POWERFUL QORIQ MULTICORE PROCESSORS FOR THE NEW VIRTUALIZED NETWORK

FRANCK ROUX
PRESENTATION : EUF-NET-T1744
22, MARCH, 2016

PUBLIC

SECURE CONNECTIONS
FOR A SMARTER WORLD

STRUCTURED FOR SUCCESS

Security & Connectivity

Best-in-class security, contactless performance and the most complete solutions to produce unmatched mobile and IoT solutions

Digital Networking

High-performance multicore solutions that transport, analyze and secure data from the edge of the network to the cloud

Automotive

Sensor and processing technology driving all aspects of the secure connected cars of today and the autonomous cars of tomorrow

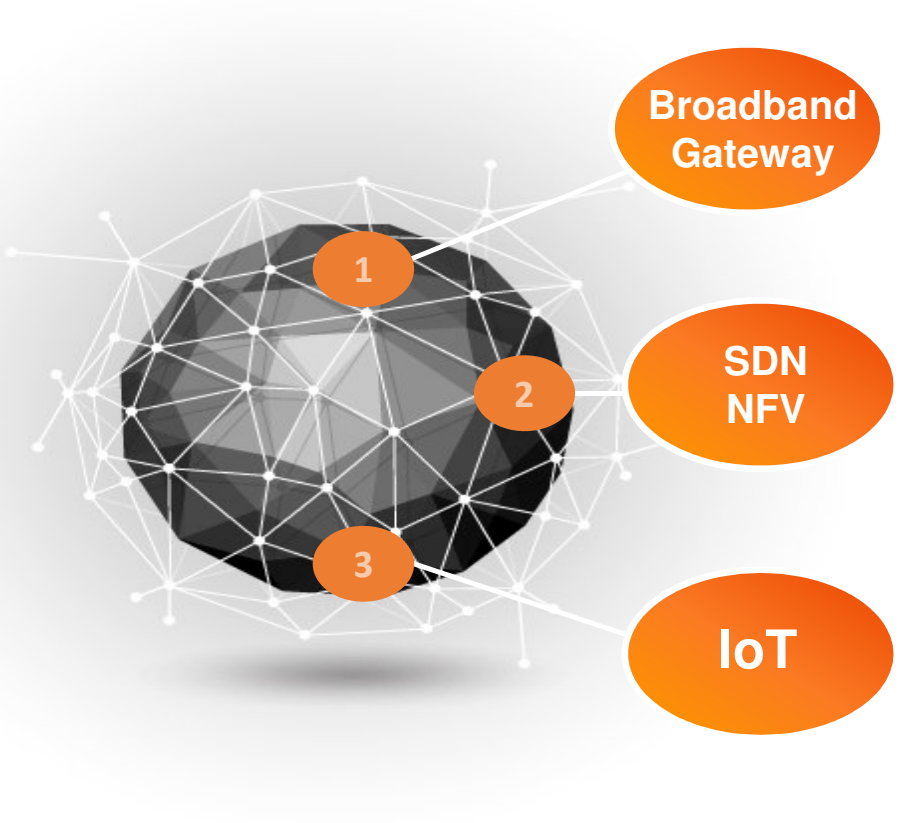
Standard Products

Leading supplier for all major automotive, identification, wireless infrastructure, industrial, mobile, lighting, consumer and computing manufacturers

RF

Solutions spanning the smartphone, wireless infrastructure, broadcast, medical, mobile radio, military, aviation, cooking and industrial markets

Solutions for Broadband Gateways, Home Networks, IoT



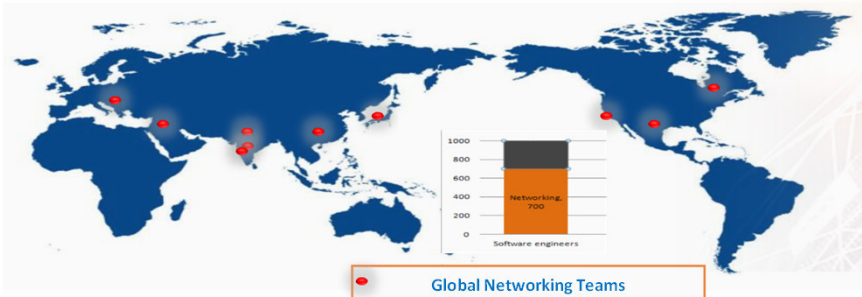
- Business and home gateways are **integral part** of NXP's **leadership position in networking**
- NXP has **strong installed base** of gateway solutions globally and builds **innovation driven solutions roadmap**

- The world's networks are **increasingly virtualized**, giving rise to **SDN** and other **software-based approaches** to network infrastructure
- Technology applied to current and roadmap solutions for vCPE

- The **Internet of Things** is dramatically growing the number of network endpoints, adding to the worldwide **flood of data** which must be **secured, analyzed and transported**
- NXP offering **industry's broadest portfolio** of solutions

Enabling Customers with Software & Solutions

- **Significant investment in Software R&D**
- **Broad range of software products**
- **Comprehensive HW+SW solutions for next generation networks**
- **Professional software services and support**
- **Active involvement and leadership in consortiums, industry forums and working groups, e.g. ONF, ETSI, LWG, InCNTRE**



Global Networking Teams
Total 700+ SW engineers

ETSI
Network Functions Virtualization
Software Defined Networking
Internet of Everything
ONF
OPEN NETWORKING FOUNDATION
InCNTRE
Linaro
OpenDataPlane .org
Chipmaker's Advisory Board
Founding Member

NXP DRIVING SDN AND NFV SOLUTIONS – ACCELERATING VIRTUALIZATION

Open Data Plane (ODP)

- Founder and contributor
- Cross-arch (ARM®/Power/X86/MIPS)

OPNFV Virtualization Layer

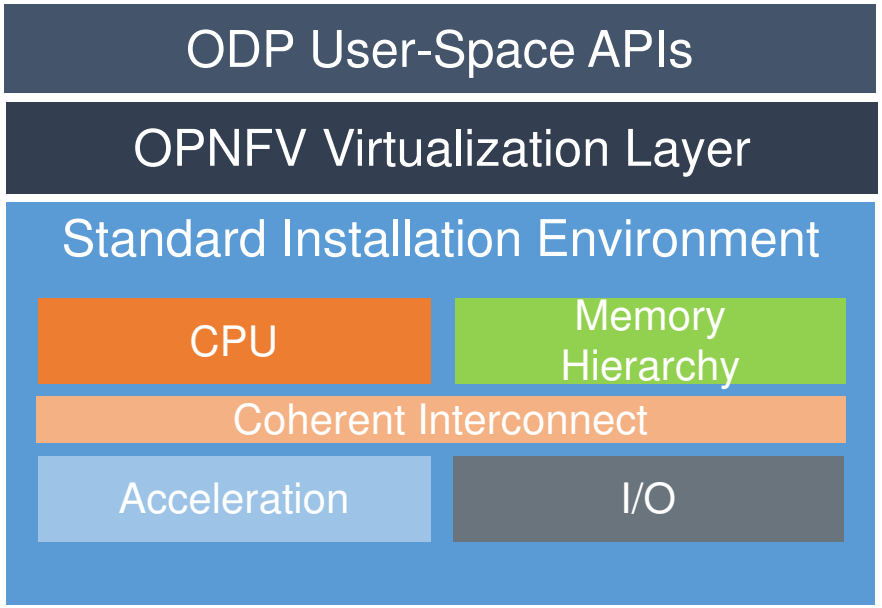
- Running on QorIQ processors
- Supporting accelerators

Installation Environment

- UEFI, ONIE, uboot

Driving Open Standards Bodies

- Linaro, ETSI NFV, OPNFV, ONF, Linux



Approach is Based on Open Ecosystem Building Blocks

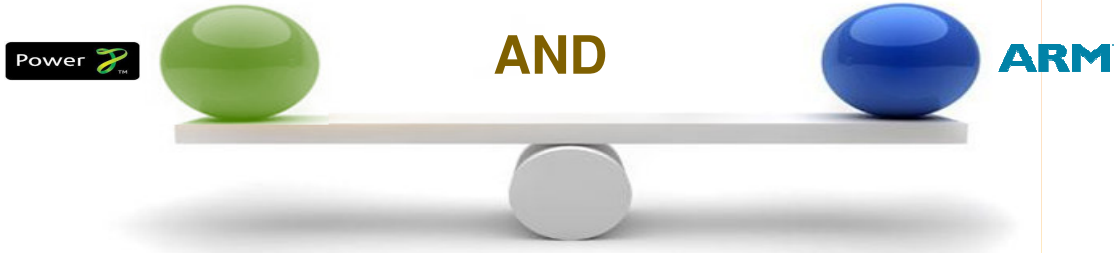
Power & ARM®: A Balanced Strategy for the Market

Continue to drive the "Core" - Power

1. #1 in wireless/wired networking
2. 9 of top 10 WLAN vendors
3. 30+ years of R&D leadership

