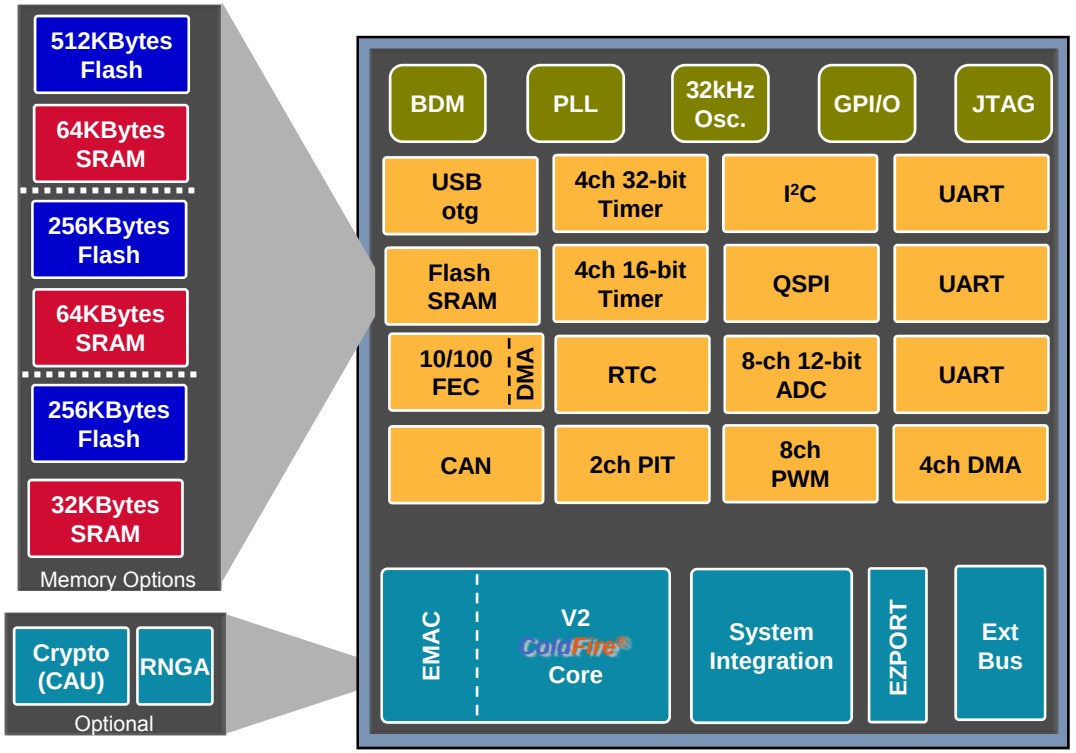
MCF5225x ColdFire Microprocessor

- 76 Dhrystone 2.1 MIPS @ 80 MHz
- Flash/SRAM options
  - 512K/64K, 256K/64K, 256K/32K
- MiniBus expansion supports 1MB memory without ALE; 256MB with ALE
- 10/100 Ethernet controller with encryption; pin-out supports Ethernet in 2-layer board
- CAN controller
- USB 2.0 OTG controller
- 3 x UARTs, I²C, QSPI
- High precision ADC and many timers
- eMAC provides low-cost DSP performance
- Ready-to-go MQX RTOS software



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Kinetis Product Family

First available broad-market MCU samples based on ARM Cortex-M4!

MCU Family	USB OTG (FS & HS)	LCD (Segment/Graphics)	NAND Flash Controller	Floating Point Unit	Ethernet (IEEE 1588)	Encryption (CAU+RNG)	Dual CAN	Hardware Tamper Detect	DRAM Controller
K70 Family 512KB-1MB, 196-256pin	●	●	●	●	●	●	●	●	●
K60 Family 256KB-1MB, 100-256pin	●		●	●	●	●	●	●	●
K50 Family 128-512KB, 64-144pin	●	●			●	●			
K40 Family 64-512KB, 64-144pin	●	●					●		
K30 Family 64-512KB, 64-144pin		●					●		
K20 Family 32KB-1MB, 32-144pin	●		●	●			●		
K10 Family 32KB-1MB, 32-144pin			●	●			●		

Common System IP	Common Analog IP	Common Digital IP	Development Tools
32-bit ARM Cortex-M4 Core w/ DSP Instructions	16-bit ADC	CRC	Bundled IDE w/ Processor Expert
Next Generation Flash Memory High Reliability, Fast Access	Programmable Gain Amplifiers	I^2C	Bundled OS USB, TCP/IP, Security
FlexMemory w/ EEPROM capability	12-bit DAC	SSI (I^2S)	Modular Tower H/ware Development System
SRAM	High-speed Comparators	UART/SPI	Application Software Stacks, Peripheral Drivers & App. Libraries (Motor Control, HMI, USB)
Memory Protection Unit	Low-power Touch Sensing	Programmable Delay Block	
Low Voltage, Low Power Multiple Operating Modes, Clock Gating (1.71V-3.6V with 5V tolerant I/O)		External Bus Interface	
DMA		Motor Control Timers	
		eSDHC	Broad 3rd party ecosystem
		RTC	

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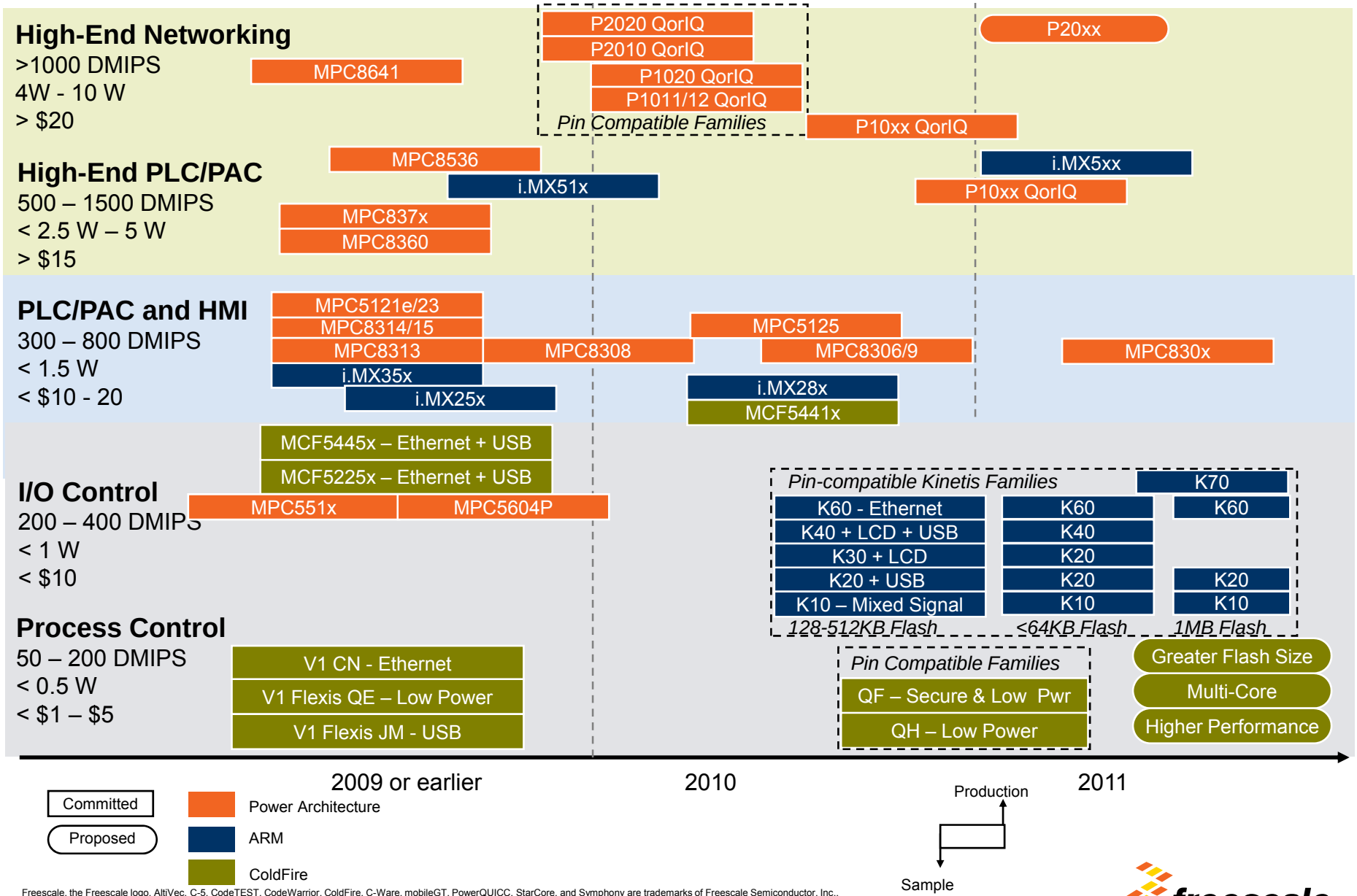
Processors for Industrial Control, Networking and HMI



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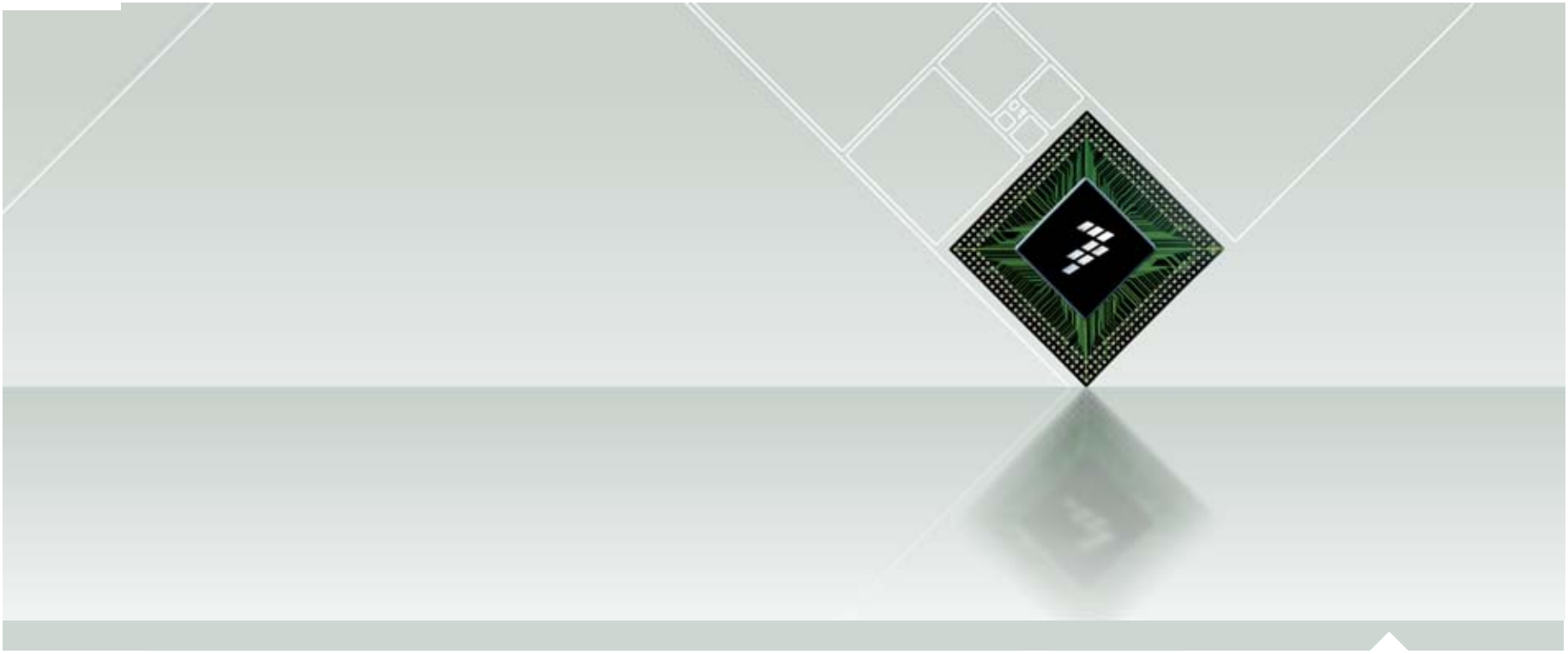

Factory Automation Solutions

Industrial Network Protocols

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Most Significant Industrial Network Protocols

Field Bus (Discrete or I/O oriented)		Industrial Ethernet*	
PROFIBUS	Most popular fieldbus solution. 31M+ nodes installed; 24% CAGR (PTO 2010). Introduced by Siemens.	PROFINET	2M+ PROFINET nodes installed; 40% CAGR (PTO 2010). Introduced by Siemens.
DeviceNet	CIP™ application layer on CAN. Very popular and still growing. Introduced by Rockwell.	EtherNet/IP	CIP application layer on Ethernet. Growing fast. Introduced by Rockwell.
CANopen / CAN	Very popular SAE-sponsored standard but losing share in factory automation. Supported by many.	EtherCAT	May dominate due to technology and ease of use. Predict >1 Mu by 2011. Introduced by Beckhoff.
Modbus-IDA	Modbus RTU is a widely used fieldbus solution, but losing share. Introduced by Schneider.	Modbus-IDA	Modbus TCP/IP is a widely used Ethernet solution, but growing less rapidly in many markets (Schneider)

- ***Standard*** Ethernet TCP/IP protocols most common of Ethernet-based nodes
  - 6.5 Mu Ethernet TCP/IP nodes installed by 2006; 24 Mu by 2011; CAGR 24.3%

- Many deterministic industrial Ethernet protocols use a form of IEEE® 1588
  - For clock synchronization through the Ethernet network

IEEE® 1588

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Freescale Devices Support All Industrial Protocol Levels

