QorIQ Portfolio: Architecture and Capabilities Overview

AMF-NET-T1026

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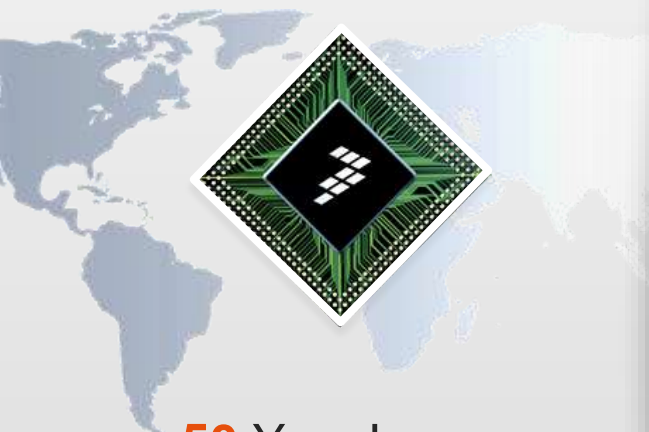
October 2013

A *Global Leader* in Microcontrollers and Digital Networking Processors

>**50** Year Legacy

>**5,500** Engineers

>**6,000** Patent Families

Five Core Product Groups

- Microcontrollers
- Digital Networking
- Automotive MCU
- Analog & Sensors
- RF

Four Primary Markets

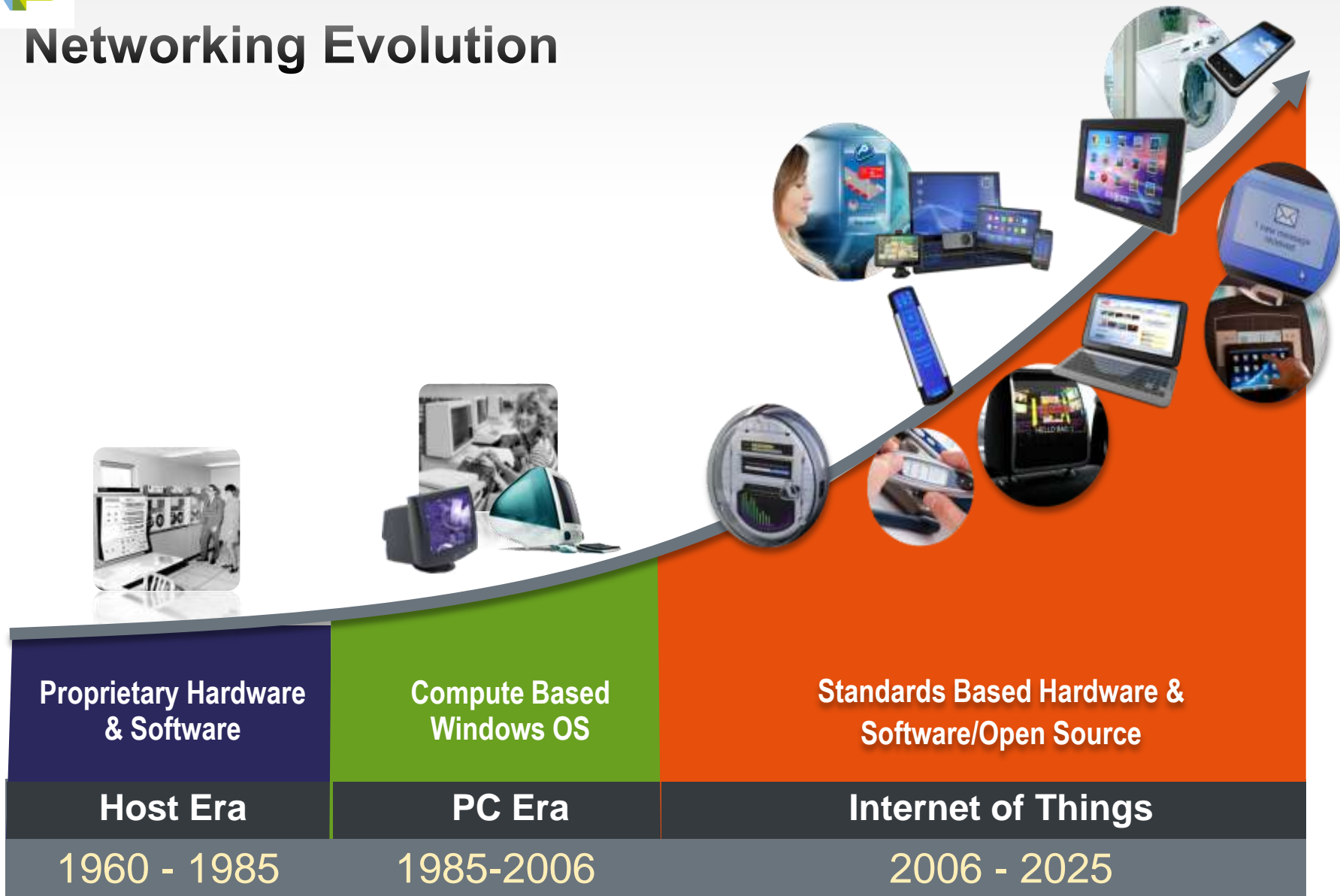- Automotive
- Networking
- Industrial
- Consumer