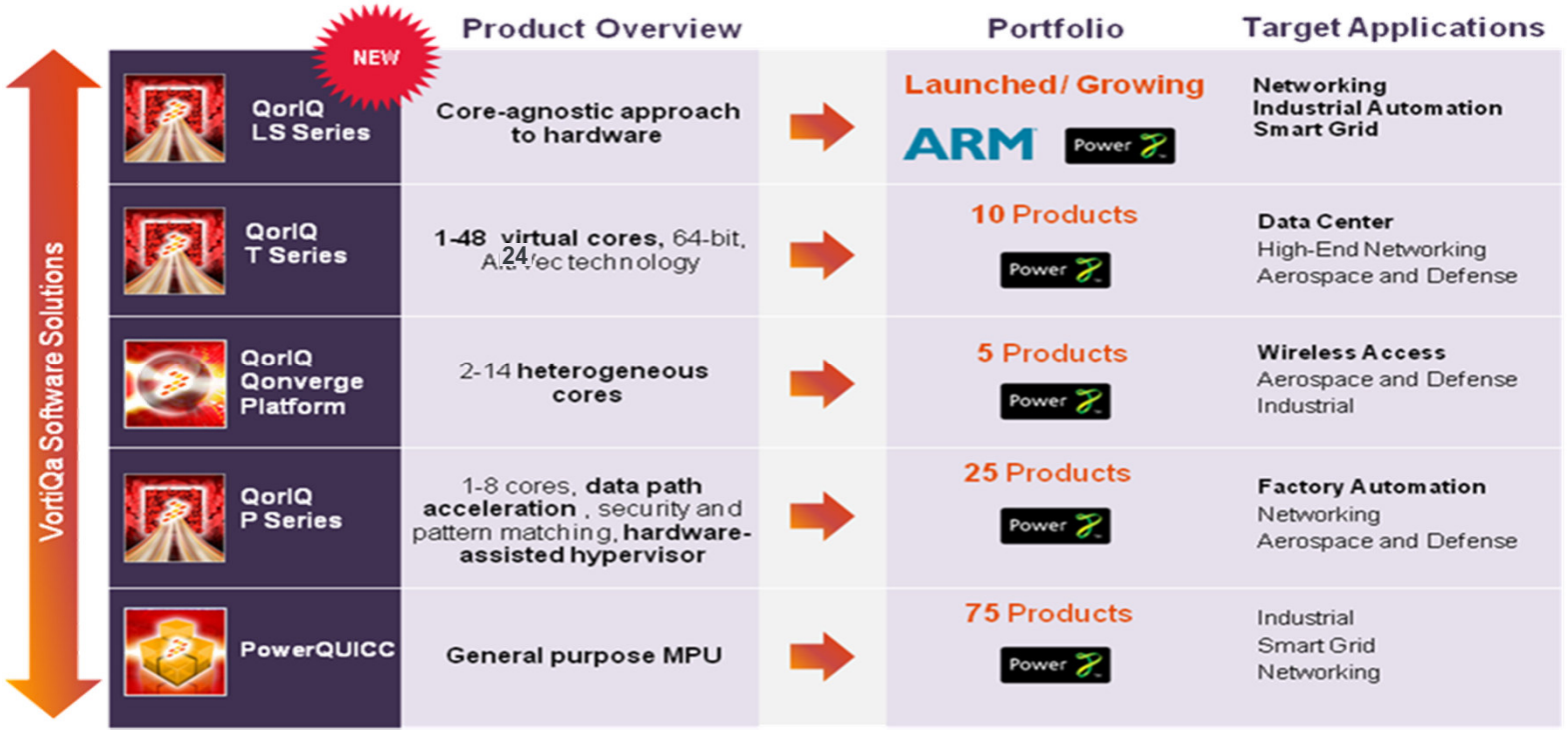
Broaden Market Reach– ARM Addition

1. First 64-bit ARM Networking SoC
2. Largest ARM portfolio for Networking
3. Auto, Consumer and Industrial
4. Utilize our communications. expertise