Target Applications

Protocols

- Motor Drives
- Motion Control
- Synchronized Servos

IRT

Deterministic
< 1 us Jitter
< 1 ms Cycle Time

PROFINET IRT, EtherCAT, PROFIBUS, CIP Sync

- Conveyor belts
- Picker arms
- PLCs, I/O Control
- Valves

RT

Deterministic
Jitter matters for Sync
1 to 100 ms Cycle Time

EtherCAT, PROFINET RT, CIP Sync, PROFIBUS, CAN

- Sensors
- Data scanner
- Inventory Management

NRT

Non-deterministic
Jitter doesn't matter
> 100 ms Cycle Time

PROFINET RT, EtherNet/IP, PROFIBUS, Modbus-IDA, CAN, EtherCAT

Number of Applications

IEEE® 1588 Precision Time Protocol

VERY Jitter sensitive; Cycle Time does not matter

www.freescale.com/connectivity

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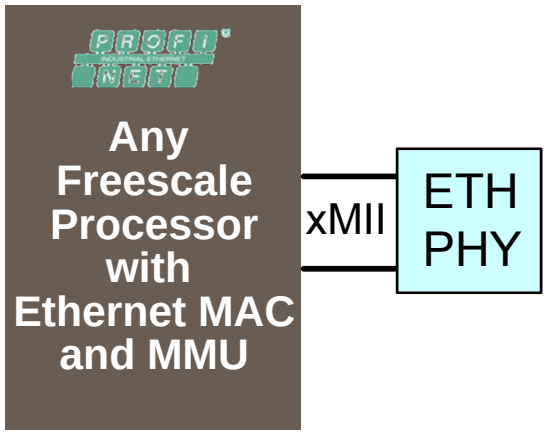
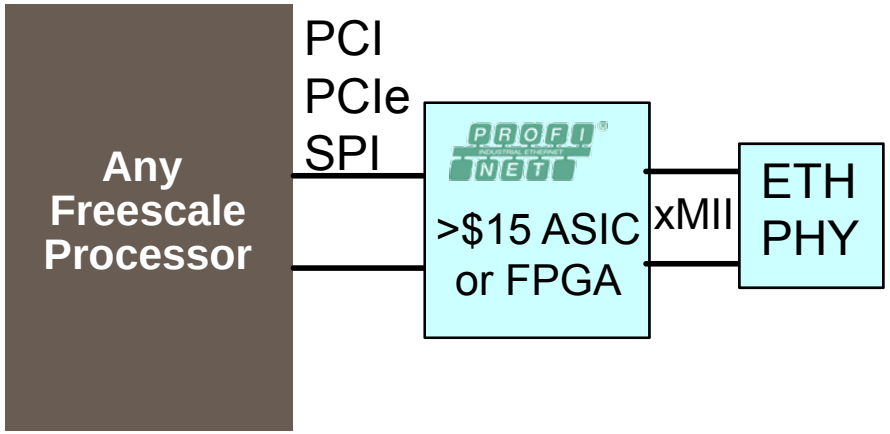
Industrial Protocol Stack Support for Freescale Processors

	Industrial Protocol	ColdFire, ColdFire+, Kinetis	i.MX	QorIQ and PowerQUICC
Industrial Ethernet	IEEE® 1588	IXXAT	IXXAT	IXXAT
	PROFINET	molex, IXXAT	IXXAT	molex, IXXAT
	EtherNet/IP	IXXAT, molex	IXXAT	IXXAT, molex
	EtherCAT Technology Group	acontis, IXXAT	acontis, IXXAT	acontis, IXXAT, .konig
	Modbus-IDA	IXXAT	IXXAT	IXXAT
	POWERLINK	IXXAT	IXXAT	IXXAT
Fieldbus	PROFIBUS			DOGAV
	DeviceNet™	IXXAT	IXXAT	IXXAT
	CAN	IXXAT	IXXAT	IXXAT

Two PROFINET Implementation Options



- **QorIQ, PowerQUICC or i.MX processor with Ethernet MAC**
  - Integrate protocol software with MPU
  - High performance MPU and memory
- **Lower cost with low risk**
  - One chip for application and PROFINET
  - PROFINET IRT not supported



- **Any processor plus ASIC**
  - Two chips from two vendors
  - ASIC supports PROFINET RT and IRT
- **Lower risk with higher cost**
  - ASIC or FPGA adds $15-$25
  - Protocol software already integrated and certified in ASIC

www.freescale.com/profibus

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Freescale Processors for Single-chip PROFINET

High-End Networking
>1000 DMIPS
4W - 10 W
> $20

High-End PLC/PAC
500 – 1500 DMIPS
< 2.5 W – 5 W
> $15

PLC/PAC and HMI
300 – 800 DMIPS
< 1.5 W
< $10 - 20

I/O Control
200 – 400 DMIPS
< 1 W
< $10

Process Control
50 – 200 DMIPS
< 0.5 W
< $1 – $5

MPC8641
P2020 QorIQ
P2010 QorIQ
P1020 QorIQ
P1011/12 QorIQ
Pin Compatible Families
P20xx
P10xx QorIQ
MPC8536
i.MX51x
i.MX5xx
MPC837x
MPC8360
MPC5121e/23
MPC8314/15
MPC8313
i.MX35x
i.MX25x
MPC8308
MPC5125
MPC8306/9
i.MX28x
MCF5441x
MCF5445x – Ethernet + USB
MCF5225x – Ethernet + USB
MPC551x
MPC5604P

2009 or earlier
2010
2011

Committed
Proposed
Power Architecture
ARM
GoldFire

Production
Sample

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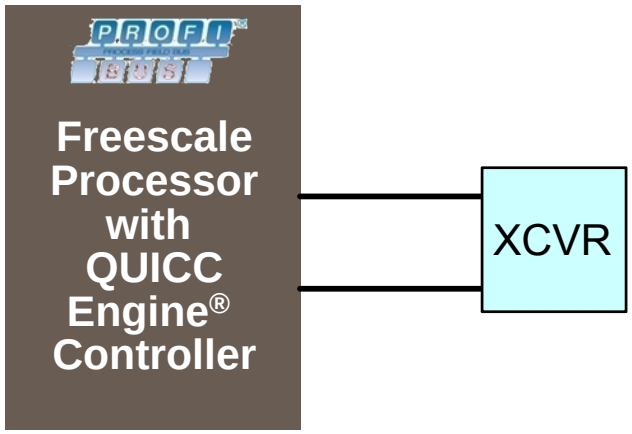
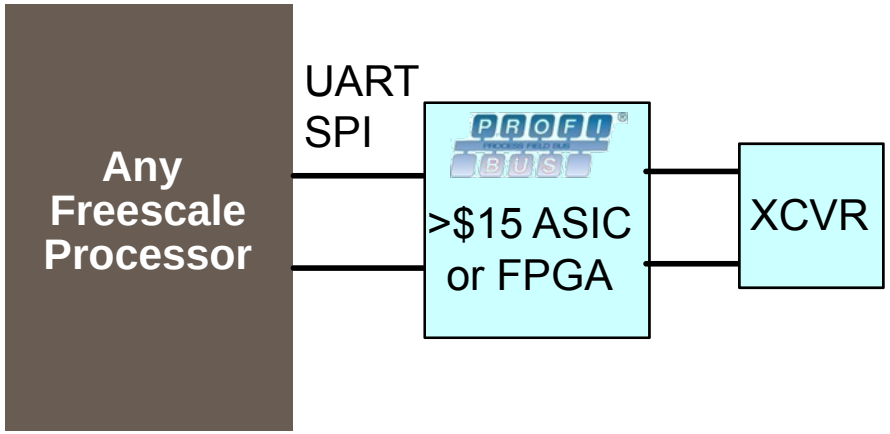
Two PROFIBUS Implementation Options



- **QorIQ or PowerQUICC with QUICC Engine® Controller (programmable)**
  - Integrate PROFIBUS layer 7 with DoGav layer 2 microcode
  - Supports up to 12 Mbps UART
- **Lower cost with low risk**
  - One chip for application and PROFIBUS
  - DoGav demo and microcode available
  - Certification needed



- **Any processor plus ASIC**
  - Two chips from two vendors
- **Lower risk with higher cost**
  - ASIC or FPGA adds $15-$20
  - Protocol software already integrated in certified ASIC
  - RTA reference schematics available

www.freescale.com/profibus

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Freescale Processors for Single-chip PROFIBUS

High-End Networking
>1000 DMIPS
4W - 10 W
> $20

High-End PLC/PAC
500 – 1500 DMIPS
< 2.5 W – 5 W
> $15

PLC/PAC and HMI
300 – 800 DMIPS
< 1.5 W
< $10 - 20

I/O Control
200 – 400 DMIPS
< 1 W
< $10

Process Control
50 – 200 DMIPS
< 0.5 W
< $1 – $5

P20xx
P1021 QorIQ
P1012 QorIQ
Pin Compatible Families
P10xx QorIQ
MPC8569
MPC8360
MPC8306/9
MPC8270 (CPM)

- Configure ports as either Master or Slave
  - Up to 125 slaves per master
- Line bit rate supports up to 12 Mbps
  - Upper limit depends on device speed

2009 or earlier | 2010 | 2011

Committed
Proposed
Power Architecture
Production
Sample

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How to Acquire PROFIBUS Solution

- PROFIBUS applications processor from Freescale

- PROFIBUS layer 2 link-layer microcode
  - License and support from either Freescale or DoGav
  - Coming soon:
    - Included with Freescale evaluation board support package (BSP)
    - Free download from www.freescale.com (password protected)
      - Same click-through software license as other BSPs
    - Supported by Freescale (with assistance from DoGav)

- PROFIBUS layer 7 application software options
  - Use your own, integrated with DoGav layer 2 microcode
    - Contract directly with DoGav for custom software development and support
  - Buy from protocol stack vendor
    - Real-time Automation, IXXAT, Softing, etc.
    - Contract directly with DoGav for custom software development

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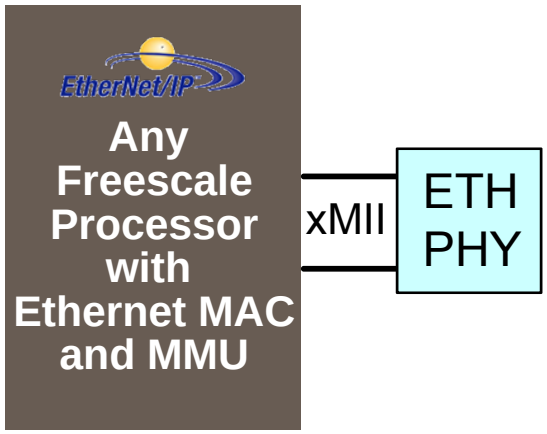
EtherNet/IP Implementation



- Source code integrated with Ethernet Controller
  - Integrates directly with Freescale OpenTCP & MQX
  - Organize target data as an Object Model
- Low cost
  - One-time source code cost
  - No additional hardware cost
- Low risk
  - RTA reference schematics available
  - Customers must understand Object Model to organize data properly

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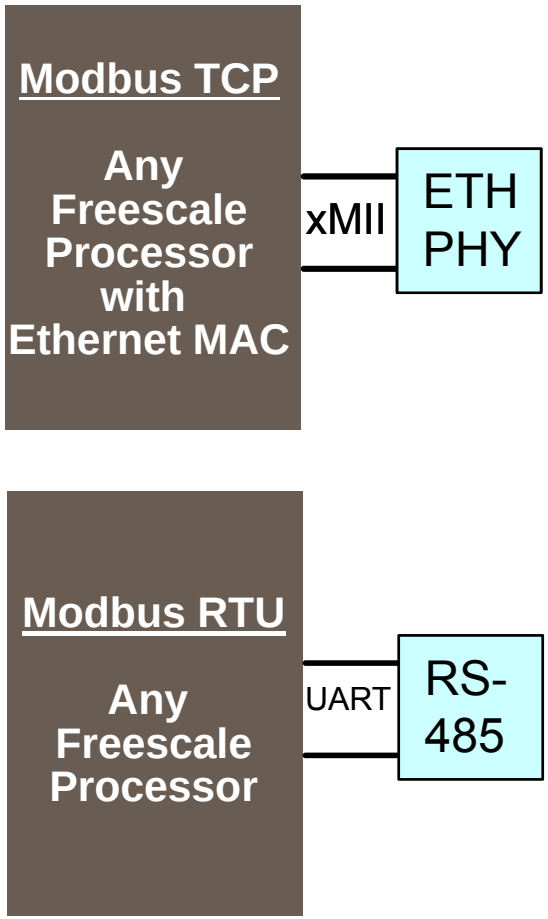
Modbus RTU and TCP Implementation



- Same application layer supports both Modbus TCP and Modbus RTU
  - Source code integrated directly with Freescale OpenTCP and MQX
- Low cost
  - One-time source code cost
  - No additional hardware cost
    - RS-485 driver for Modbus RTU
    - Ethernet PHY for Modbus TCP
- Low risk
  - RTA reference schematics available
  - Customers must organize data properly as Registers & Coils