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Digital Network

- We know Networking
  - #1 in the market
  - We work every day to move information quickly, protected and efficiently
- Balance portfolio now and in the future.
  - Broad spectrum of devices delivering the right price, power and performance for your application
  - Balanced portfolio of Power and ARM architectures now and tomorrow.
  - Comprehensive software support for the processor
- Service Matters
  - Ease of doing business with
  - Longevity – best in industry
  - Sales/FAE support
  - Comprehensive Software support to take advantage of processor architecture
  - Documentation

Networking Evolution

Proprietary Hardware & Software	Compute Based Windows OS	Standards Based Hardware & Software/Open Source
Host Era	PC Era	Internet of Things
1960 - 1985	1985-2006	2006 - 2025

Connectivity Fuels Growth in MPU

50B Connected Nodes by 2020*

Computers | People | Everything

1T
100B
10B
1B
10M

$100 — Cost to Connect
Things Connected
$1
1¢

Past | Today | Future

1990 | 2000 | 2010 | 2020

*Source Ericsson

Networked Infrastructure: $3.5B SAM

1 Cloud

2 Wireless

3 Enterprise

Networked Everything: $1B SAM

1 Factory Automation

2 Smart Energy

3 Transportation

Performance scaling and technology challenges

Source: UT Dept. Computer Science
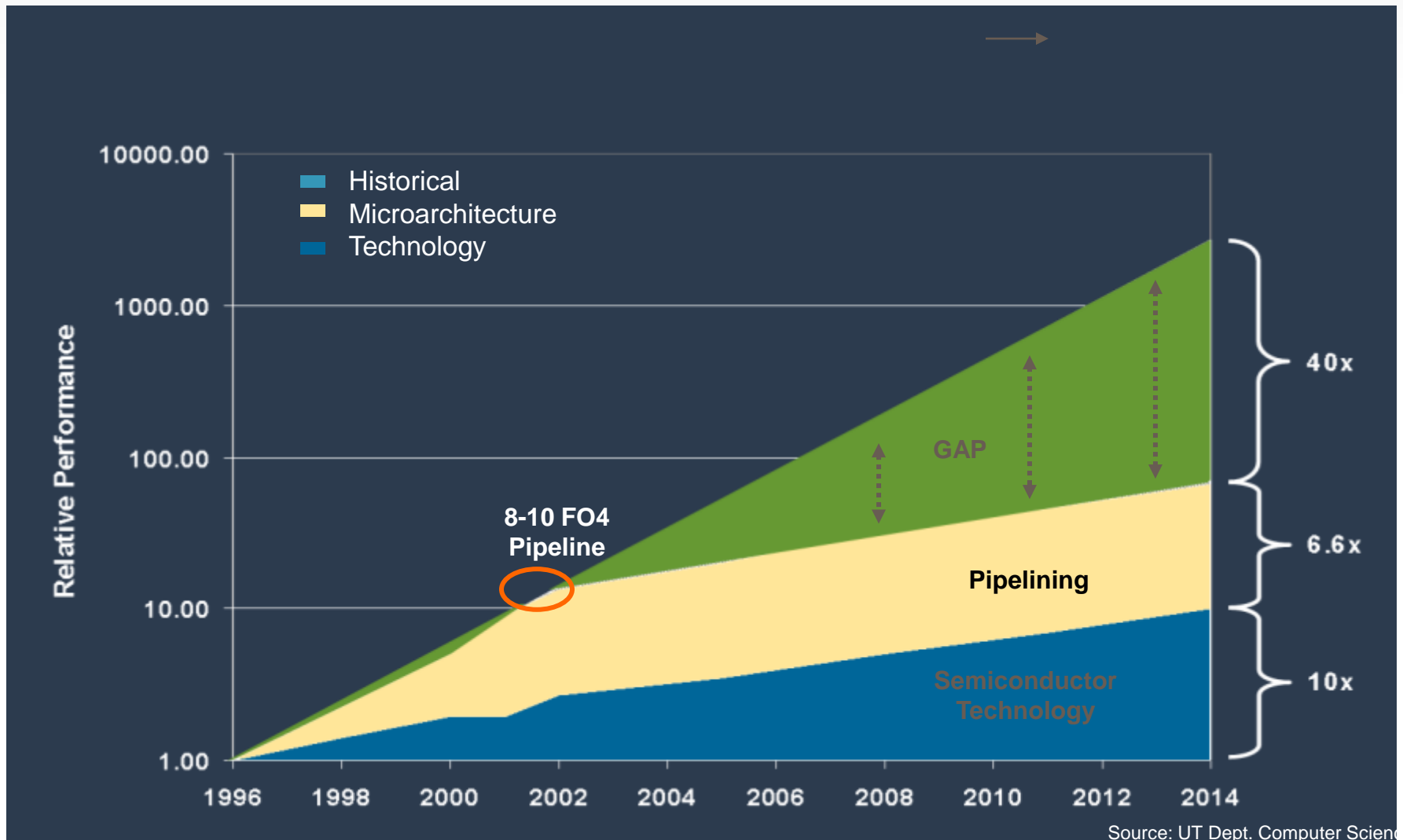
Freescale Networking: Leadership Credentials