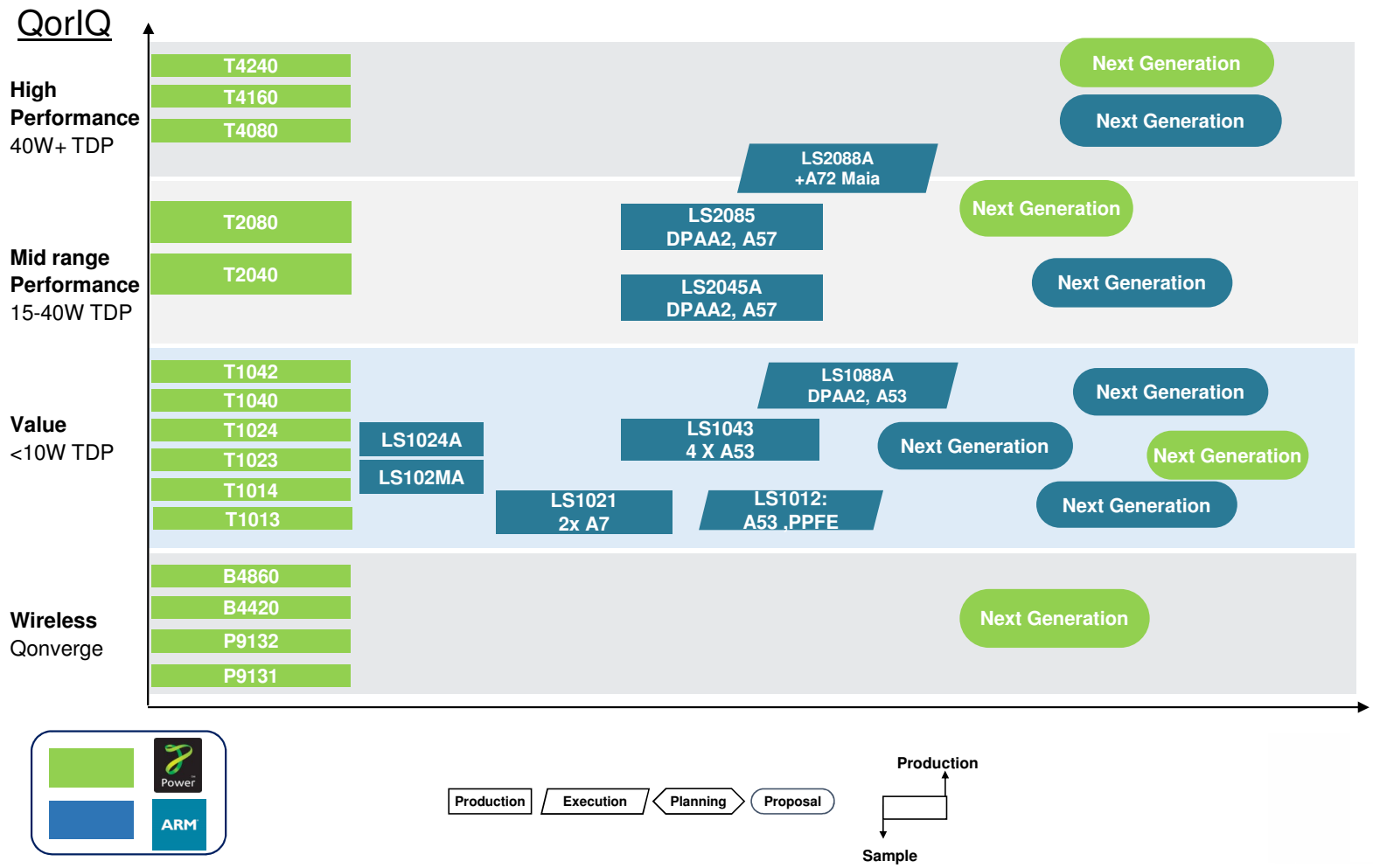


NXP has infrastructure in place to support both Power and ARM

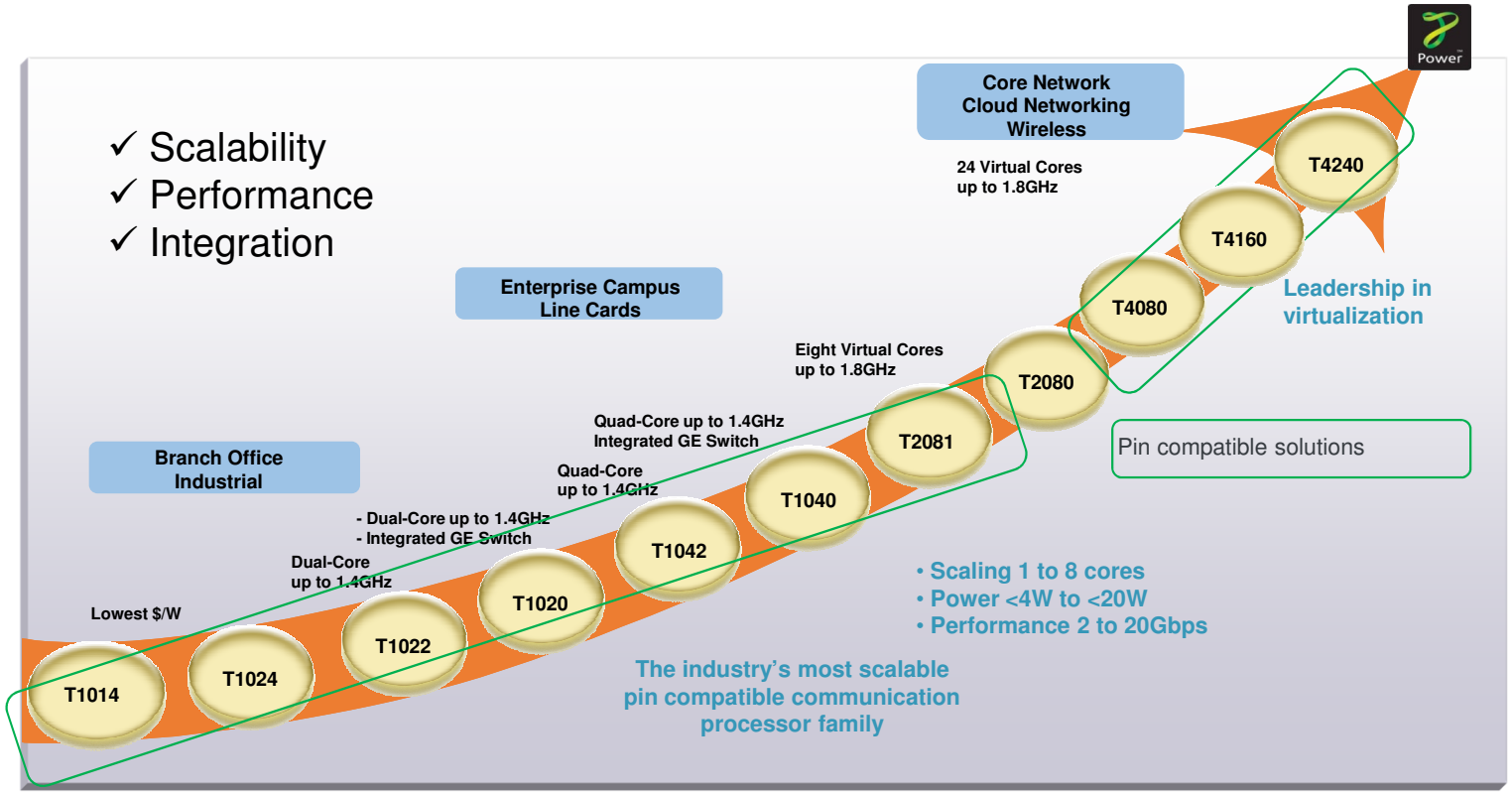
Broadest and Most Scalable Portfolio



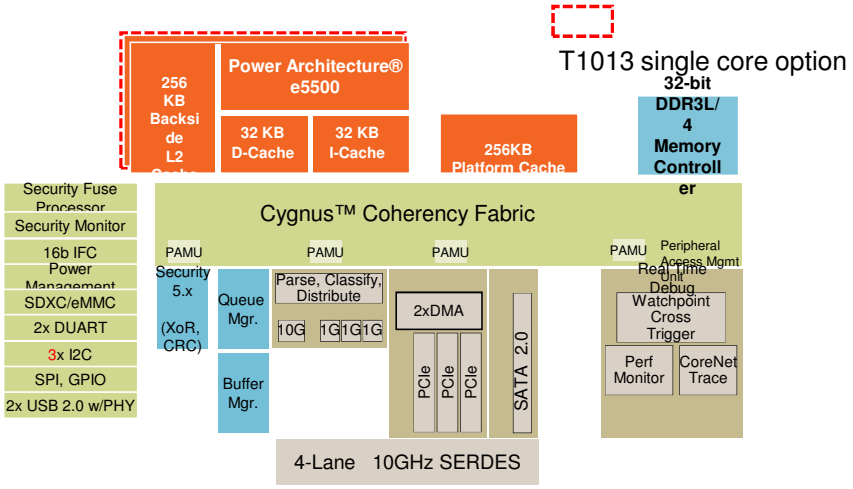
QorIQ Multicore Communications Processor Solution Roadmap



Continuing the Leadership: Power-based SoC Solutions



Leading Performance T1013/23 , Solution for Wifi EAP



Datapath Acceleration

- SEC- crypto acceleration
- Full MACsec/CAPWAP/DTLS offload for WLAN

Device

- 28HPM Process
- 525-pin LCFC package
- 19x19 mm, 0.8mm pitch

Power targets

- 3-4W Typical

Processor

- 1-2x e5500, 64b, up to 1.4GHz
- Each with 256 KB backside L2 cache
- 256KB Shared Platform Cache w/ECC
- Supports up to 64GB addressability (36 bit physical addressing)

Memory Subsystem

- 36/b DDR3L/4 Controller up to 1600MTs
  - 1300MTs in 1GHz version

Cygnus Switch Fabric

High Speed Serial IO

- 3x PCIe Gen2 Controllers
- 1x SATA 2.0, 3GB/s
- 2 USB 2.0 with PHY

Network IO

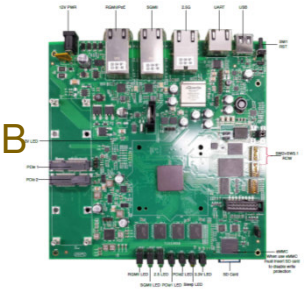
- FMan packet Parse/Classify/Distribute
- Lossless Flow Control, IEEE 1588
- 4x 10/100/1000 Ethernet Controllers
- 4x GbE or 3x GbE+ 1x 1, 2.5, 5, 10GbE or QSGMII
- MACsec on all ports

Green Energy Operation

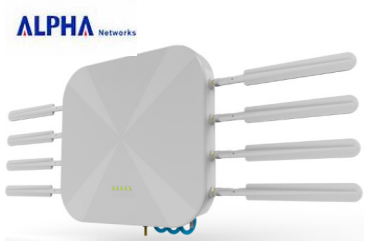
- Fanless operation dual-core 1.4GHz

T1 Reference Designs

T1024 RDB



T1023 RDB



T1023RDB-WLAN

Feature	T1024RDB	T1023RDB
Form Factor	1u Rack Mount	Mini ATX
Processor	T1024 to 1400MHz	T1023 to 1400MHz
PCIe	2x mini 1 lane , 1x Slot	2x 1 lane mini PCIe
Ethernet	2x RGMII, 1x 2.5G or 1x 1, 2.5 or 10GbE Copper	2x RGMII, 1x 2.5G
WLAN solutions	BROADCOM, Quantenna Communications, AQUANTIA, QUALCOMM, Celeno	
SATA	Yes 1 lane	No
USB	2x USB 2.0	2x USB 2.0
UART	x2	x2
TDM	Yes, via QE riser card	No
DDR	DDR3L 64b 2GB	DDR4 32b 2GB
Boot	NOR	NAND
JTAG	Yes	Yes
Board files & BOM	Yes	Yes

T1040 Target Markets, Key Features

Enterprise Routers/Switches

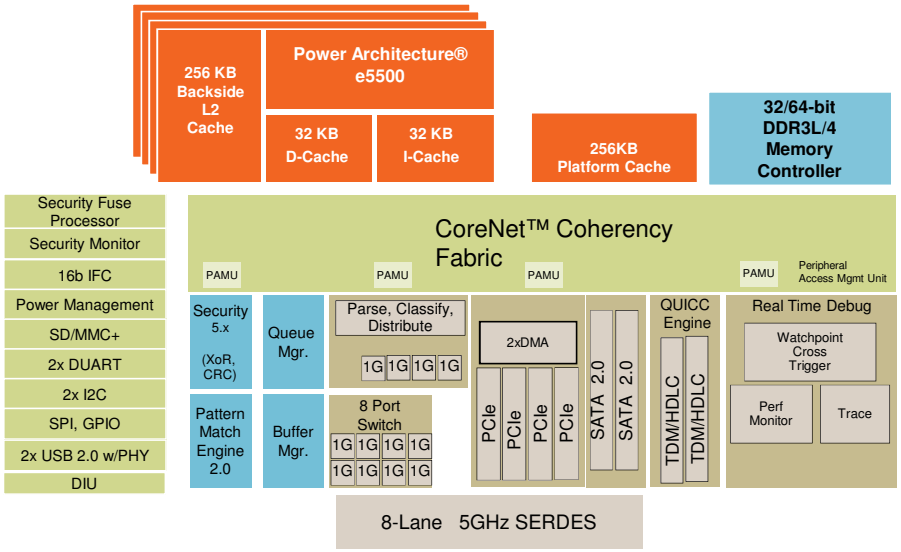
Industrial Computing and Networking

UTM Security Appliances

The T1040 embedded processor are architected to provide maximum performance per watt

- Highest performance CPU cores in a power envelope
- Integration multilayer Gigabit Ethernet switch to reduce system cost and design complexity.
- Offload engines – Encryption/ Decryption for high performance security
- Deep packet inspection offload engine enabling UTM services.
- DPAA – for QoS and balanced networking performance
- Virtualization to support customers and 3rd party software
- Small form factor, fanless and convection cooled designs

T1040



Device

- 28HPM Process
- 780-pin LCFC package
- 23x23mm, 0.8mm pitch

Power targets

- Enable Convection cooled system design

Datapath Acceleration

- SEC- crypto acceleration
- PME- Reg-ex Pattern Matcher

Processor

- 4x e5500, 64b, up to 1.4GHz
- Each with 256KB backside L2 cache
- 256KB Shared Platform Cache w/ECC
- Supports up to 64GB addressability (36 bit physical addressing)

Memory SubSystem

- 32/64b DDR3L/4 Controller up to 1600MHz

Cygnus Switch Fabric

High Speed Serial IO

- 4x PCIe Gen2 Controllers
- 2x SATA 2.0, 3Gb/s
- 2x USB 2.0 with PHY

Network IO

- FMan packet Parse/Classify/Distribute
- Lossless Flow Control, IEEE 1588
- Up to 4x 10/100/1000 Ethernet Controllers
- **8-Port Gigabit Ethernet Switch**
- QUICC Engine
  - HDLC, 2x TDM

Green Energy Operation

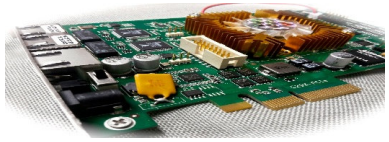
- Fanless operation quad-core 1.2GHz
- Packet lossless deepsleep
  - Programmable wake-on-packet
  - Wake-on-timer/GPIO/USB/IRQ