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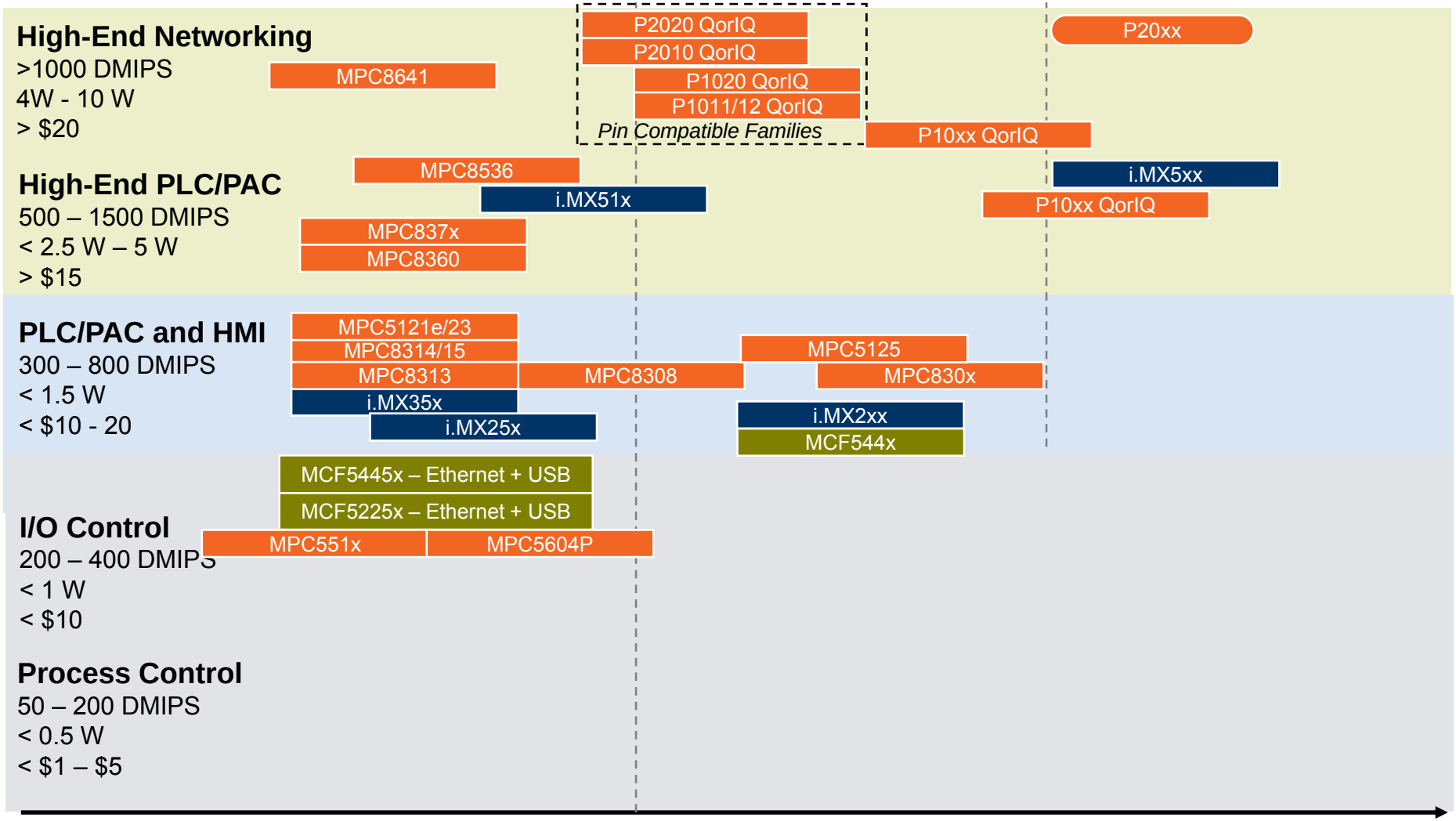
PROFINET IO, EtherNet/IP, Modbus TCP Support



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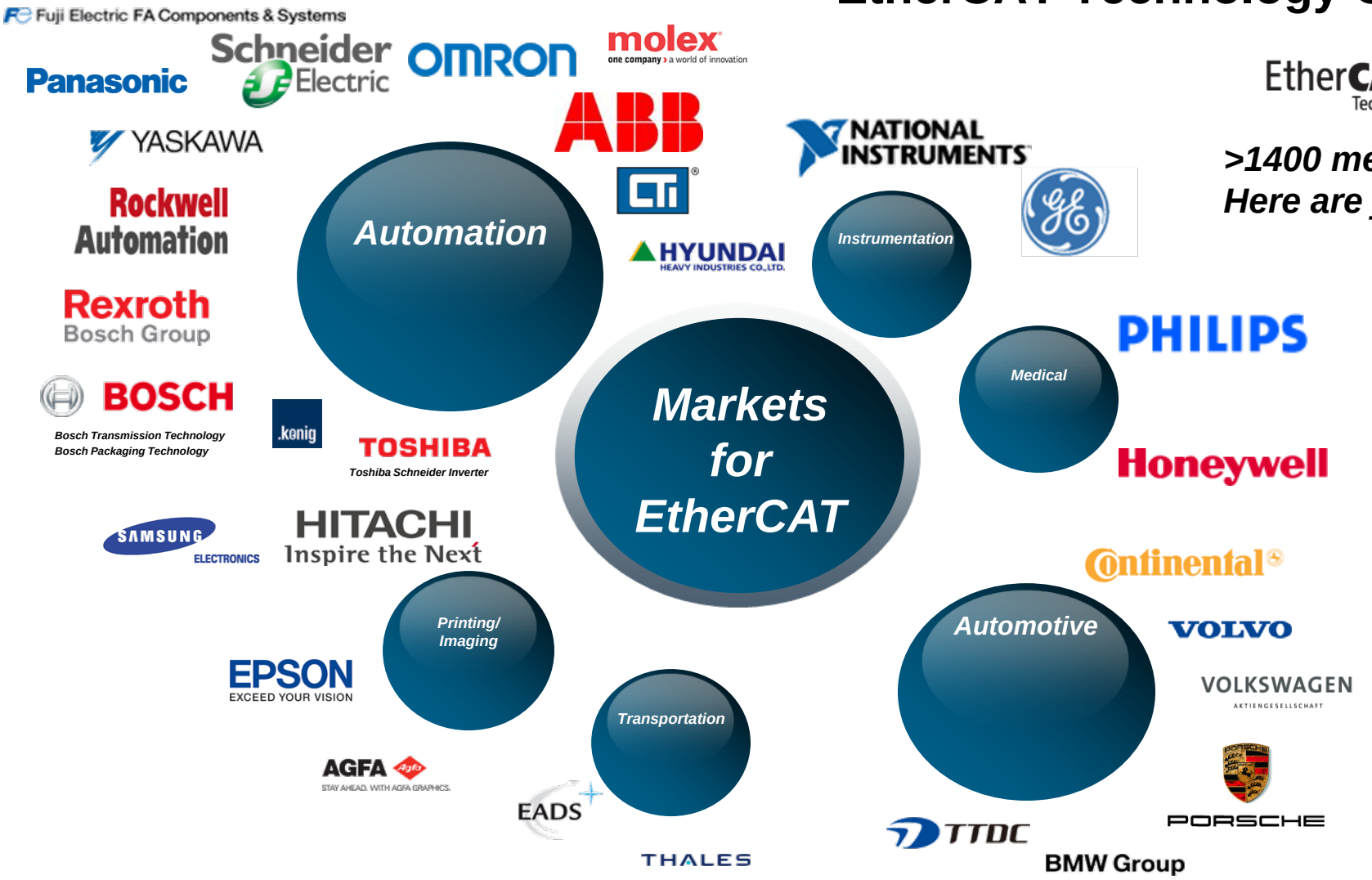
EtherCAT Technology Group



EtherCAT Technology Group

>1400 members
Here are just a few

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EtherCAT Opportunity

►EtherCAT emerging as very important for FA&D, industrial transportation and energy segments

- Supported by our protocol partners acontis, IXXAT, and Koenig

►Key customers actively drive it

- Alternative to protocols controlled by top three
  - Siemens (PROFINET)
  - Rockwell (EtherNet/IP)
  - Mitsubishi (CC-Link IE)
- OMRON is funding growth in Japan
- Embraced by ABB, Schneider, National Instruments, etc.

►EtherCAT is an international standard (IEC, ISO, SEMI)

- Sets new standards for real-time performance and topology flexibility
  - Real-time control over 10/100 Ethernet
  - Offers high precision device synchronization
  - Meets or beats legacy fieldbus cost
  - Eliminates switches and hubs
  - One master can support up to 20k slaves
  - Existing application S/W runs over EtherCAT
    - CANOpen, SERCOS, TwinCAT
  - Includes cable redundancy options
  - Supports functional safety (SIL3)

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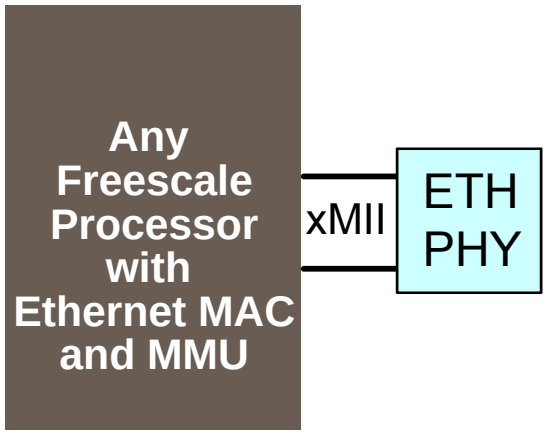
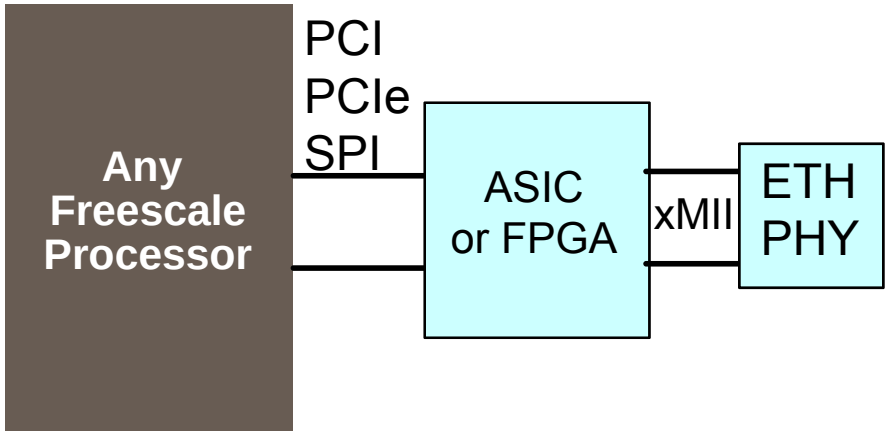
EtherCAT Implementation



- ▶ EtherCAT master
  - Any processor with standard Ethernet
- ▶ Lower system cost
  - MPU needs high performance and memory
  - Same software cost as ASIC option
- ▶ Low risk
  - Complicated source integrated into MPU by partners. Tested in 2 plugfests.



- ▶ EtherCAT slave
  - Any processor plus ASIC or FPGA
    - 2 vendors
  - ASIC supports EtherCAT layer 2
- ▶ Higher system cost
  - ASIC adds $5 - $15 to system cost
- ▶ Lower risk
  - Complicated source already integrated into ASIC

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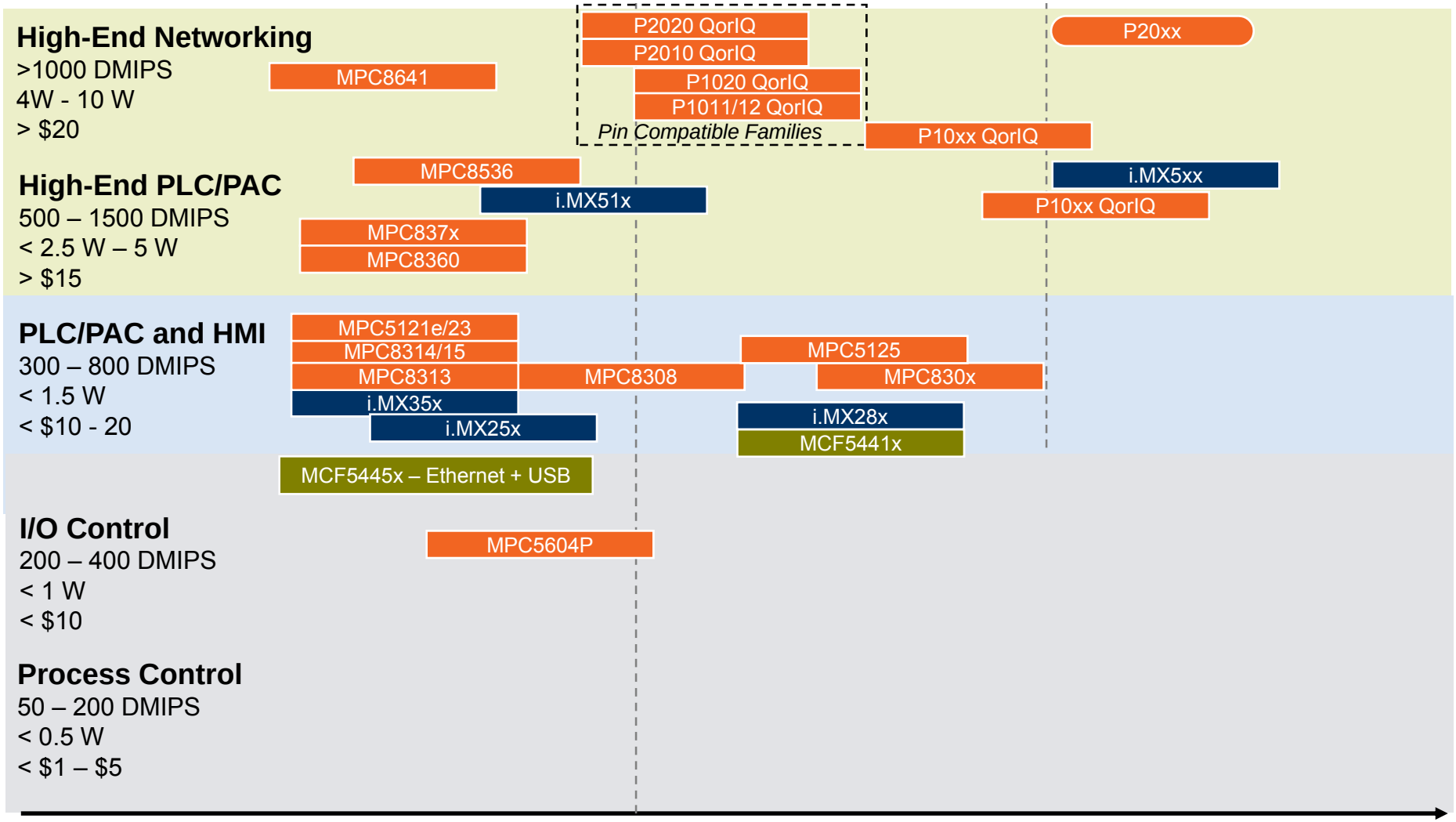
Processors for EtherCAT Master