Market Leadership:

#1 in Embedded Processors in Wired and Wireless Communications[1]

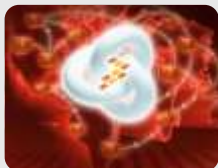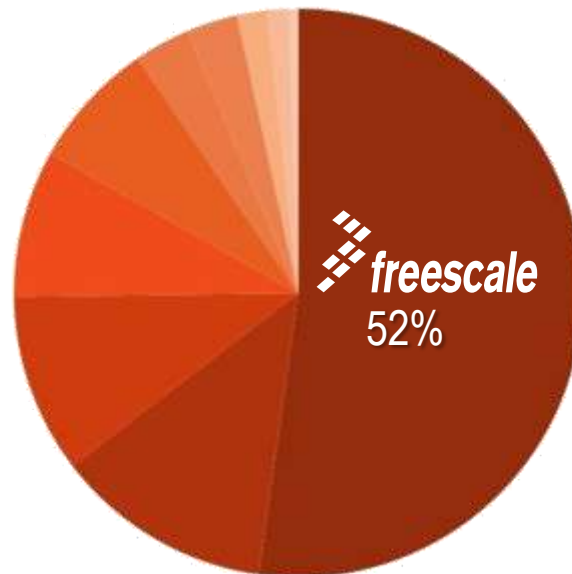**#2** in Programmable DSPs[2]

Key Product Families:

QorIQ
Multicore SoC Processors

QorIQ Qonverge
Heterogeneous SoC Processors

VortiQa
Software System Solutions

2012 Market Share in
Embedded Processors in Wired & Wireless Communications[1]

freescale
52%

Industry's Broadest, Most Scalable Portfolio

	Product Overview		Portfolio	Target Applications
QorIQ LS Series	**Core-agnostic approach to hardware**	→	Freescale's unrivaled networking expertise with Arm's expansive ecosystem reach ARM Power.ORG	• Networking • Industrial Automation • Smart Grid
QorIQ T Series	**1-24 cores,** 64-bit, AltiVec technology	→	**6 family members in 2013** Power.ORG	• Data Center • Aerospace and Defense • High-End Networking
QorIQ Qonverge Platform	1-6 **heterogeneous cores**	→	**5 family members in 2013** Power.ORG freescale StarCore	• Aerospace and Defense • Industrial • Wireless Access
QorIQ P Series	1-8 cores, **data path acceleration**, security and pattern matching, **hardware-assisted hypervisor**	→	**25 family members in production** Power.ORG	• Networking • Aerospace and Defense • Factory Automation
PowerQUICC	**General purpose MPU**	→	**75 family members in production** Power.ORG	• Industrial • Smart Grid • Networking

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SWAaP – Bringing Assured Computing to Swap

QorIQ (P & T series)Assured Computing Platform

Protection against Theft

- *Theft of Functionality* – loss of control of the system's functionality
- *Theft of Data* – where a data protection policy exists, loss of data to an unauthorized party
- *Theft of Uniqueness* - loss of product differentiation through reverse engineering, duplication, and unapproved inter-operability.