T Series Offers True Performance Scalability
T2080, T4080, T4160 and T4240

	T2080	T4080	T4160	T4240
CPU (64b)	e6500			
Cores (threads)	4 (8)		8 (16)	12 (24)
CPU Frequency	1.8 GHz	1.67 GHz	1.8 GHz	
L2 Cache per core	512KB			
Platform Cache	512KB	1MB		1.5MB
DRAM Interface	1x DDR 3/3L	2x DDR 3/3L		3x DDR 3/3L
CoreMark		58,545	126,432	187,874
IPFwding perf (small pkt)	24Gbps		36Gpbs	48Gbps
IPSec perf (large pkt)	14Gbps	32Gpbs		32Gbps
Max # Ethernet	4x 1/10GE + 4x 1GE	2x 1/10 GE + 12x 1GE		4x 1/10GE + 12x 1GE
PCIe	4x PCIe: Gen 2.0/3.0	3x PCIe: Gen 2.0/3.0		4x PCIe: Gen 2.0/3.0
Power (typ 65C) at Fmin	11W-1.2GHz	19W-1.5GHz	24W-1.5GHz	28W-1.5GHz
Pin Compatibility	25x25 mm 896p FCBGA	45x45mm 1932-pin FCBGA		

-NXP T2/T4 iNIC boards

-C29x Crypto Coprocessor
Public/Private Key Management Acceleration



Dev board shown, ODM production board available

-NXP VortiQa software enables value added appliance functionality in TOR switch platform

Security Firewall

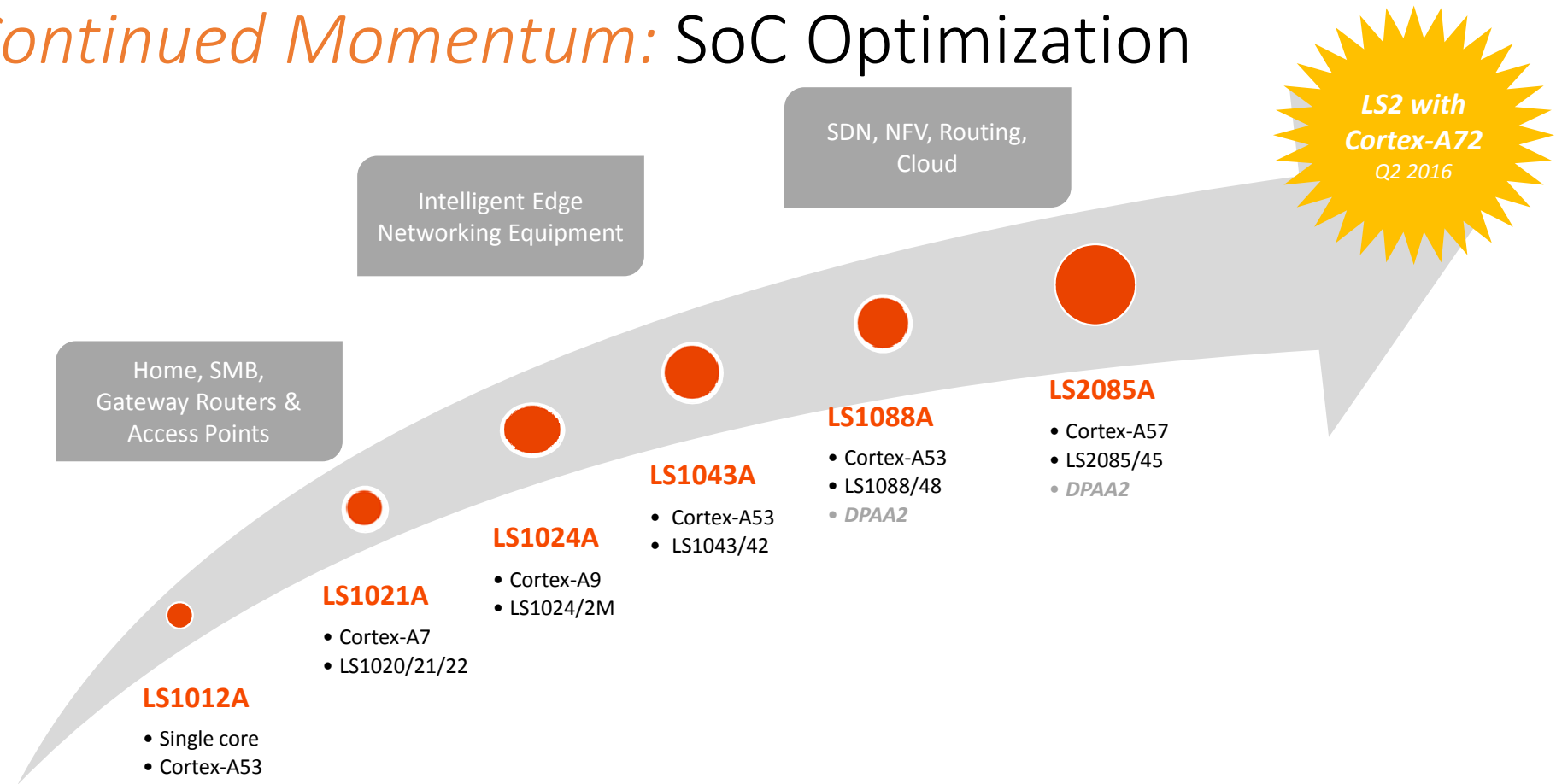
Application Identification Service

ADC/Load Balancer

Value added network services hosted on integrated QorIQ multicore communications processor

10 Gbps Services Throughput

Continued Momentum: SoC Optimization



First to announce the extremely low-power Cortex®-A72 core in a networking processor

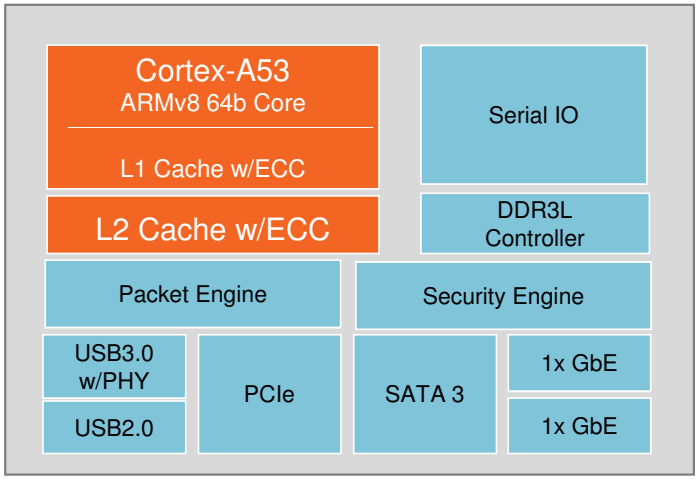
LS1012A Differentiated Features & Target Applications

Performance tarts with the Core

- First 64-bit ARM® Cortex® -A53 core to be offered in a **sub- 10x10 mm** package, delivering over **2,000 CoreMark®** of performance at **1W (typical)** for outstanding performance at exceptionally low power utilization
- **Best in class** 2.5 CoreMark / mW ratio

Broadest range of peripheral and I/O features in the sub-$10 ASP price range

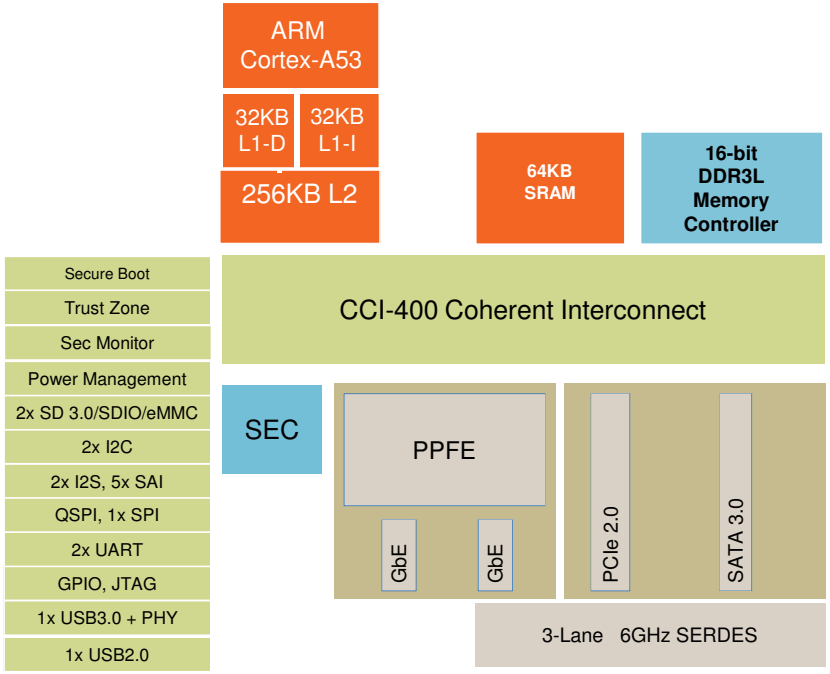
- Only product in its class to offer **Packet Acceleration** for **IP forwarding and NAS,** delivering outstanding packet throughput for this power/package envelope
- **Trust and Security acceleration** enables root of trust and high performance encryption consistent with much higher cost microprocessors
- **First in its class** to offer 64-bit support for **battery powered** mobile applications and **performance efficiency**
- Only 1W 64-bit processor to combine **USB 3.0 with integrated PHY, PCIe, 2.5 Gigabit Ethernet and SATA3 on a single SoC** to enable lower system-level costs
- Enables **low-cost, 4-layer board** level designs together with **high system level integration** to support ultra-small form factor systems



LS1012A Target Applications
Consumer NAS
Value tier IOT gateway
Battery Powered Mobile NAS
Entry BB Ethernet Gateway
Trusted Gateway
Industrial Automation & Control
Building Control systems
Ethernet Drives
Networked Audio