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How to Acquire EtherCAT Solution

- EtherCAT applications processor: Buy from Freescale
  - Evaluation board and board support package available for Linux

- EtherCAT Master protocol software integrated with OS
  - Buy from protocol stack vendor and OS vendor
    - Acontis or IXXAT with Green Hills INTEGRITY OS
    - Koenig KPA with QNX Neutrino RTOS
  - Joint support by protocol and OS vendor
    - OS vendors to offer board support package for selected Freescale evaluation platforms – P2020 and MPC8536 are first ones
      - Integration source code available for license from each vendor
    - Contract custom software development from protocol vendor

www.freescale.com/ethercat

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Summary

▶ Freescale meets industrial control requirements

- Scalable system performance from 100 to 20,000+ MIPS
- Reduced system cost with integrated processors starting <$15
- Fanless operation at 85C: 800 MIPS <2W, 1800 MIPS <3.5W

▶ Leading partner solutions and tools

- IEEE 1588, PROFINET and CAN from IXXAT
- PROFIBUS from DoGav
- EtherCAT from acontis and Koenig
- Industrial-grade safety-certified OS from Green Hills, QNX and others

▶ Rugged devices with long life and reliability

- Industrial or automotive qualification for -40C to +85C ambient
- Stability of 10 or 15 year product longevity statement
  - www.freescale.com/productlongevity

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For More Information

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  - Factory Automation – www.freescale.com/factoryautomation
  - Industrial protocols – www.freescale.com/connectivity
  - IEEE® 1588 – www.freescale.com/IEEE1588
  - Motor Control – www.freescale.com/motorcontrol
  - Product Longevity Program – www.freescale.com/productlongevity
  - 8-bit microcontrollers – www.freescale.com/8bit
  - 16-bit DSC, microcontrollers – www.freescale.com/dsc , www.freescale.com/16bit
  - 32-bit ColdFire microcontrollers – www.freescale.com/coldfire
  - 32-bit ARM processors – www.freescale.com/imx , www.imxcommunity.org
  - 32-bit Power Architecture processors – www.freescale.com/powerpc
- Protocol Partners:
  - acontis technologies GmbH – http://www.acontis.com
  - DoGav Systems Ltd – www.dogav.net
  - IXXAT Automation GmbH – www.ixxat.com
  - Koenig Prozessautomatisierungs GmbH – www.koenig-pa.de
  - Molex Inc. – www.molex.com
  - Real-Time Automation (RTA) – www.rtaautomation.com

Thank-you!

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Industrial Protocol Partners

Enablement for 32-bit processors

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Industrial Protocol Stack Support for Freescale Processors

	Industrial Protocol	ColdFire, ColdFire+, Kinetis	i.MX	QorIQ and PowerQUICC
Industrial Ethernet	IEEE® 1588	IXXAT	IXXAT	IXXAT
	PROFINET	molex, IXXAT	IXXAT	molex, IXXAT
	EtherNet/IP	IXXAT, molex	IXXAT	IXXAT, molex
	EtherCAT Technology Group	acontis, IXXAT	acontis, IXXAT	acontis, IXXAT, .konig
	Modbus-IDA	IXXAT	IXXAT	IXXAT
	POWERLINK	IXXAT	IXXAT	IXXAT
Fieldbus	PROFIBUS			DOGAV
	DeviceNet™	IXXAT	IXXAT	IXXAT
	CAN	IXXAT	IXXAT	IXXAT

IXXAT Automation GmbH

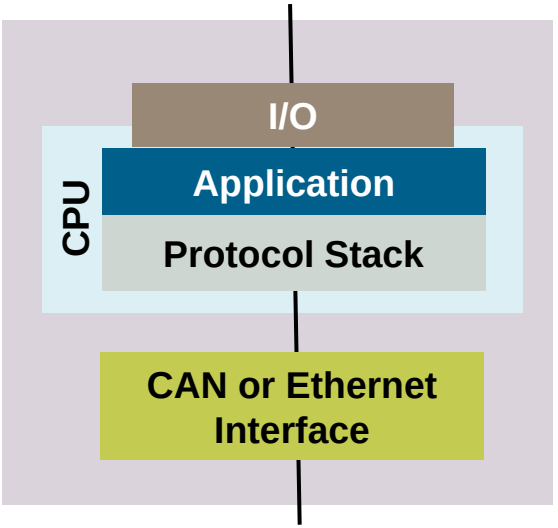
IXXAT is a German-based leading supplier for embedded communication systems for industrial and automotive applications

- Established 1987 with 20+ profitable growth years
  - 2009 sales of $16.9M worldwide
  - 80 employees (most are developers)
    - Weingarten, Germany; New Hampshire, USA
  - Represented globally in >15 countries

- Freescale products supported
  - QorIQ™ and PowerQUICC® processors
  - ColdFire® MCUs and MPUs
  - i.MX applications processors

- Contact Bill Seitz
  - seitz@ixxat.com , 603-471-0800 X102
  - 120 Bedford Center Rd., Bedford, NH 03110

- Download free evaluations from www.ixxat.com



Protocols supported:

- IEEE® 1588
- PROFINET
- EtherNet/IP™
- EtherCAT®
- Modbus
- POWERLINK
- CAN® – CANOpen®, J1939, DeviceNet™

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acontis technologies GmbH

acontis is a German-based leading supplier for EtherCAT Master technology

- Established 1999 with global distribution
  - Used by many Blue Chip companies
  - Located in Weingarten, Germany
- Freescale products supported
  - QorIQ™ and PowerQUICC® processors
  - ColdFire® MCUs and MPUs
  - i.MX applications processors
- Contact: Stefan Zintgraf
  - s.zintgraf@acontis.com , +49 751 56030 30
  - Haehnlehofstr. 5, D-88250 Weingarten, Germany
- Download free evaluations from www.acontis.com/eng/products/index.php

AT-EM EtherCAT Master Stack

- Full EtherCAT compliance to support all EtherCAT protocols and slaves
- Powerful feature packs
  - Hot connect, redundancy, distributed clocks
- Sophisticated diagnostic features

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Koenig Prozessautomatisierungs GmbH (KPA)

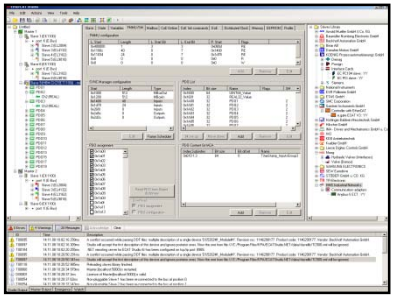
KPA is a German-based provider of EtherCAT protocol stacks, configuration tools and services

- Established 1986 in Feucht, Germany
  - Joined EtherCAT Technology Group (ETG) 2004
  - 60+ employees
    - Feucht, Germany (near Nuremberg)
    - Associated company “Visutech” in Minsk, Belarus
  - Distribution partners
    - RADIC Technologies, Stenihoff, easiTEC S.r.l., Micronet

- Freescale products supported
  - QorIQ™ and PowerQUICC® processors

- Contact Gerhard Spiegel
  - gerhard.spiegel@koenig-pa.com
  - Phone: +49 (9128) 725 652
  - www.koenig-pa.de

KPA studio EtherCAT



KPA master EtherCAT

KPA slave EtherCAT

KPA boards EtherCAT

EtherCAT Specialties

- KPA Studio EtherCAT
  - configuration & diagnostics tool
- KPA Master EtherCAT
  - master stack for various OS
- KPA Slave EtherCAT
  - slave stack for various OS
- KPA Slave Tester EtherCAT
  - slave tester tool
- KPA EtherCAT Boards
  - PCI & PC104 slave boards

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Molex Inc.

one company › a world of innovation

Molex delivers complete interconnect solutions for markets including data communications, telecommunications, consumer electronics, industrial, automotive, medical, military, lighting and solar

- Established 1938
  - Second largest worldwide connector manufacturer
  - 2010 sales of $3B
  - Active participation in ODVA (technical board) and PI (PROFINET core WG) organizations
  - *PROFINET Competence Center*
  - *Official provider of EtherNet/IP tools for ODVA Plugfest*

- Freescale products supported
  - QorIQ™ and PowerQUICC® processors
  - ColdFire® MCUs and MPUs
  - i.MX applications processors

Technology provider for:

- PROFINET IO
- EtherNet/IP
- CIP Safety EtherNet/IP
- CIP Safety DeviceNet

- Contact Martial Maneché
  - martial.maneche@molex.com , +33 (0) 2 32 96 51 32
  - 41 rue mazagran, 76320 Caudebec-les-Elbeuf, FRANCE

- Contact our experts: www.molex.com/links/iccc

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Real-Time Automation (RTA)

RTA is a USA-based leading supplier of industrial protocols and solutions

- Established 1989 by John Rinaldi
  - 10 employees in Milwaukee WI, USA
  - Focus on networking, control & developers
  - "Media is irrelevant“
- Freescale products supported
  - QorIQ™ and PowerQUICC® processors
  - ColdFire® MCUs and MPUs
  - i.MX applications processors
- Contact John Rinaldi
  - rinaldi@rtaautomation.com, 414-453-5100
  - 150 S. Sunnyslope Road Suite 150, Brookfield, WI 53220
- Download evaluation information from www.rtaautomation.com

Protocols supported:

- PROFINET
- PROFIBUS
- EtherNet/IP™
- Modbus
- CAN® - CANOpen®, DeviceNet™

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DoGav Systems Ltd

DoGav is an Israel-based software solution provider with more than 10 years experience developing production-ready microcode for PowerQUICC processors

- Established 1984
  - 5 employees in Petach Tikva, Israel
  - USA sales based in New York, USA
- Freescale products supported
  - QorIQ™ and PowerQUICC® processors
  - 10+ years providing microcode design services for PowerQUICC CPM and QUICC Engine™ Controller
  - 25+ years collaboration with Freescale and Motorola
- Contact David Gabbay
  - dg@dogav.net , +972-3-933-7197
  - 18 Nahum St., Petach Tikva, 49247 Israel
  - www.dogav.net

Protocols supported

- PROFIBUS DPv1
  - Master and Slave

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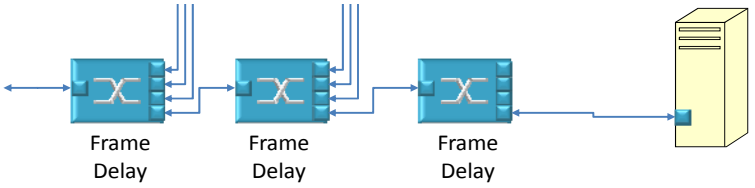
Ethernet is changing

Cut-Through switching / Two port MAC Relay [Data Centre, Server Farms, ..]

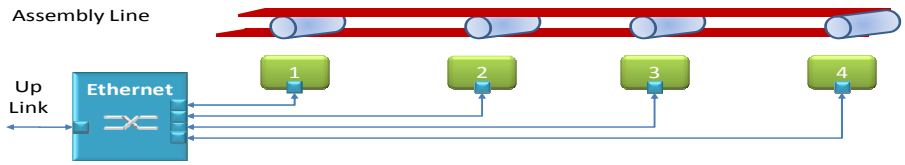
Store-Forward introduces large Transport Latencies

For 100Mb/s Ethernet Transport times are:-
10 Store forward switches = 11.00 times point to point
10 Cut through switches = 1.09 times point to point

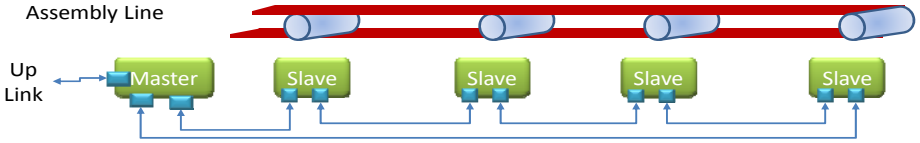


Industrial Ethernet Protocols [Manufacturing, Medical, ….]

Star topology
Too costly in cabling



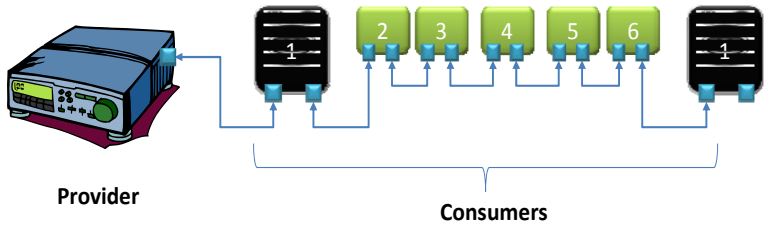
Line/Ring/Daisy Chain topology
Cost effective cabling



Audio Visual Bridging [Home, Car, Infrastructure …..]