QorIQ Assured Computing
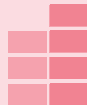
- *Secure Boot* - start from Trusted Code base or don't start at all
- *Domain Separation* – Isolation of cores from each other
- *Threat Detection* – both physical and network attacks
- *Secure Debug -* debug and update software code in a trust environment remotely

Increase Security – Lower cost
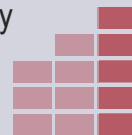
- **Elimination of multiple devices – TPM, FPGA's, custom devices**
- **Fewer exposed busses that are vulnerable to snooping**
- **COTs devices are lower cost than custom ASICs or high cost FPGAs**
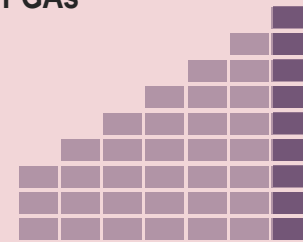
>**Assured Computing without compromising performance**

QorIQ AMP Series Unleashes AltiVec Technology
– the Next Generation

AltiVec on T4240

- *128-bit SIMD engine*
- *Executes on every clock cycle*
- *Improved load /store to ease bit alignment*
- *New instructions for video analytics*
- *Royalty Free library - from Mentor*
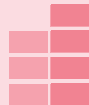
QorIQ AMP with AltiVec

- *Every e6500 core has an AltiVec unit*
- *Increase in performance with multithreading - no wasted cycles waiting on instructions*
- *Implemented across the QorIQ AMP family T2 – T4*

T4240 with AltiVec

- 12 AltiVec units
- Algorithms and data protected by trust architecture
- 192 GFLOPS of performance
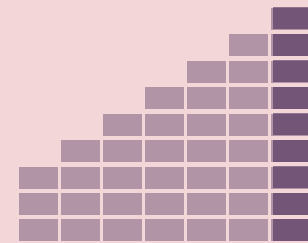
AltiVec across the T2-T4 families – More performance and power choices

QorIQ Communications Processor Roadmap
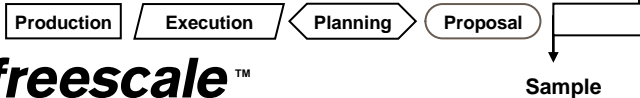
QorIQ T4240 - T Series
– A Look Under the Hood
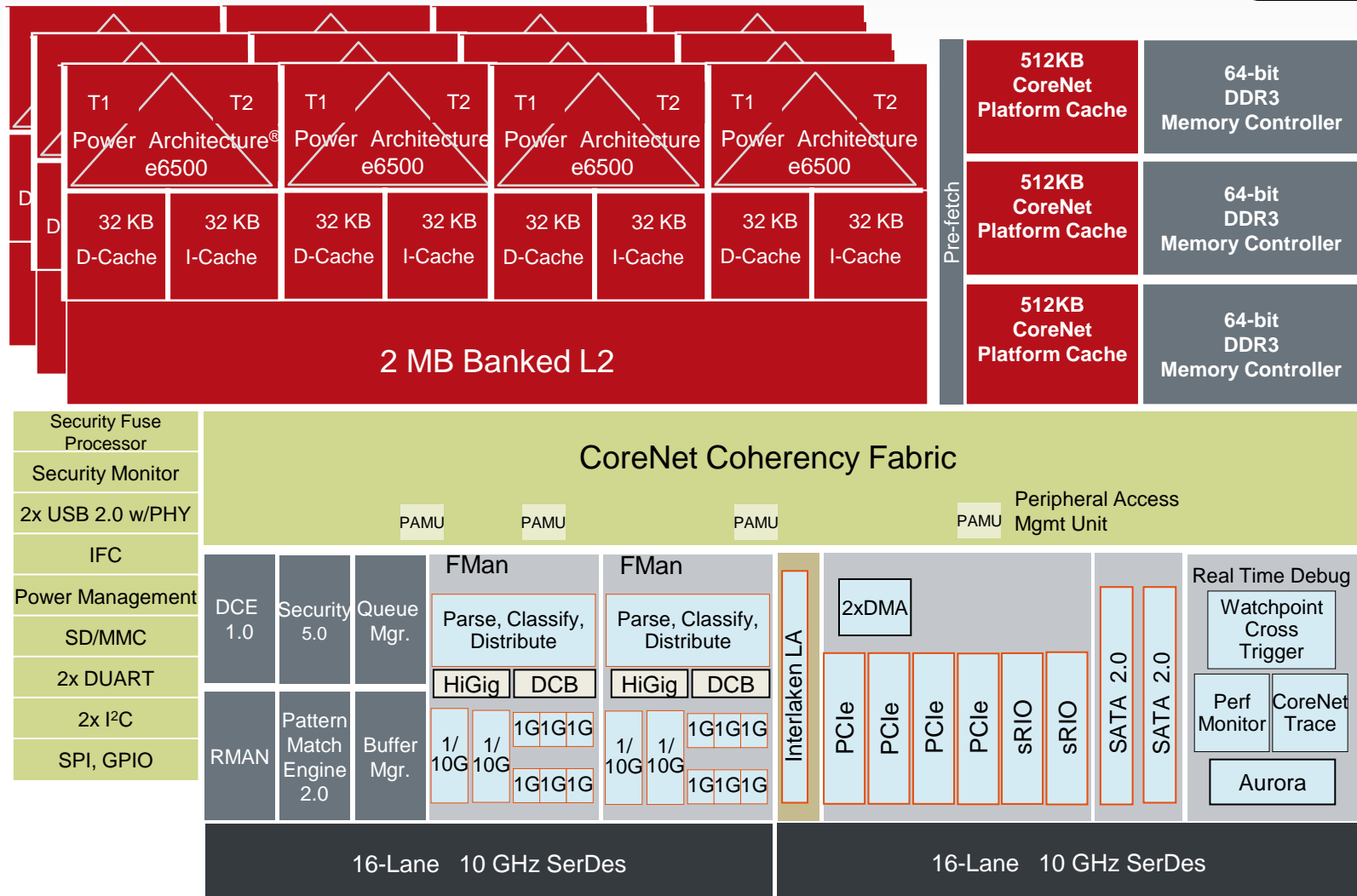
Layerscape Architecture: High Level View