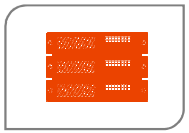
LS1012A Block Diagram

- Single ARMv8 64-bit Cortex® -A53 processor
  - 1840 DMIPS / 2240 Coremark @ 800MHz
  - NEON Co-processor and DP FPU
  - 256 KB L2 cache with ECC
- Memory Controller
  - DDR3L up to 1000 MHz
  - 16-bit data bus, 1 chip select
- High Speed Interconnect
  - 1x PCI Express Gen2
  - 1x SATA Gen3
  - 1x USB 3.0 w/PHY
  - 1x USB 2.0 w/ULPI
- Ethernet Packet Accelerator
  - 2x GbE (2.5G or 1G)
- Datapath
  - Packet Acceleration Engine (PPFE)
  - Security acceleration engine (SEC)
- 2x SD 3.0/SDIO/eMMC
- QSPI, 1x SPI, 2x UART, 2x I2C
- 2x I2S, 5x SAI
- Secure Boot, Trust Architecture, ARM® TrustZone
- Advanced Power Management
- Package: 9.6x9.6mm, routable in 4-layers



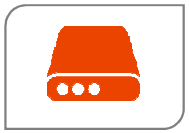
Samples	Production
April-2016	Q4-2016

Scalable LS1 Portfolio for Broad Range of Applications
Reaching New Applications Developers



Enterprise Networking
- High-speed interfaces
- Security engine
- ECC-protected caches

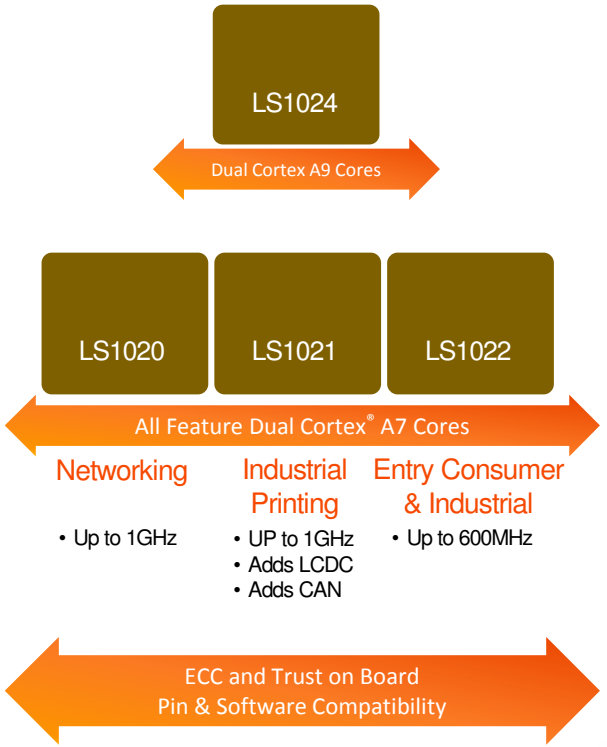
Industrial Automation and Control
- Industrial interfaces
- LCD for HMI support
- Industrial protocol support



IoT Gateways
- Multi-protocol support
- High-bandwidth LAN/ WAN support

Digital Home
- Acceleration engines
- High-bandwidth LAN/ WAN support

The LS1 processor family extends NXP market leadership



LS102x Family - Differentiated Features

Performance starts with the core

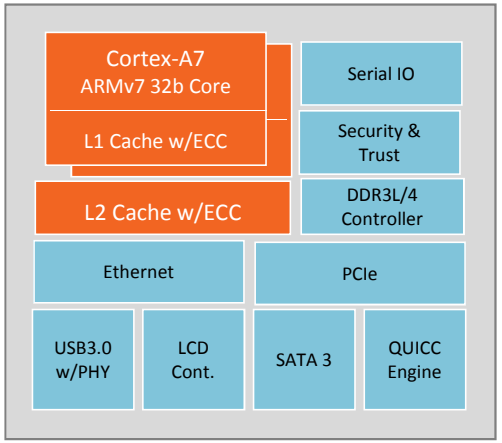
- Dual ARM® Cortex® -A7 cores delivering **over 6,000 CoreMark®** of performance at under **3W (typical)** for improved performance without increased power utilization

Defense-in-depth security protection

- **Secure boot**, ARM **TrustZone** and manufacturing protection

Broadest range of peripheral and I/O features in its class

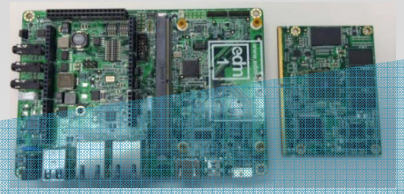
- Only product in its class to offer **ECC protection** for both **L1/L2 caches**, meeting networking requirements for **high reliability**
- **Virtualization support** enables partitioning of CPU resources on low-power parts for increased system productivity
- **First in its class** to offer support for **DDR4** memory ensuring continued **performance efficiency**
- Only communications processor to combine **LCD controller, USB 3.0 with integrated PHY, SD /MMC and SATA3 on a single SoC** to enable lower system-level costs
- **QUICC Engine** provides **proven support** for protocols required in industrial, building and factory automation applications



LS102x Target Applications
Multi-service IoT Gateway
Industrial automation & control
Point of Sale terminals
ATM Machines
Secure Access Point
Hot Spots
Management processor
Smart Energy Gateway
Robotics

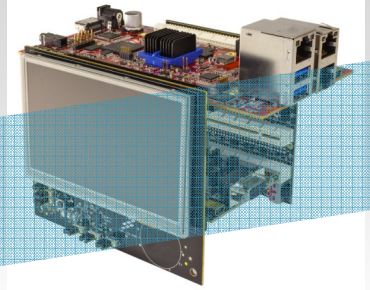
LS1021A ARM® Enablement Platforms

Potion board Platform



- **Low-cost, highly integrated HW/SW solution** for IoT developer communities
- Support **Arduino** modules, and **HDMI** displays
- **Available in August-2015**
- **Starting at $115**

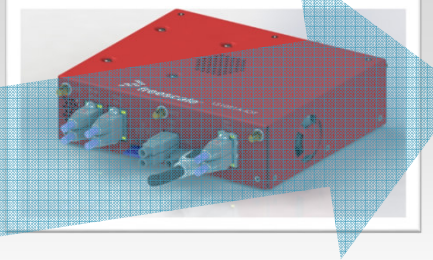
Tower-based Development Platform



THE TOWER SYSTEM

- **Rapid prototyping platform** for Industrial applications
- **Modular design** supports a range of connectivity options
- **Cost-effective**, open source development platform
- Designed to **simplify product evaluation**
- **$269 USD - Available NOW**

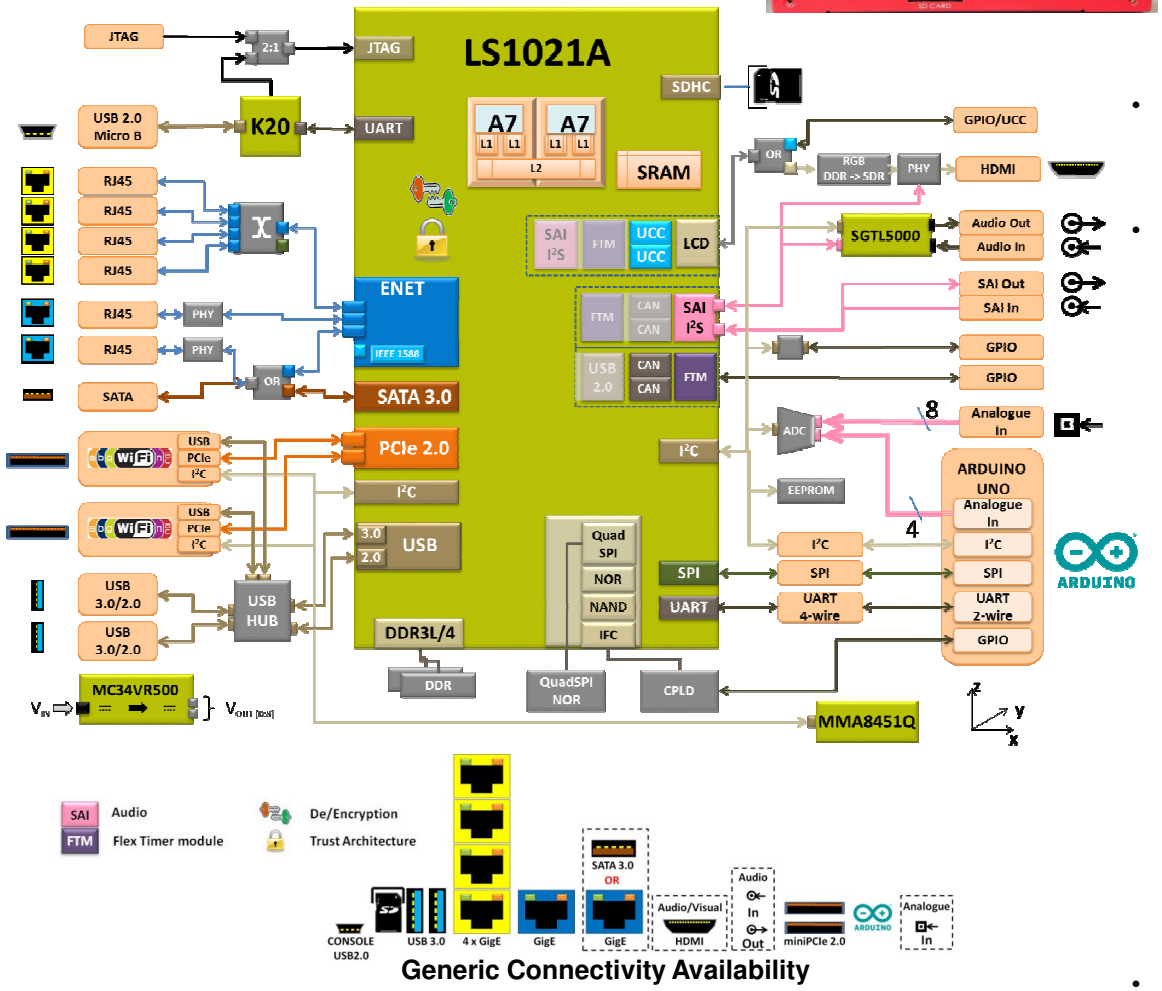
IoT Gateway Reference Design



- **Multi-protocol support** for IoT devices
- Support **Arduino** modules, and **HDMI** displays
- **High speed WAN / LAN** for Cloud connectivity
- **Cost-effective**, open source development platform
- Designed to **accelerate time to market**
- **$429 USD - Available NOW**