Normalised Latency [2ms]

1st Speaker buffers audio until all speakers receive audio and presentation time is reached



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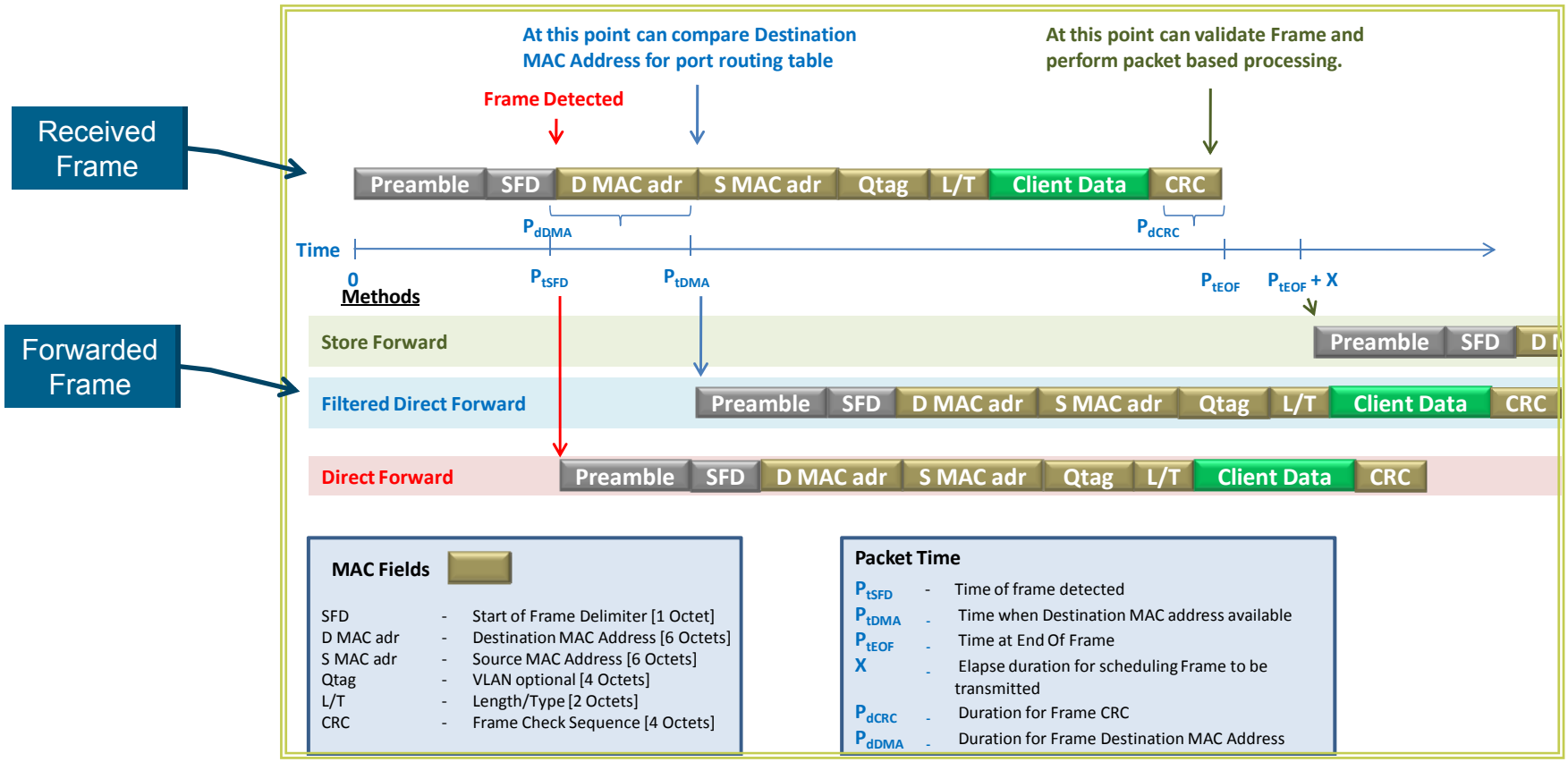
Types of Forwarding



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BACK-UP

32-bit Processor Roadmap for Industrial Control and Networking

QorIQ, PowerQUICC, ColdFire, ColdFire+, i.MX and Kinetis

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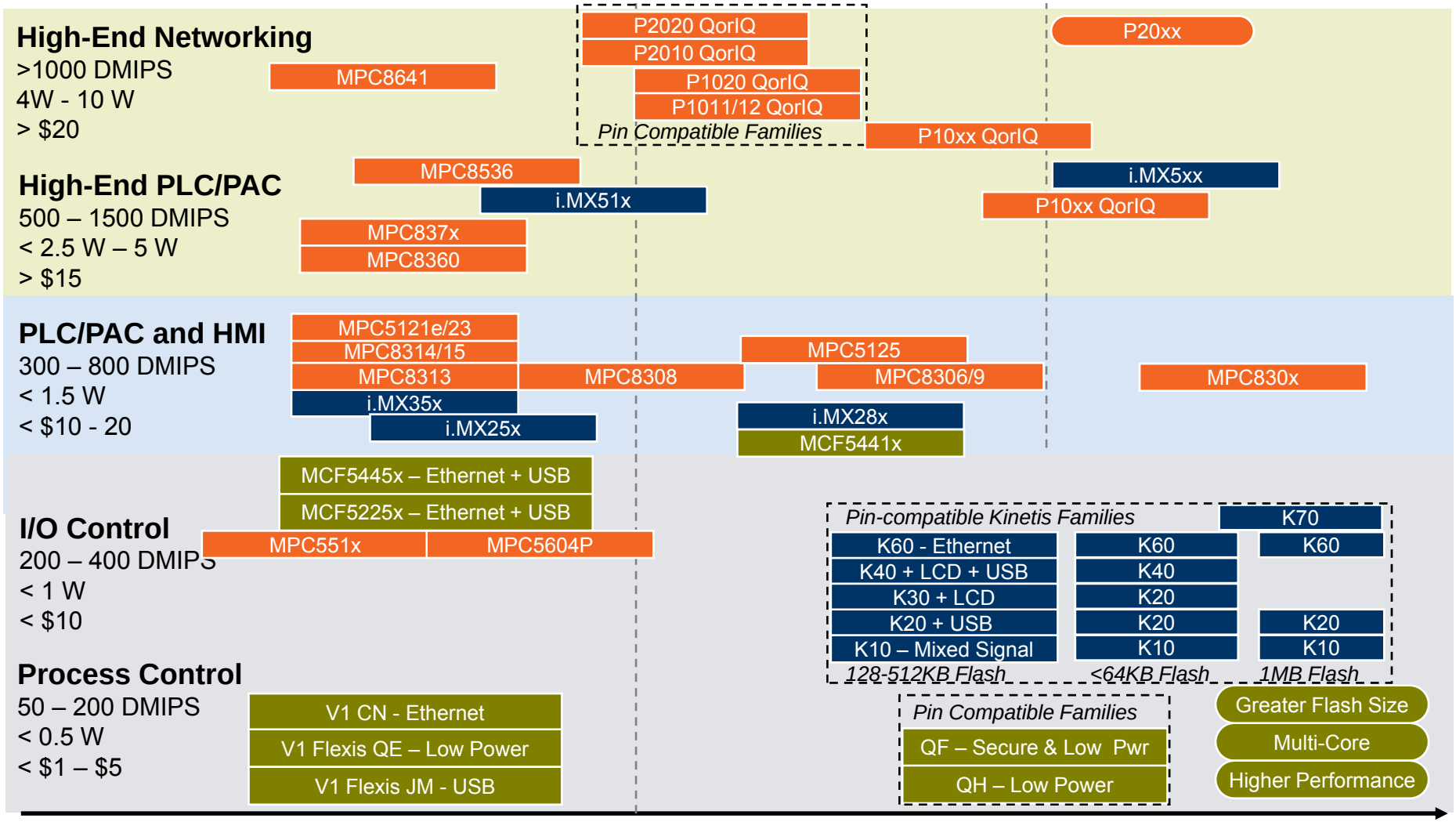
Processors for Industrial Control, Networking and HMI



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Introducing the MPC830x PowerQUICC II Pro Portfolio

For less than $10, MPC830x PowerQUICC II Pro processors offer 770 DMIPS performance, extensive on-chip connectivity, and fanless operation for industrial and commercial networking applications.

- MPC8308 – 266 to 400 MHz
  - Performance/price optimized MPC8308 combines 16/32-bit DDR2 memory controller with ECC, 2 x Gigabit Ethernet, PCI Express, USB and eSDHC targeting smart metering gateways, wireless media gateways, factory automation & test/measurement equipment. In mass production today.
- MPC8306/S – 133 to 266 MHz
  - MPC8306 integrates QUICC Engine, CAN, USB, SDHC and IEEE® 1588 support ideal for industrial control, factory automation and test/measurement equipment
  - MPC8306S features QUICC Engine (HDLC/TDM, 10/100) and USB targeting networking equipment such as low-end base station line cards and branch access gateways
- MPC8309 – 266 to 400 MHz
  - Richly featured with QUICC Engine, CAN, USB, SDHC, PCI and IEEE® 1588 support for networking, industrial control, factory automation and test/measurement equipment

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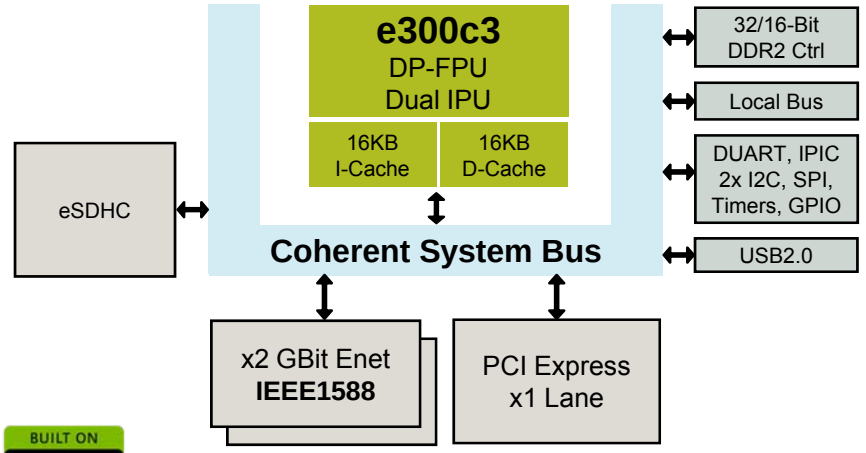
Features

- e300c3 up to 400 MHz
  - 16K I/D 4-way L1 cache
  - Double Precision FPU + Dual IU
- DDR2 up to 333MHz
  - 32/16-bit, with ECC Support
- Local Bus
  - Both NAND / NOR flash boot support
- x2 10/100/1000Mbps Gbit Ethernet
  - MII / RGMII / SGMII
  - IEEE1588 support
- x1 PCI Express v1.0a
- USB 2.0 - Host / Device / OTG
- eSDHC (host controller)
- 2x UART, 2x I2C, SPI, GTM, RTC
- 3 dedicated GPIOs
  - Additional available based on peripherals used
- Multi-channel DMA controller



- **Power:** Sub-1.3W @ 333MHz CPU
- **Package:** 473 MAPBGA, 19x19mm, 0.8mm pitch

In Mass Production
10Ku Pricing Starting at **$9.94**

Low-cost Networking / Industrial Control with PCI Express & 16/32-bit DDR2 w/ ECC

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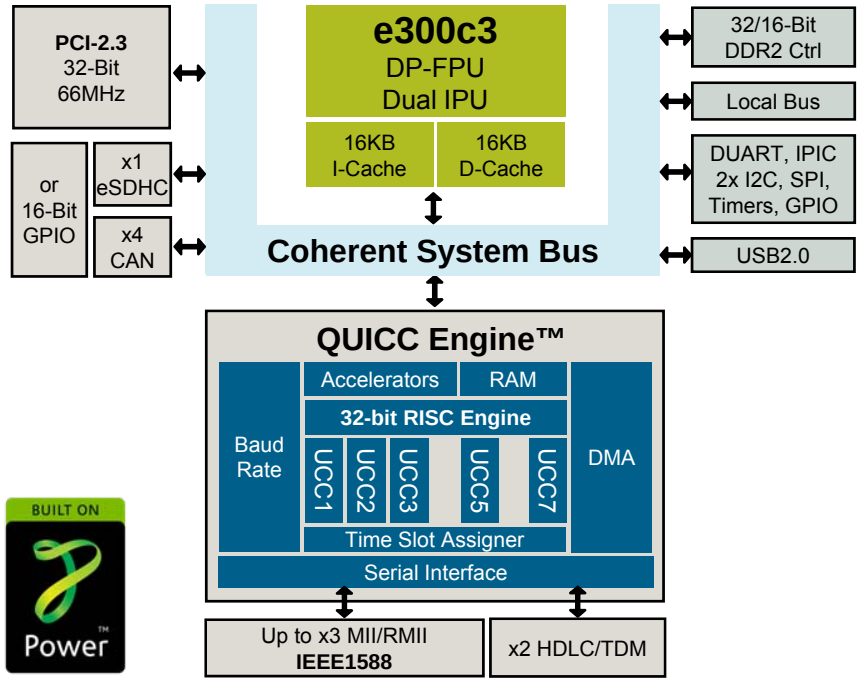
MPC8309

- e300c3 up to 400 MHz
  - 16K I/D 4-way L1 cache
  - Double Precision FPU + Dual IU
- DDR2 up to 333MHz
  - 32/16-bit, with ECC Support
- Local Bus
  - Both NAND / NOR flash boot support
- x3 10/100Mbps Ethernet
  - MII / RMII
  - IEEE1588 Support
- PCI-2.3, 32-bit @ 66 MHz
- x2 HDLC/TDM
  - Up to 128 channels
- USB 2.0 - Host / Device / OTG
- eSDHC (host controller)
- 4x CAN 2.0B Controllers
- 4x UART, 2x I2C, SPI, GTM, RTC
- 64 Muxed GPIO
  - MUX'd 16 GPIO with eSDHC / x4 CAN
- Multi-channel DMA controller