General Purpose Processing Layer (GPPL)

CPU(s) · · ·

Caches · · ·

Mem. Cont. · · ·

Application IO Processing Layer (AIOP)

Decomp Engine	Security Engine	Load Balance Engine	Pattern Match Engine	L2-L7 Switch Engine	Packet Buffer

Accelerated Packet Processor

Wire Rate I/O Processing Layer (WRIOP)

Ethernet Interlaken	100/40/10/1G	RapidIO	PCI-Express

SERDES

System Interfaces / Control / Tuning

Core Agnostic (ARM, Power Arch)
- Initial Product ARM V7.
- ARM V8 Product Roadmap.
- Continued Support for Power Arch.

Scalable Independent Layers
- Sized to Application Need.
- Real Time Monitoring / Debug.

Consistent Programming Interface
- Deterministic Performance.
- Complexity of HW Accelerator Hidden.

Programming Ease of General Purpose MPU, With Power Consumption Advantage of HW Acceleration, But Without Specific Programming Complexity

Comprehensive Portfolio Based on ARM Technology

Kinetis Microcontrollers
Design Potential. Realized

Industry's most scalable ultra-low-power, mixed-signal MCU solutions based on the ARM® Cortex™-M and Cortex™-M0+ architectures.

- Consumer
- Industrial

Vybrid Controller Solutions
Rich Apps in Real Time.

Real-time, highly integrated solutions with best-in-class 2D graphics to enable your system to control, interface, connect, secure and scale.

- Consumer
- Industrial
- Automotive

i.MX Application Processors
Your Interface to the World.

Industry's most versatile solutions for multimedia and display applications, with multicore scalability and market-leading power, performance & integration.

- Consumer
- Industrial
- Automotive

QorIQ Processors built on Layerscape Architecture
Accelerating the Network's IQ

Industry's first software-aware, core-agnostic networking system architecture for the smarter, more capable networks of tomorrow – end to end.

- Consumer
- Industrial
- Networking

Freescale has the industry's broadest range of solutions built on ARM® technology for automotive, industrial, consumer and networking applications.
Find your ideal solution at the price, performance and power level you desire,
and leverage the extensive software and tool bundles available to speed and ease your design process.

Networking SoC Reference Software Architecture

Freescale Linux SDK

Guest Linux Instance

NCSW Bare Board

NSCW Apps	

NCSW USDPAA Driver

USDPAA Apps
Linux Apps	Vortiqa Apps	Cust Apps	Demo Apps

Std Linux App	Std Linux Control	ASF Apps	USDPAA

User Space

QEMU

Std Linux APIs (pthreads, sockets, hugetlbfs, scheduler, etc.)

system call interface

KVM

Device Manager I/F

NCSW Kernel Library
Kernel Modules
NCSW OS Wrappers

Linux Net Stack	ASF Control	Zero Copy Socket

ASF (Fast Path)

NCSW Bare Board Wrappers

Kernel Space

Kernel Drivers
RMAN	SEC	FMAN	BMAN	QMAN	PME

USDPAA Drivers
RMAN	SEC	FMAN	BMAN	QMAN	PME

NCSW Low Level Drivers

Firmware Acceleration
Microcode	DPAA Accel.