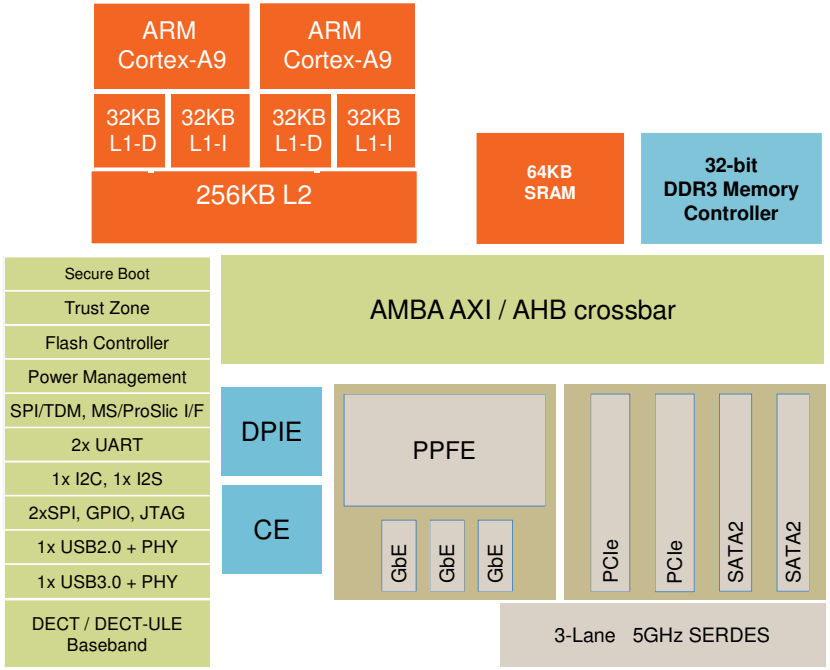
Features and Capabilities

LS1021A IoT Base Board



- **Memory**
  - DDR3L 1GB
  - QuadSPI NOR Flash 128MB
- **Connections**
  - Up to 2 x RJ45 GigE direct connect
  - 4 x RJ45 GigE Switched
  - Up to 1 SATA
  - 2 x USB 3.0
  - 2 x mini PCIe (USB, I²C, PCIe)
  - Up to one display (LCD) via HDMI
  - Audio
    - OUT via HDMI or Jack
    - In via Jack
  - Console port/JTAG via USB 2.0
  - GPIO
  - GPIO or FTM
  - LCD or UCCs or GPIO
  - Analogue inputs [8]
  - Arduino connectors
    - Analogue, inputs [4], I2C, SPI, UART (2-wire) and GPIO
- **Accelerometer**
  - MMA851Q

LS1024A Block Diagram



Datapath Acceleration

- **CE** - crypto acceleration
- **PPFE** - Programmable Packet Forwarding Engine
- **DPIE** – Deep Packet Inspection Engine

General Purpose Processing

- 2 x ARM® A9 CPUs, up to 1.2GHz
  - 256KB L2 cache
- Neon SIMD & FPU in all CPUs
- 16/32b DDR3 with ECC up to 1066MT/s

Accelerated Packet Processing

- 2Gbps PPPoE/NAT routing with 64B packets
- 2Gbps crypto acceleration
- Deep Packet Inspection Engine
  - Antivirus
  - Application-specific QoS
  - Advanced Diagnostics

DECT

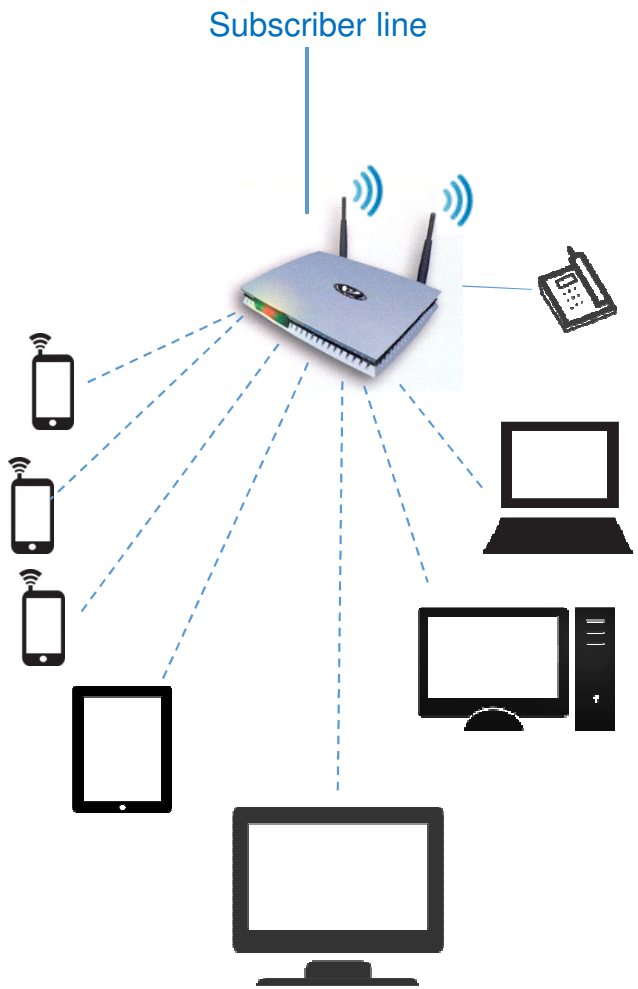
- Integrated DECT and DECT-ULE baseband processor

High-speed Interfaces

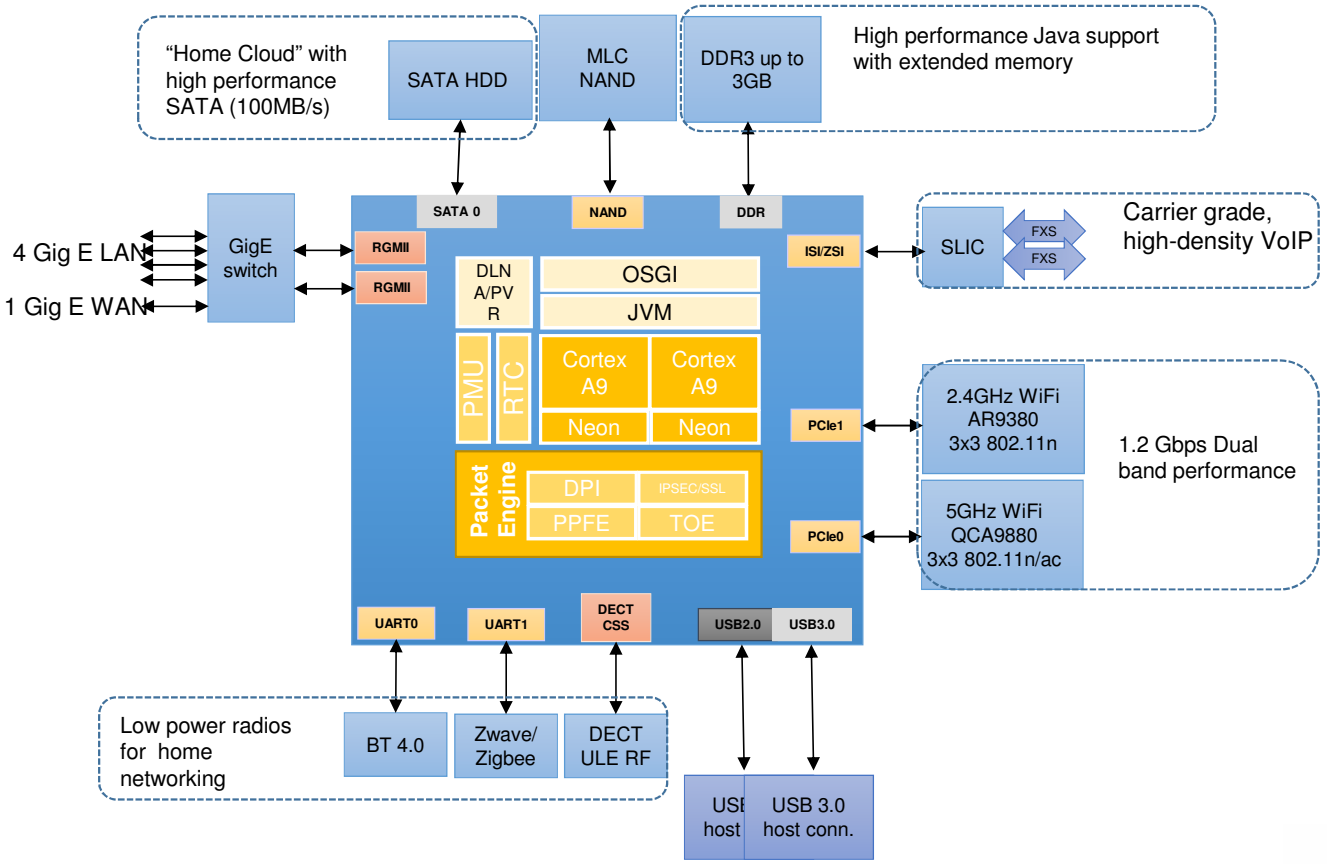
- 2x PCIe 2.0, 1 lane each
- 2x SATA 2.0 with RAID 0/1/5
- 1x USB 3.0 with PHY
- 1x USB 2.0 (Host/Device) with PHY
- 3x GbE (3x RGMII or 2x RGMII and 1x SGMII)