- **Power:** Sub-1.6W @ 333MHz CPU, 200MHz QE
- **Package:** 489 MAPBGA, 19x19mm, 0.8mm pitch

Sampling Now, Qualification Feb 2011
10Ku Pricing Starting at **$8.55**

Low-cost Networking / Industrial Control with PCI-2.3 & 16/32-bit DDR2 w/ ECC

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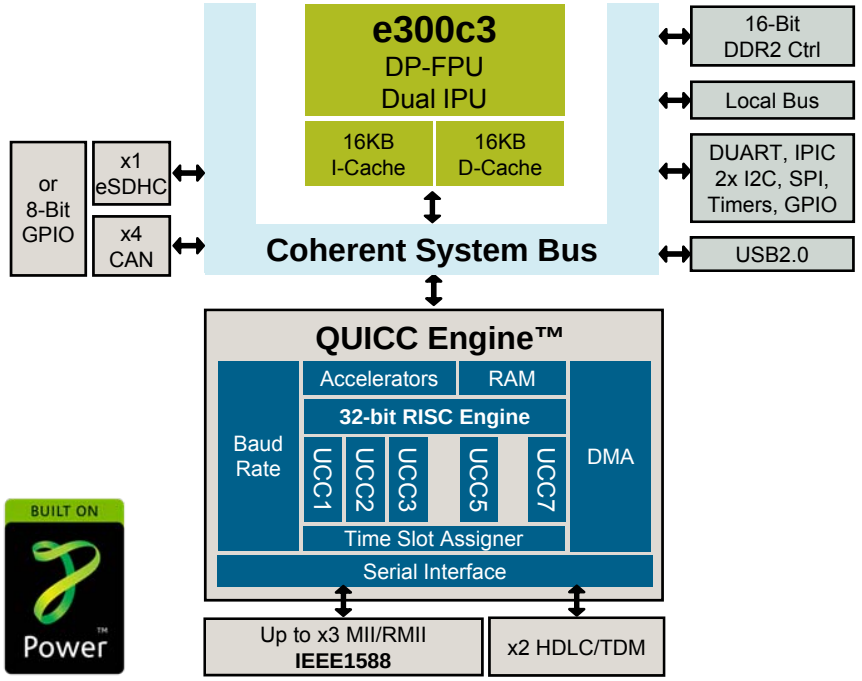
MPC8306

Features

- e300c3 up to 266 MHz
  - 16K I/D 4-way L1 cache
  - Double Precision FPU + Dual IU
- DDR2 up to 266MHz
  - 16-bit interface
- Local Bus
  - Both NAND / NOR flash boot support
- x3 10/100Mbps Ethernet
  - MII / RMII
  - IEEE1588 Support
- x2 HDLC/TDM
  - Up to 128 channels
- USB 2.0 - Host / Device / OTG
- eSDHC (host controller)
- 4x CAN 2.0B Controllers
- 4x UART, 2x I2C, SPI, GTM, RTC
- 56 Muxed GPIO
  - MUX'd 8 GPIO with eSDHC / x4 CAN
- Multi-channel DMA controller



- **Power:** Sub-1.2W @ 266MHz CPU, 200MHz QE
- **Package:** 369 MAPBGA, 19x19mm, 0.8mm pitch

Sampling Now, Qualification Nov 2011
10Ku Pricing Starting at **$7.49**

Low-cost Industrial Control / Factory Automation adding CAN, eSDHC & IEEE 1588

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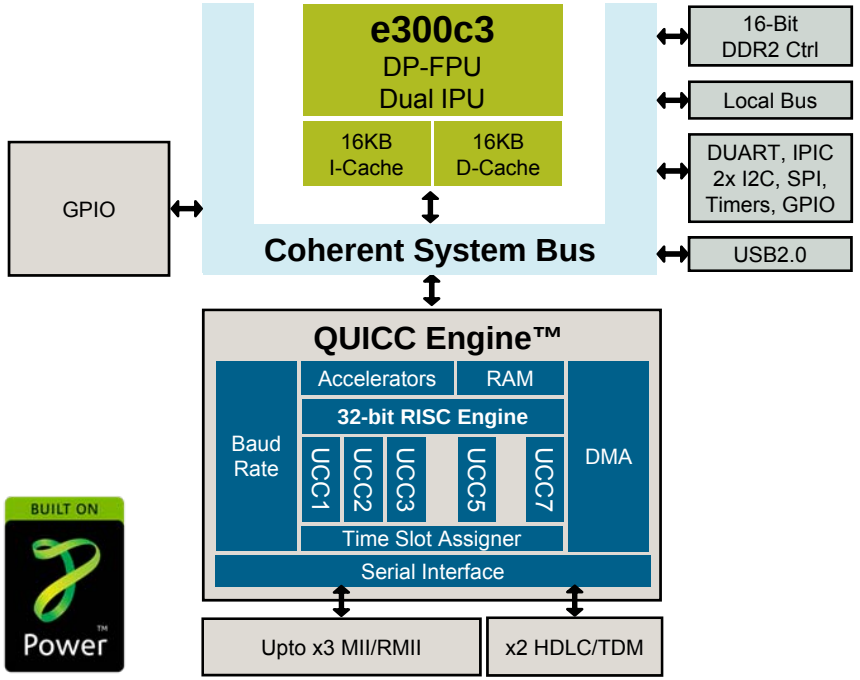
MPC8306S

Features

- e300c3 up to 266 MHz
  - 16K I/D 4-way L1 cache
  - Double Precision FPU + Dual IU
- DDR2 up to 266MHz
  - 16-bit interface
- Local Bus
  - Both NAND / NOR flash boot support
- x3 10/100 Ethernet
  - MII / RMII
- x2 HDLC/TDM
  - Up to 128 channels
- USB 2.0 - Host / Device / OTG
- 4x UART, 2x I2C, SPI, GTM, RTC
- 56 Muxed GPIO
  - 8 dedicated GPIO
- Multi-channel DMA controller



- **Power:** Sub-1.2W @ 266MHz CPU, 200MHz QE
- **Package:** 369 MAPBGA, 19x19mm, 0.8mm pitch

Sampling Now, Qualification Nov 2011
10Ku Pricing Starting at **$6.99**

Low cost entry level Networking with Fast Ethernet, HDLC, TDM & USB

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MPC8306/S and MPC8309 Development Schedule

Planned SoC Milestones	MPC8306/S	MPC8309
General Samples Rev 1.1 (PPC)	Sept.15, 2010	Oct. 15, 2010
Qualification (MPC)	Nov. 30, 2010	Feb. 15, 2011

Enablement & Documentation Milestones		
SoC Factsheets	Aug. 1, 2010	Aug 1., 2010
MPC830x Eval Kit Factsheet	August 1, 2010	
Hardware Specification (NDA)	NOW	NOW
Reference Manual (Ver. 1.0)	NOW	Oct 30, 2010
(Low cost MPC830x eval kit) w/ Linux® BSP (general customers)	Dec 15, 2010	Dec 15, 2010

Key Documentation available before Alpha samples
Product Brief, Hardware Spec, User manual, Errata

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MPC830x Feature Overview

	MPC8308	MPC8309	MPC8306	MPC8306S
Core Max Freq	e300c3 w/ DP-FPU 400 MHz (768MIPS)	e300c3 w/ DP-FPU 400 MHz (768MIPS)	e300c3 w/ DP-FPU 266 MHz (510MIPS)	e300c3 w/ DP-FPU 266 MHz (510MIPS)
L1 Cache I/D	16K / 16K	16K / 16K	16K / 16K	16K / 16K
DRAM Ctrl	32/16-bit DDR2 @333 ECC Support	32/16-bit DDR2 @333 ECC Support	16-bit DDR2 @266	16-bit DDR2 @266
Memory Bus	Non-muxed 25-bit addr & 16-bit data	Muxed 26-bit addr & 16- bit data	Muxed 26-bit addr & 16-bit data	Muxed 26-bit addr & 16-bit data
PCI/ PCIe	PCI Express 1.0a x1	32-bit PCI-2.3 @66MHz	-	-
Ethernet	2x 10/100/1000 Mbps IEEE1588	3x 10/100 Mbps IEEE1588	3x 10/100 Mbps IEEE1588	3x 10/100 Mbps
HDLC	-	2x, Normal/Bus modes	2x, Normal/Bus modes	2x, Normal/Bus modes
USB	1x USB2 OTG	1x USB2 OTG	1x USB2 OTG	1x USB2 OTG
UART	x2	x4	x4	x4
SPI	x1	X1	x1	x1
SD/SDIO	x1	x1	x1	-
CAN2.0A/B	-	x4	x4	-
Package Body / Pitch	473 MAPBGA 19x19 mm / 0.8 mm	489 MAPBGA 19x19 mm / 0.8 mm	369 MAPBGA 19x19 mm / 0.8 mm	369 MAPBGA 19x19 mm / 0.8 mm
Power	Sub-1.3W @ 333 MHz	Sub-1.6W @ 333 MHz	Sub-1.2W @ 266 MHz	Sub-1.2W @ 266 MHz
10Ku Pricing (Starting Production)	**$9.94**	**$8.55**	**$7.49**	**$6.99**

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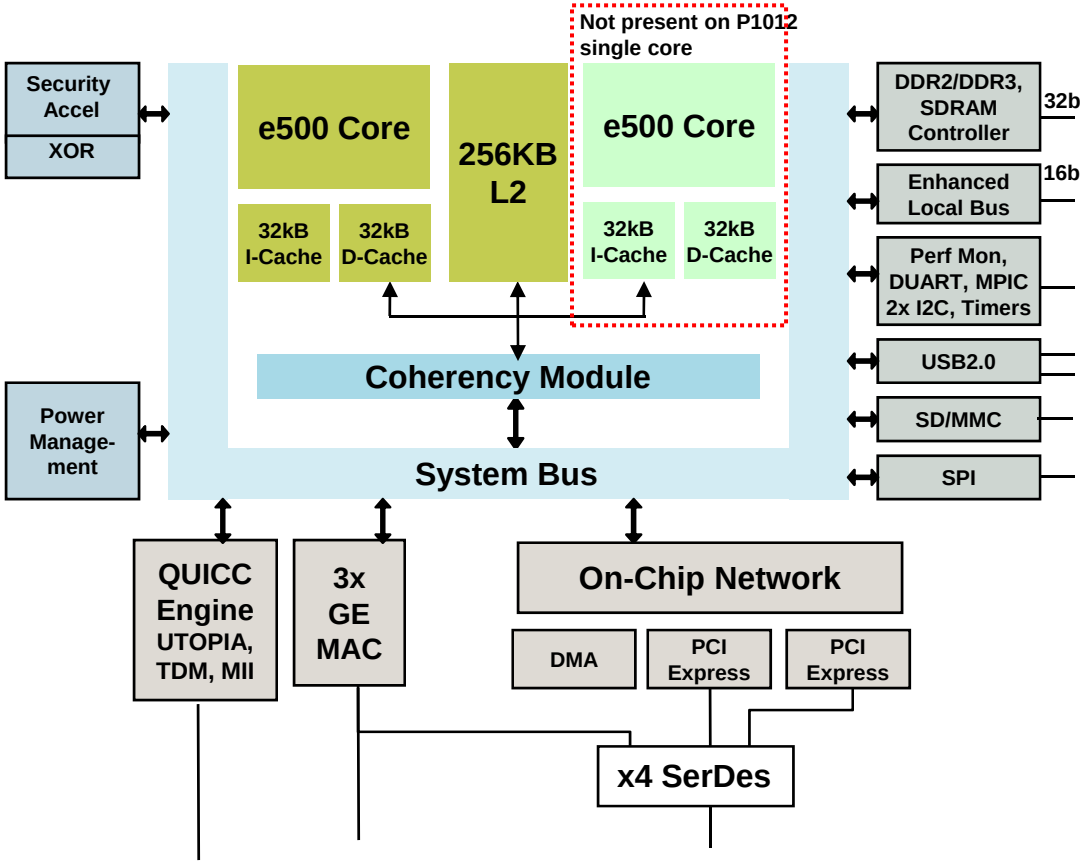
P1012/P1021 QorIQ Processor



- **Single or Dual e500 Power Architecture™ core**
  - 533 – 800 MHz (up to 1800 MIPS) per core
  - 256KB frontside L2 cache with ECC
  - 36 bit physical addressing, DP-FPU
- **System Unit**
  - 32-bit DDR2/DDR3, 667 MHz data rate with ECC
  - Integrated SEC 3.3 Security Engine
  - Open-PIC Interrupt Controller, Performance Monitor
  - 2x I^2C, Timers, 16 GPIO, 2x UART
  - USB 2.0 Controller Host/Device
  - 16-bit Local Bus can boot from NAND Flash
  - SPI controller can boot from SPI serial Flash
  - SD/MMC card controller can boot from Flash cards
  - Three 10/100/1000 Ethernet Controllers (eTSEC) with Jumbo Frame support, SGMII interface
    - IEEE® 1588v2 Support
  - QUICC Engine® for protocols and legacy interfaces
    - 4 x TDM interfaces with HDLC support
    - 4 x UCC for Serial Protocols, e.g. PROFIBUS
  - Two PCI Express 1.0a Controllers up to 2.5Gbps
  - Power Management
- **Process & Package**
  - 45nm SOI, 0.95V+/-50mV, -40C to 125C Tj
  - 689-pin TePBGAII