MMU
PAMU

FSL Embedded Hypervisor (Optional)

Accel (Non-DPAA)	QE/uQE	DPAA	e500v2	e500dp	e500mc	e5500	e6500	ARM

Community developed Software
FSL developed Software
Customer/Partner developed Software
SOC Functional Block

QorIQ Qonverge SoC Portfolio from Freescale
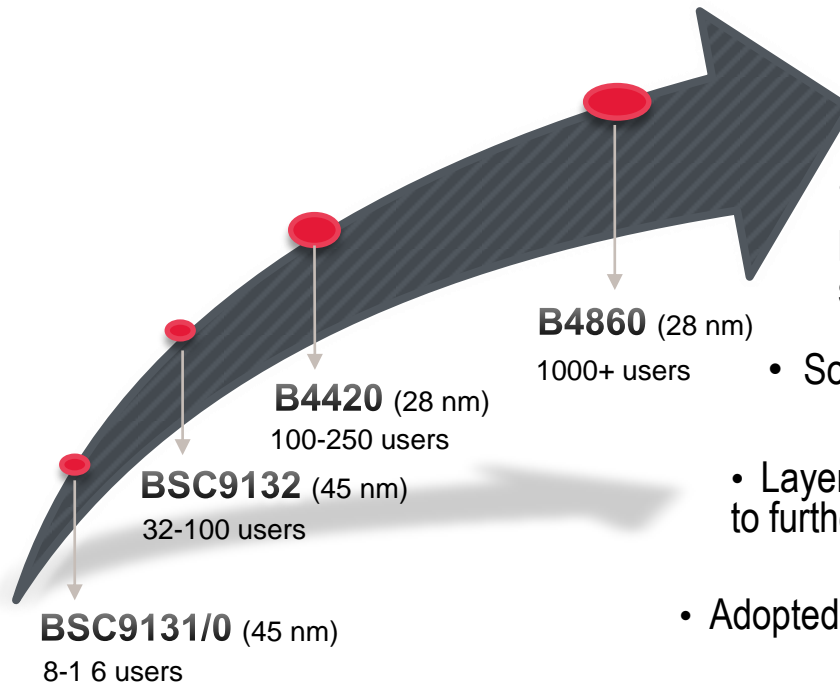
QorIQ Qonverge Base Station-on-Chip SoC Series

- Advanced core and acceleration technologies, highly-balanced architectures for baseband processing integration, advanced process technologies

- Freescale delivering industry's first complete SoC portfolio from home femto to multi-sector macro base stations

- Software compatibility across different devices

- Layer-1 and transport software stacks for small cell solutions to further expedite time to market

- Adopted by Industry leading base station OEMs

B4860 (28 nm)
1000+ users

B4420 (28 nm)
100-250 users

BSC9132 (45 nm)
32-100 users

BSC9131/0 (45 nm)
8-1 6 users

- Broad portfolio from Femto to Macro with on-time, on-specification release track record
- Common architecture and software tool sets including CodeWarrior Development Suite
- Software and tools ecosystem catering for Tier-1 wireless OEMs and broad market customers
- Rich third-party ecosystem for tools, operating system and application software