Supports Industrial Ethernet and PROFIBUS, low power consumption

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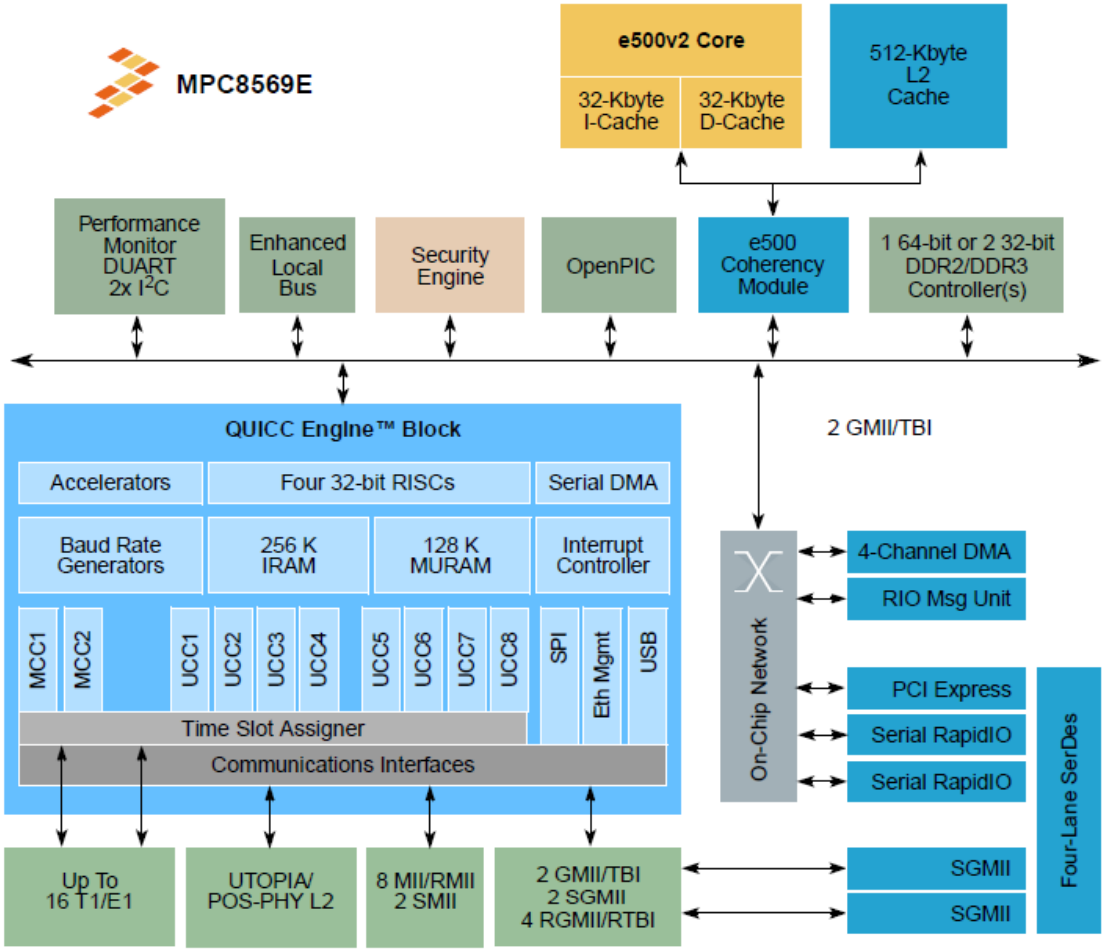
MPC8569E Product Features



- **e500 PowerPC** from 800MHz to 1.33 GHz
  - 512KB L2 Cache w/ ECC
  - 36bit physical addressing
  - Double Precision Floating Point
- **System Interfaces**
  - 64b or 2x32-bit DDR2/3 w/ ECC
  - 800 Mbps/pin data rate
  - 16-bit Local Bus for SRAM/Flash
  - Timers, DUART, 2xI²C, GPIO, SPI
  - USB 2.0 Full Speed
- **High Speed Serial Interfaces**
  - Dual SGMII
  - Single PCI-Ex controller supporting x1, x2, x4
  - Dual serial RapidIO™ interfaces supporting dual x1 or single x4
- **QUICC Engine**
  - 4 RISCs up to 667 MHz
  - Maximum of 8 Ethernet interfaces, one per UCC:
    - Up to 8x 10/100 Ethernet
    - Up to 4x 10/100 Ethernet and 4x GbE
    - Maximum 2 of the 4 total GbE over SGMII
  - Multi-PHY UTOPIA/POS-PHY L2 (16-bit)
  - IEEE1588 Support v2
  - 16 x T1/E1 (512 x 64kbps channels)
- **Security Engine (SEC3.0)**
  - ARC4, 3DES, AES, RSA/ECC, RNG, XOR, Single pass SSL/TLS, Kasumi, SNOW
- **Four-channel DMA**
- **45nm SOI process technology**
- **Power <7W for 800MHz up to 10W for 1.3GHz**

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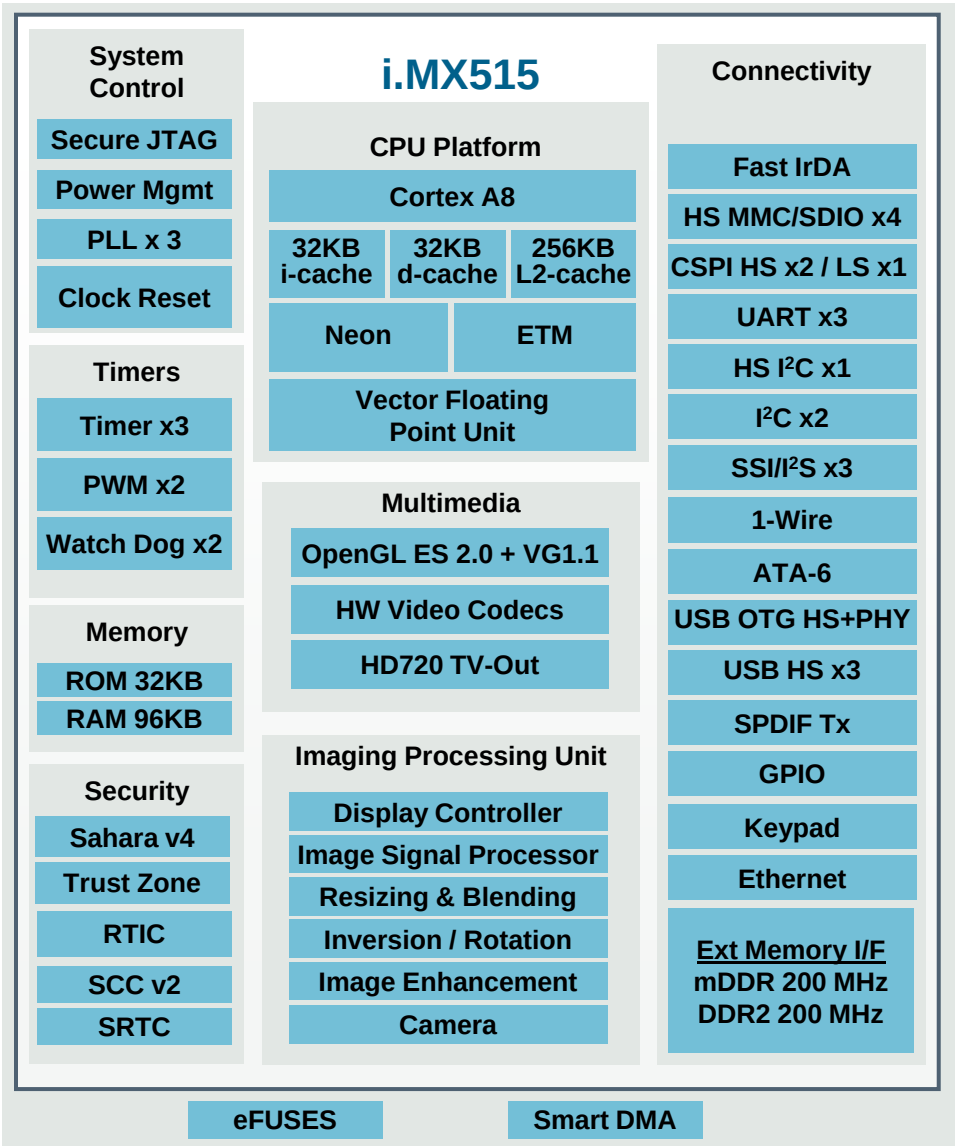
i.MX51 Application Processor

- Specifications:
  - CPU: Cortex A8, up to 1GHz
  - Process: 65nm, LP/GP
  - Core Voltage: 0.7-1.1V
  - Package: 13x13 0.5mm, 19x19 0.8mm
  - Temp Range: -20 to 85C, -40 to 85C
- Camera
  - Camera and Display I/F (legacy
  - Image Sensor Processor (ISP)
  - Up to 8Mpixel @ 15fps, Up 133Mpixel/sec
  - Resizing, Inversion, Rotation
  - Color Space conversion, video/graphics combining
- Display
  - Display I/F (legacy and MIPI DSI)
  - Up to WXGA display - 24 bit @ 60fps
  - Secondary Display Support
- Connectivity
  - High speed USB OTG w/ embedded Phy, Host HS x3
  - Up to 400Mbps MobileDDR, DDR2
  - SLC/MLC NAND Flash 8/16-bit, NAND/NOR
  - High speed MMC\SDIO, UART, I2C, SPI
  - ATA-6
  - 3.3V support on HD, SDIO, and SIM I/F
- Security
  - TrustZone
  - AES, DES/3DES, SHA-1, SHA-224, SHA-256
  - Run time integrity checker (RTICv3)
  - Secure High Assurance Boot
  - Security Controller (SCC), including Secure RAM and Security Monitor
  - Random Number Generator Accelerator
  - Secure JTAG Controller
  - Secure real-time clock
  - Universal Unique Identification
  - Tamper Detection

1600 MIPS
<1W

Energy Efficient Solutions by Freescale



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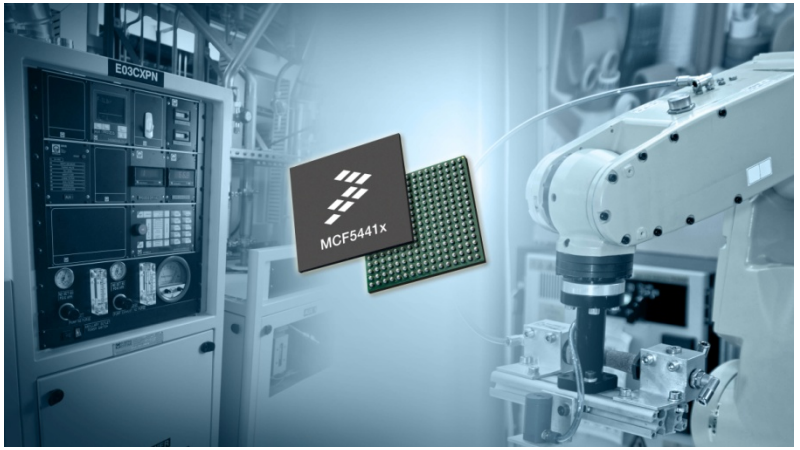
Introducing the Newest Freescale Industrial MPUs



i.MX28x

- ARM9™ architecture
- <0.5 W for hand-held and battery-powered applications
- On-chip power management
- Graphical display controller
- Secure boot
- Linux® OS and Windows® Embedded CE OS

Shared features:

- Extensive connectivity
- Dual 10/100 Ethernet with IEEE® 1588 time-stamping
- 3-port Layer 2 Ethernet switch (L2 Switch)
- <0.5 W for fanless operation
- Industrial Qualification
- Product Longevity –15 years

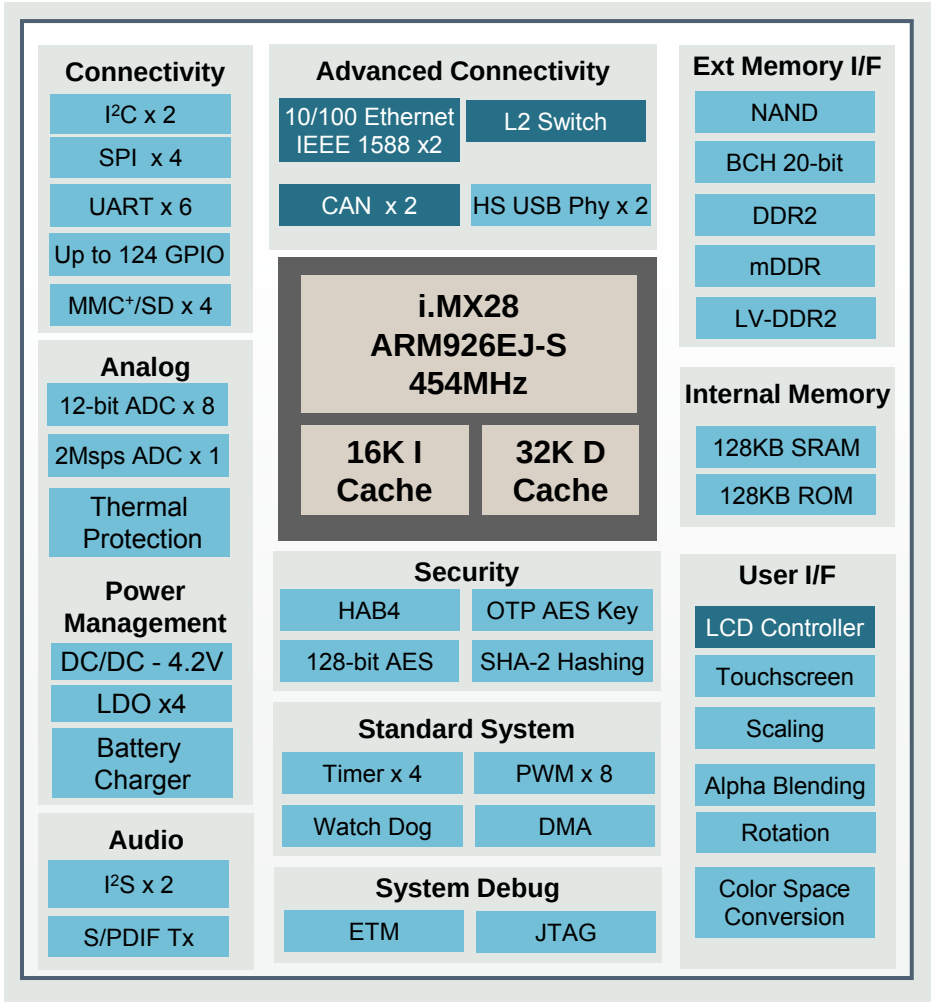
MCF5441x

- ColdFire™ V4 architecture
- Motor control integration - PWM Timers, DACs, ADCs
- 10 serial ports
- DACs for sensors and audio interface
- True Random Number Generator (RNG) for enhanced data security
- MQX™ RTOS, Linux OS, and CodeWarrior™ v10

i.MX28x Applications Processor

► Key Features and Advantages

- ARM9 Core with 454 MHz performance
- <0.5 W maximum power
  - On-chip Power Management for device and external components
  - Freescale Energy Efficiency Mark
- Display interface with touch screen
  - Rich user experience
- Extensive connectivity
  - Dual 10/100 Ethernet with IEEE 1588 hardware timestamp and L2 Ethernet switch
  - Dual CAN controllers
  - Dual USB with integrated PHY
  - Many other IO peripherals
- Real-time control
  - Integrated ADC and PWM
- Secure boot
- Industrial qualification
  - Product longevity – 15 years
  - -40C to +85C ambient operating temperature
- Packaged to reduce manufacturing cost
  - 0.8 mm pitch (289 BGA)
  - Product variants for a range of applications
- Linux and Windows Embedded CE