QorIQ Qonverge Processing Platform

Performance →

B4xxx

Samples Now

- Supports high-performance applications
- Multiple DSP and QorIQ cores

BSC9132

Available Now

- 2 MPU cores
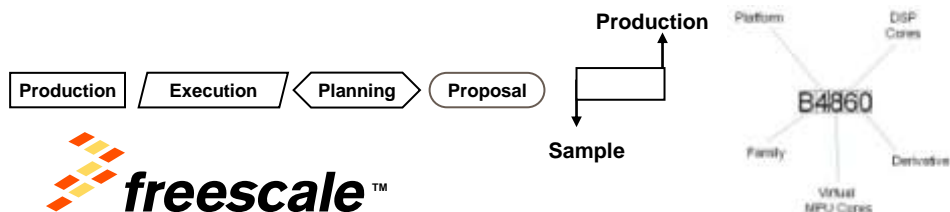- 2 DSP cores
- Below 12W

BSC9131

Available Now

- Up to 1 GHz
- 1 e500 MPU core
- 1 SC3850 DSP core

Unmanned Aircraft

Double conversion UPS

Unmanned Vehicle

Aerospace/Defense Communications

Power Relay

QorIQ Qonverge Roadmap

Macro & C-RAN
1000+ users
LTE 1.8 Gbps, 3 sectors
8 x 8 MiMO
WCDMA - 6 Cells

- P4080
- MSC8156
- MSC8157/8

Metro
100 - 200+ Users
LTE 600Mbps, 2 sectors
4 x 4 MiMO
WCDMA – 4 cells

- P3041
- MSC8156
- MSC8157

Pico/Enterprise
32 – 100 Users
LTE 300Mbps, 1 sector
2 x 4 MiMO
WCDMA – 2 cells

- BSC9132
- P2020
- MSC8154

Home/SMB
8 – 16 Users
LTE 150Mbps, 1 sector
WCDMA – 1 cell
2 x 2 MiMO

- BSC9131
- P1014
- 8313

B4xxx

B4860

Pin Compatible Families

B3xxx

B4420

B2xxx

B1xxx

Available Now

1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
2013				**2014**				**2015**			

Production | Execution | Planning | Proposal

Production

Sample

Platform

DSP Cores

B4860

Family

Derivative
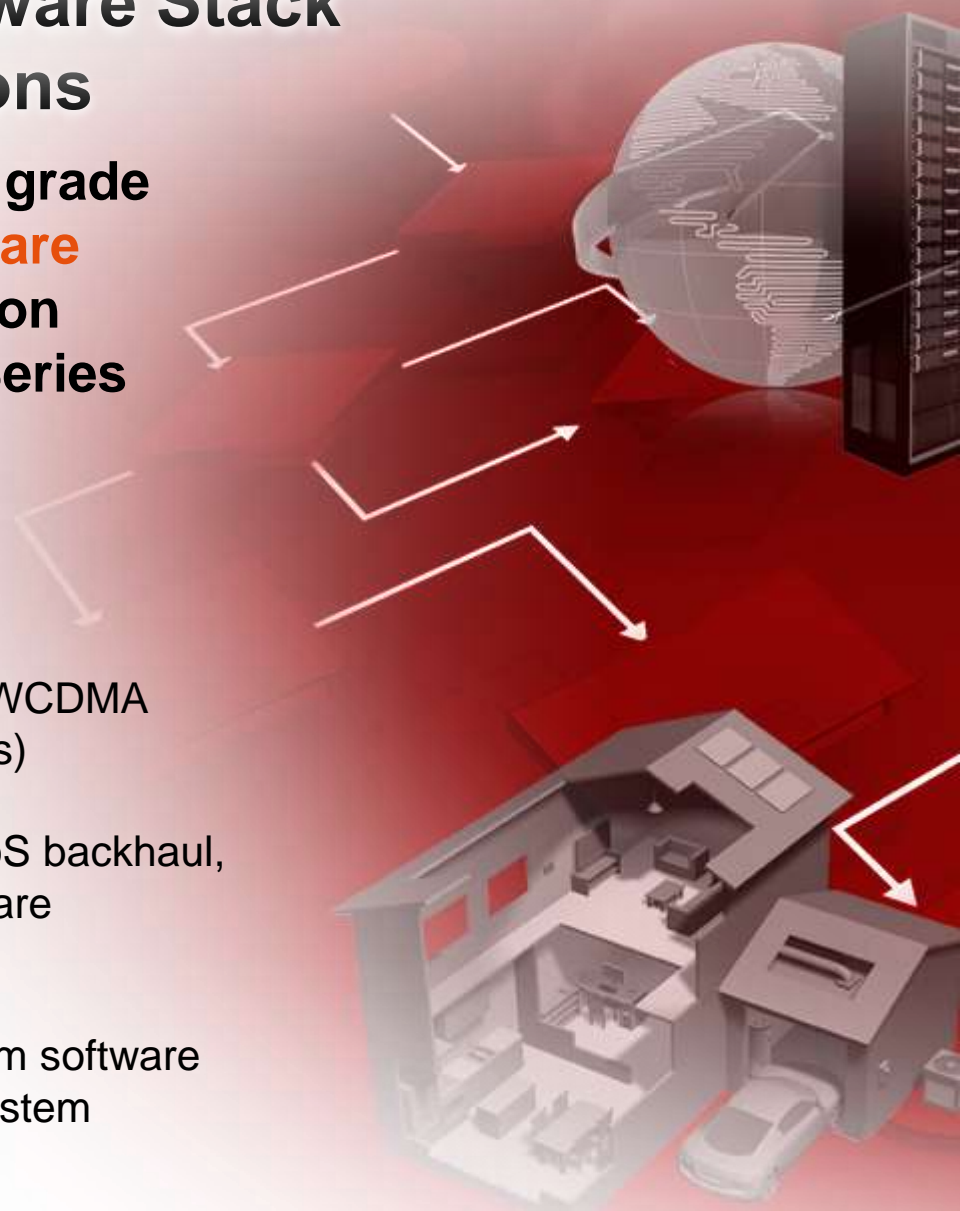
Virtual MPU Cores

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QorIQ Qonverge B4860 – Block Diagram & Benefits
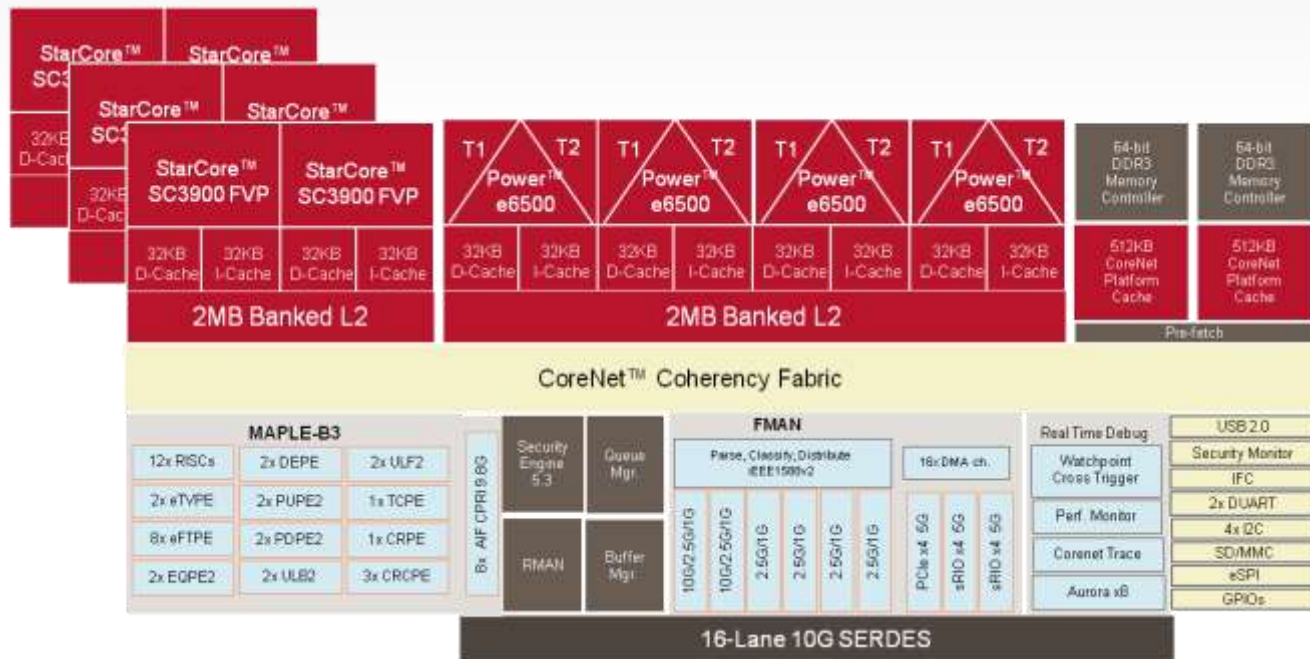
- **Next generation, e6500 Dual-Thread Power Architecture® cores offer highest CoreMark/Watt with AltiVec technology for dramatic L2 scheduling acceleration**
  - Next generation, SC3900 StarCore provides 2x DSP performance compared to competitive offerings
  - Above 21GHz of Programmable Performance
  - Smart hardware acceleration for Layer 1, 2, Control and Transport allows for best in class performance, power and cost
- **Large scale SoC integration allows for simpler programming models and easier load balancing**
- **Integrated, rich I/O including backhaul & antenna interfaces provides flexibility, interoperability and reduces overall system cost**

VortiQa LTE Layer 1 Software Stack for Small Cell Base Stations

- **A comprehensive, commercial grade L1, L2, L3 and Transport Software solution integrated and tested on BSC9131/2 and scalable to B-Series QorIQ Qonverge platforms**

  - LTE-FDD/TDD and WCDMA (HSPA+) L1 software (licensed by Freescale)

  - L2/L3 software for LTE-FDD/TDD and WCDMA (licensed by Aricent and CCPU/RadiSys)

  - Transport software, including IPsec, QoS backhaul, etc., through Freescale's VortiQa software (licensed by Freescale)

  - Development tools and operating system software (available through Freescale and ecosystem partners)

Digital Network

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  - #1 in the market
  - We work every day to move information quickly, protected and efficiently
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  - Comprehensive software support for the processor
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  - Ease of doing business with
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  - Sales/FAE support
  - Comprehensive Software support to take advantage of processor architecture
  - Documentation