Pricing: 10K units MSRP from $5.27 - $9.90

Not available on all variants

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i.MX28x Development Platform

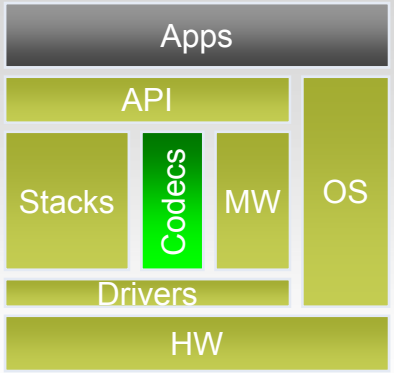
Hardware Platform

- Ease of Use – BSP and demo images, development environment build demonstration, video tutorials, schematic and layout, documentation
- Small, single-board design with optional add-on LCD module
- MCIMX28EVK – $399
- MCIMX28LCD – $199

Software

Linux and Microsoft Windows Embedded CE Operating Systems

- Full-featured, scalable, optimized and proven OS
- Product-worthy software for reference designs and product development
- Simplifies hardware management
- Streamlines software development



- Use EVK to differentiate and accelerate product development
- Broad multimedia codec library
- IEEE 1588 stack from IXXAT
- Growing developer community

www.imxcommunity.org

Full Hardware Evaluation and Development Platform

Complete software package
Simple download at no cost

Price. Performance. Personality.

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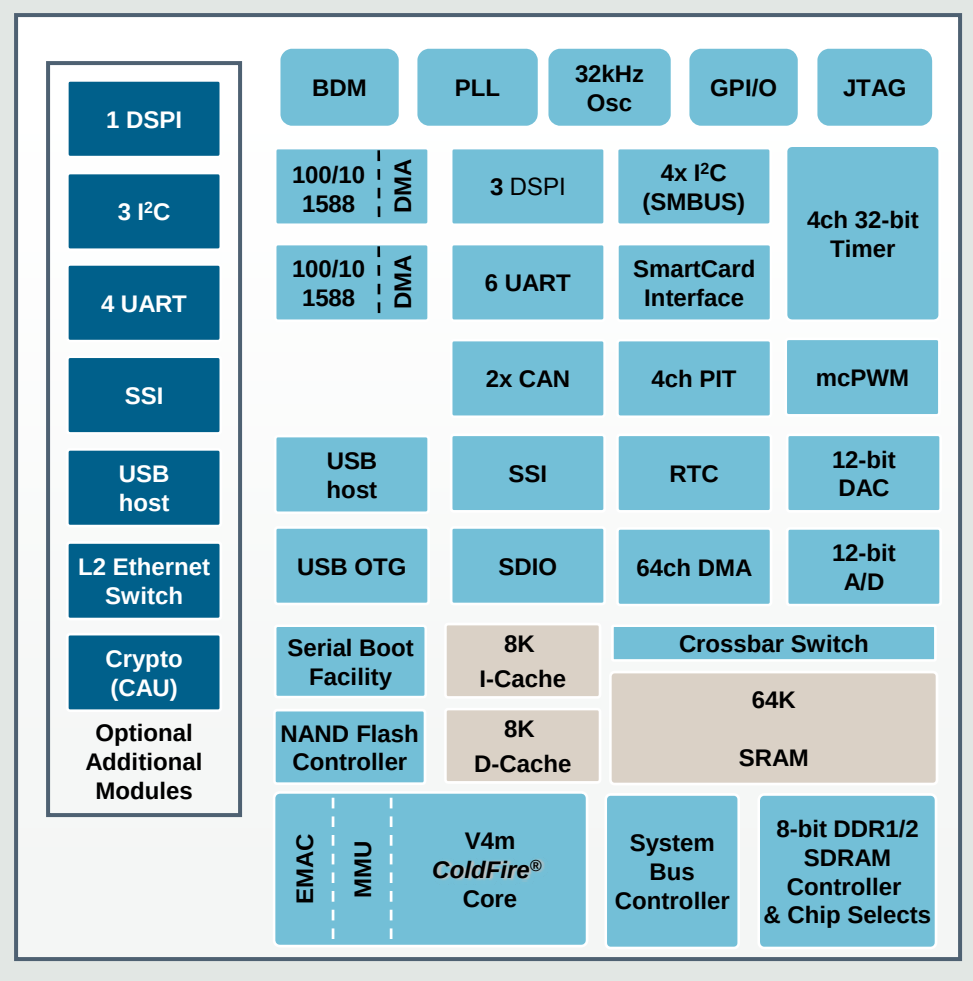
MCF5441x Microprocessors

Key Features and Advantages

- V4m Core, Up to 385 Dhrystone 2.1 MIPS @ 250 MHz
- < 0.5 W Power
- Extensive connectivity
  - Dual 10/100 Ethernet with IEEE 1588 hardware timestamp and L2 Ethernet switch
  - Dual CAN controllers
  - Up to 10 serial ports
  - Many other IO peripherals
- Real-time control
  - 2x 4 ch. 12-bit ADC with simultaneous / parallel sampling
  - 2x 12-bit DAC
- True Random Number Generator (RNG) for enhanced data security
- Industrial Qualification
  - Product longevity – 15 years
  - -40° C to 85° C temperature range
- Packaged to reduce manufacturing cost
  - Product variants for a range of applications
- MQX RTOS, Linux OS, and CodeWarrior v10



Pricing: 10K units MSRP from $4.99 - $9.49

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MCF5441x Development Platform

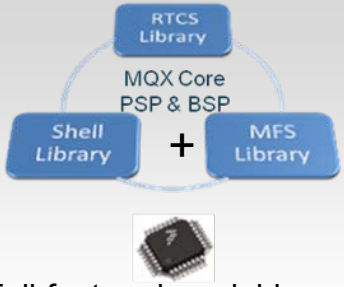
Hardware Platform

Tower System

- Modular, expandable development platform for 8/16/32-bit MCUs/ MPUs
- Rapid eval, prototyping with maximum hardware reuse
- Supported by range of MCU and peripheral plug-in boards and growing web community www.towergeeks.org

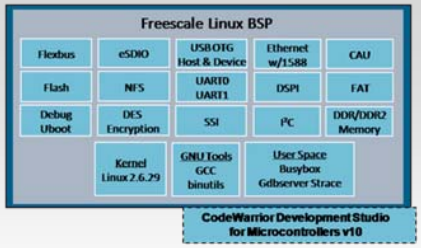
Complimentary Operating Systems

Freescale MQX



- Full-featured, scalable, optimized and proven RTOS
- Simplifies hardware management
- Streamlines software development
- Reduces development cost while speeding time to market

Linux



- Support for 2.6.29 Linux kernel
- u-boot with ColdFire patches
- GNU tools: gcc, eglibc, & binutils.
- GDB debugger
- Wide range of BSP drivers offering broad application scope

Software

CodeWarrior *IDE*

- Eclipse environment
- Processor Expert code generation wizard
- Build, debug and flash tools
- Software analysis
- Kernel-aware debug
- Host platform support

Enables prototyping application development

Comprehensive OS solutions for embedded control and connectivity

Accelerates development time

Extensive. Enabled. Easy.

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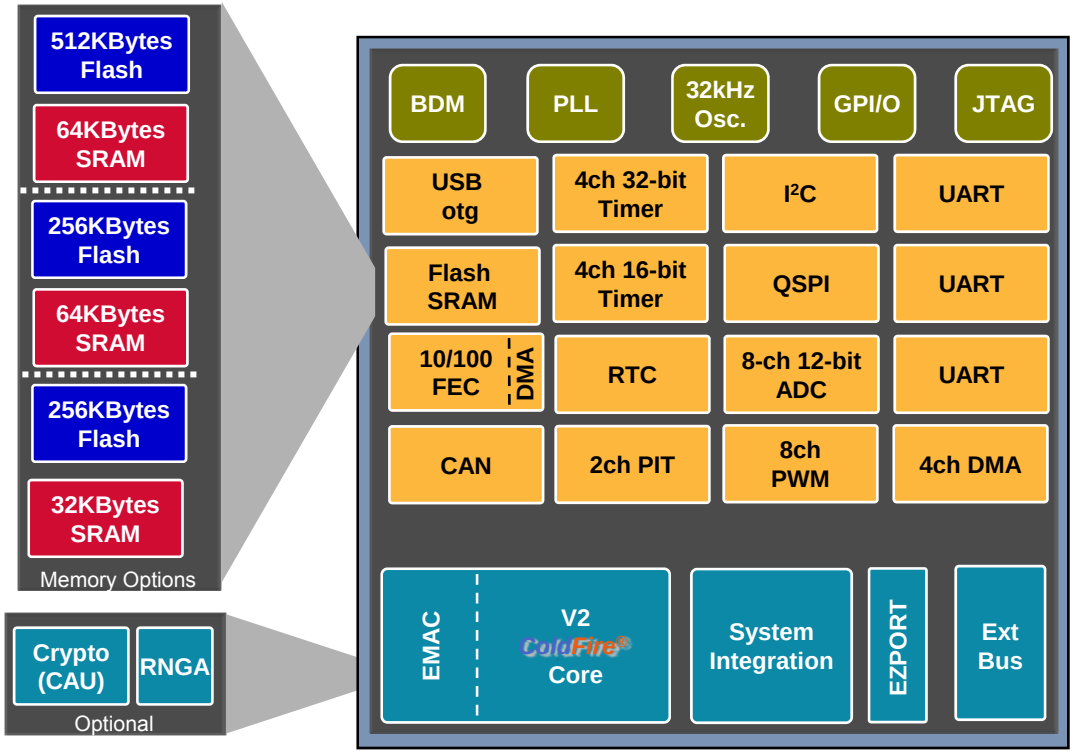
MCF5225x ColdFire Processor

- 76 Dhrystone 2.1 MIPS @ 80 MHz
- Flash/SRAM options
  - 512K/64K, 256K/64K, 256K/32K
- MiniBus expansion supports 1MB memory without ALE; 256MB with ALE
- 10/100 Ethernet controller with encryption; pin-out supports Ethernet in 2-layer board
- CAN controller
- USB 2.0 OTG controller
- 3 x UARTs, I²C, QSPI
- High precision ADC and many timers
- eMAC provides low-cost DSP performance
- Ready-to-go MQX RTOS software



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Kinetis Product Family

First available broad-market MCU samples based on ARM Cortex-M4!

MCU Family	USB OTG (FS & HS)	LCD (Segment/Graphics)	NAND Flash Controller	Floating Point Unit	Ethernet (IEEE 1588)	Encryption (CAU+RNG)	Dual CAN	Hardware Tamper Detect	DRAM Controller
K70 Family 512KB-1MB, 196-256pin	●	●	●	●	●	●	●	●	●
K60 Family 256KB-1MB, 100-256pin	●		●	●	●	●	●	●	●
K50 Family 128-512KB, 64-144pin	●	●			●	●			
K40 Family 64-512KB, 64-144pin	●	●					●		
K30 Family 64-512KB, 64-144pin		●					●		
K20 Family 32KB-1MB, 32-144pin	●		●	●			●		
K10 Family 32KB-1MB, 32-144pin			●	●			●		

Common System IP	Common Analog IP	Common Digital IP	Development Tools
32-bit ARM Cortex-M4 Core w/ DSP Instructions	16-bit ADC	CRC	Bundled IDE w/ Processor Expert
Next Generation Flash Memory High Reliability, Fast Access	Programmable Gain Amplifiers	I^2C	Bundled OS USB, TCP/IP, Security
FlexMemory w/ EEPROM capability	12-bit DAC	SSI (I^2S)	Modular Tower H/ware Development System
SRAM	High-speed Comparators	UART/SPI	Application Software Stacks, Peripheral Drivers & App. Libraries (Motor Control, HMI, USB)
Memory Protection Unit	Low-power Touch Sensing	Programmable Delay Block	Broad 3rd party ecosystem
Low Voltage, Low Power Multiple Operating Modes, Clock Gating (1.71V-3.6V with 5V tolerant I/O)		External Bus Interface	
DMA		Motor Control Timers	
		eSDHC	
		RTC	

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