Gateway Market Vision

- Residential Customers demanding ever **higher bandwidth**
- Support for **latest WiFi formats** and data-rates is critical
- Video moving to OTT / IP delivery
- Video playback on **multiple device formats** around the home:
  - Smartphone, tablet, smart TV, PC
- UHDTV is coming, managing **bandwidth & QoS** will be challenging
- Set-Top-Box will be replaced by **headless gateway** with **wireless distribution** of content in the home
- Potential impact of **SDN**…



Example Modular Gateway Solution based on LS1024A



LS1024A Application Performance

WAN -LAN: IP Forward/NAT routing

Frame size (B)	Bi-dir throughput (IPv4) - Mbps	CPU utilization	Bi-dir throughput (IPv6) - Mbps	CPU utilization
64	2000	<2%	2000	<2%
128	2000	<2%	2000	<2%
256	2000	<2%	2000	<2%
512	2000	<2%	2000	<2%
1024	2000	<2%	2000	<2%
1280	2000	<2%	2000	<2%
1518	2000	<2%	2000	<2%

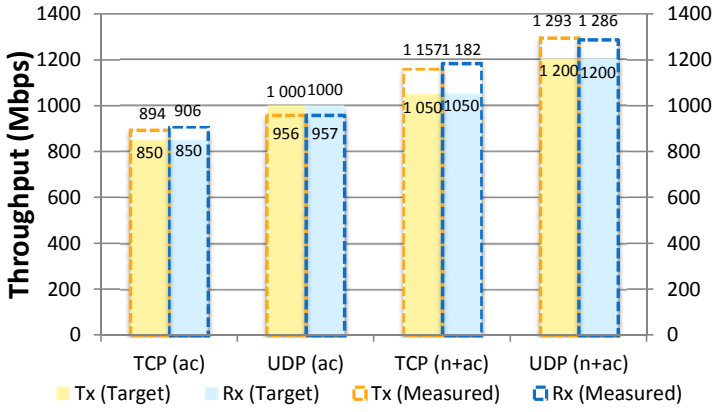
Security Applications (3DES/SHA1)

Frame size (B)	Bi-dir throughput (IPv4) - Mbps	CPU utilization	Bi-dir throughput (IPv6) - Mbps	CPU utilization
256	2000	<2%	2000	<2%
[illegible]	2000	<2%	2000	<2%
[illegible]	2000	<2%	2000	<2%
[illegible]	2000	<2%	2000	<2%
[illegible]	2000	<2%	2000	<2%

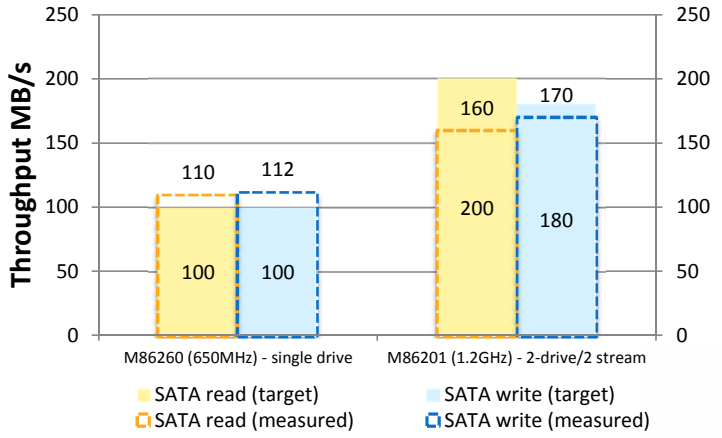
Line Rate performance with little or no CPU load on the A9

Concurrent 200Mbps of DPI upto L7

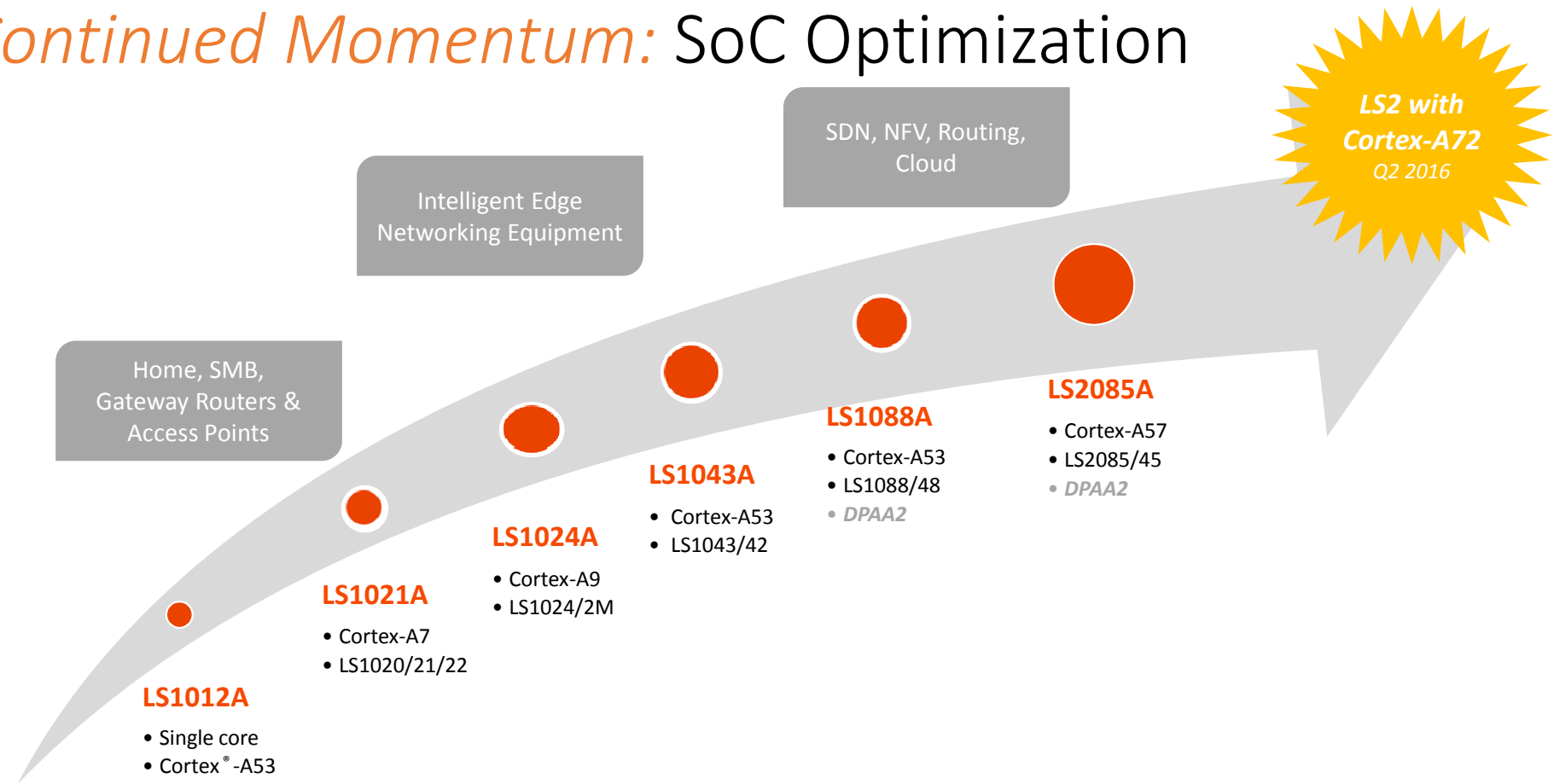
WLAN to Ethernet



CNAS: SAMBA Read/Write



Continued Momentum: SoC Optimization

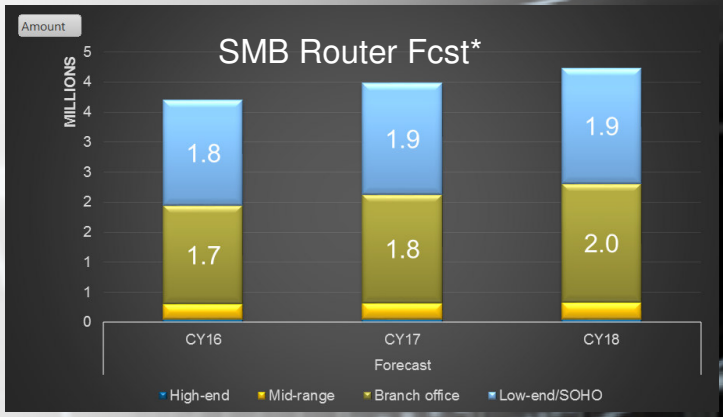


First to announce the extremely low-power Cortex® -A72 core in a networking processor

vCPE Routers – Enabling the Intelligent Edge

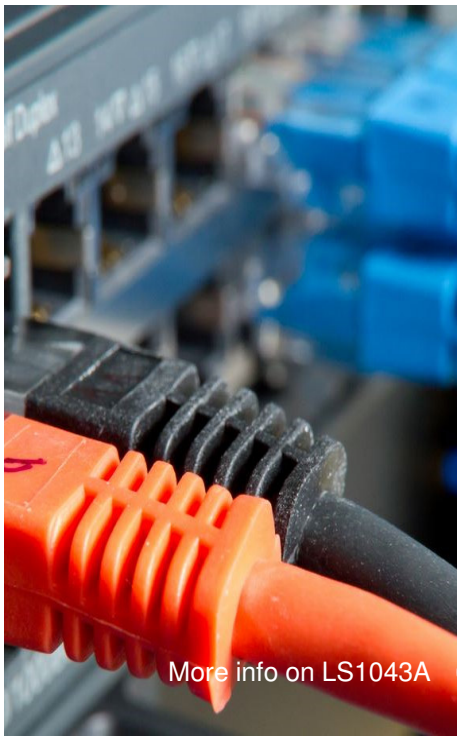
Next-gen Edge Platforms must:

- Support multiple wired & wireless access technologies
- Deliver secure, high-speed communications
- Scale software across logical & physical processing resources
- Authenticate new services & updates
- Offload key tasks for best performance/watt
  - Example: 5-tuple parse, tunneling, en/decryption, flow tracking, frag/reassembly, QoS, TM



* Infonetics Q3 2014

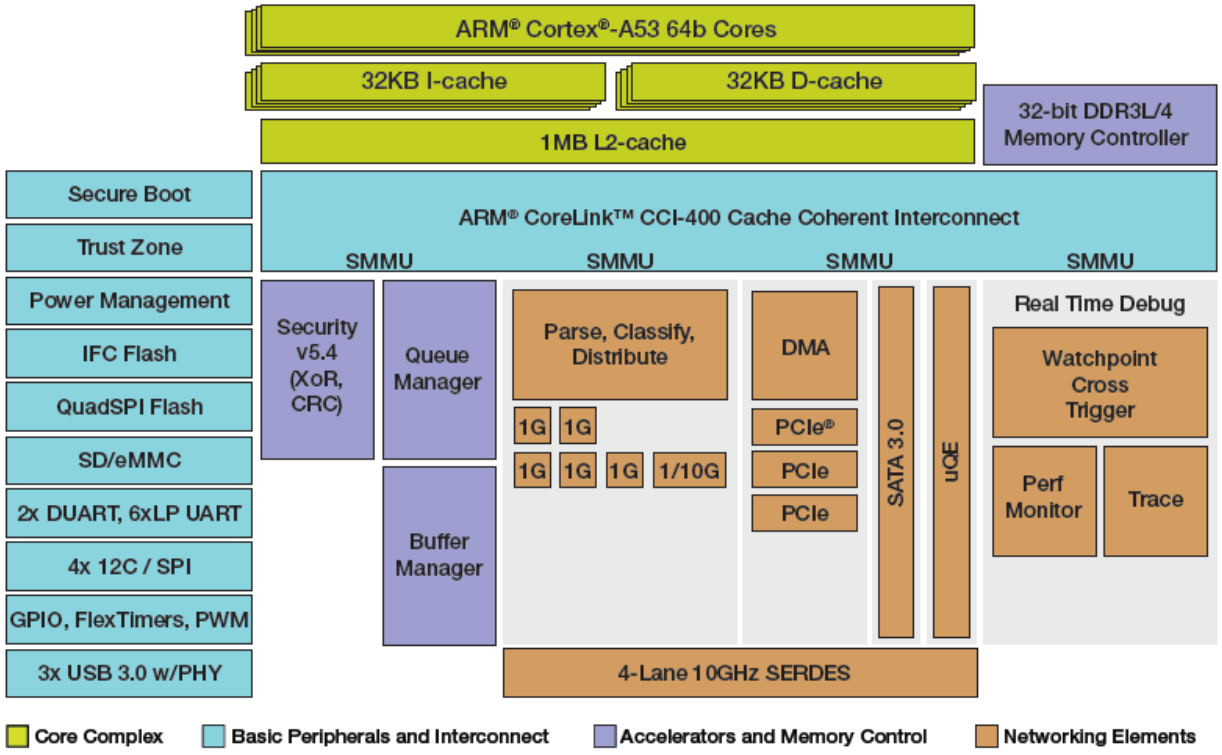
QorIQ LS1043A Processor



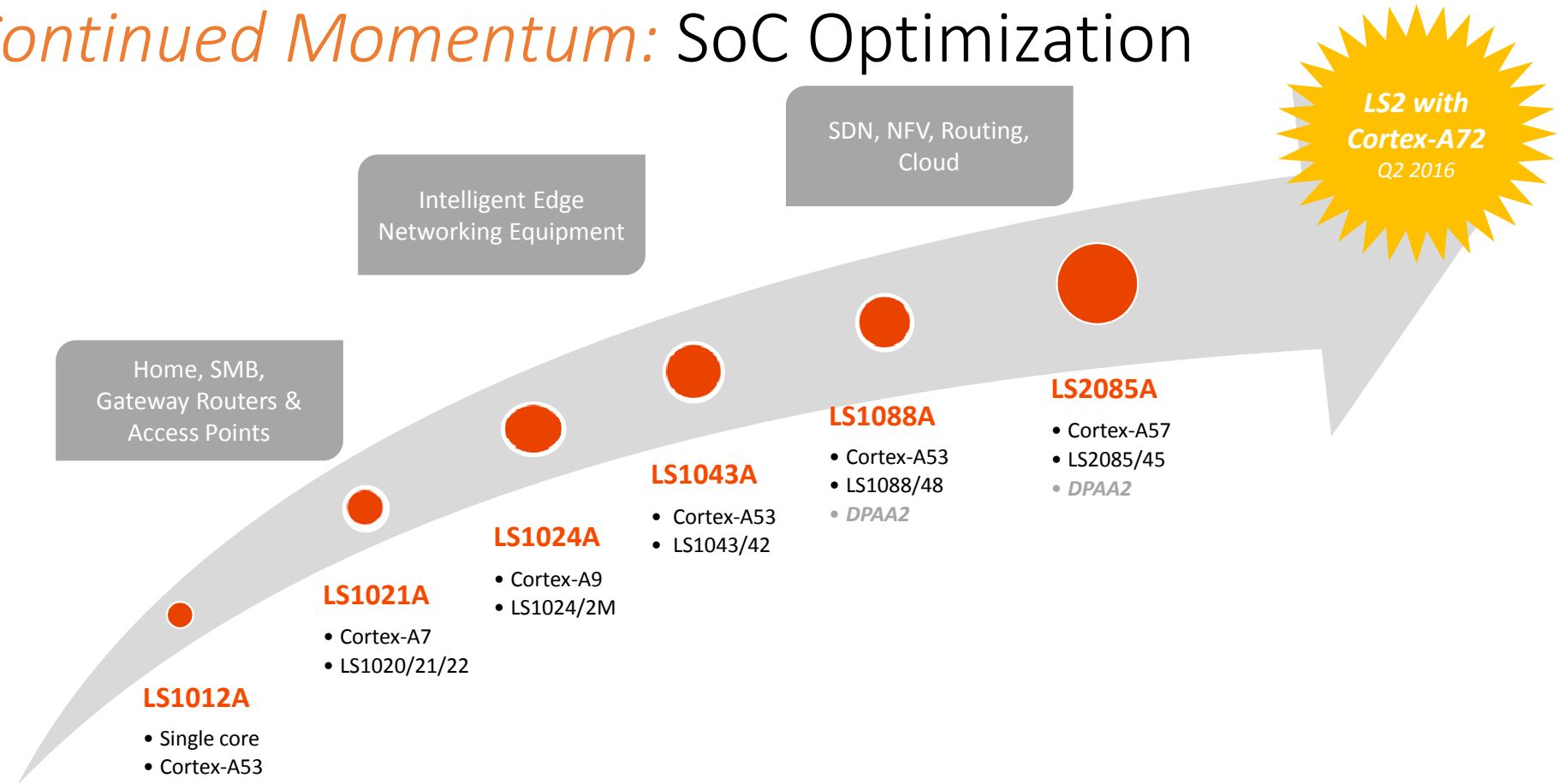
The industry's most efficient
64-bit communications processor based on
ARM® technology targeting vCPE applications

- **Targeted performance and power efficiency**
  - 4x ARM® Cortex®-A53 cores, estimated over 16,0000 CoreMarks
  - Leading packet processing offload technology: greater than 10 Gbps performance
  - Low power to 6 W
- **Purpose-built for fanless, small form factor networking applications**
  - Integrated services branch routers, SDN & NFV edge platforms, industrial PLC and control, security appliances
  - High level of integration for low Bill of Materials
- **Simplified, adaptable edge presence for reduced opex**
  - Evolves with virtualized services, OVS, NFV services platform
  - Offloads advanced and latency sensitive applications such as application ID, QoS & security
  - Secure software updates with advanced virtualization hardware

QorIQ LS1043A – Efficient Cores with Optimized Features

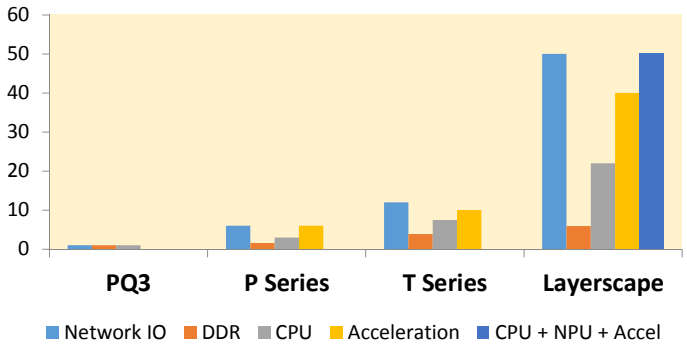


Continued Momentum: SoC Optimization



First to announce the extremely low-power Cortex® -A72 core in a networking processor

DPAA2.0: A New Architecture for a New Network



Many-core processor approach is not sustainable due to power, software complexity and integration costs

Need to provide right mix of high performance and programmability

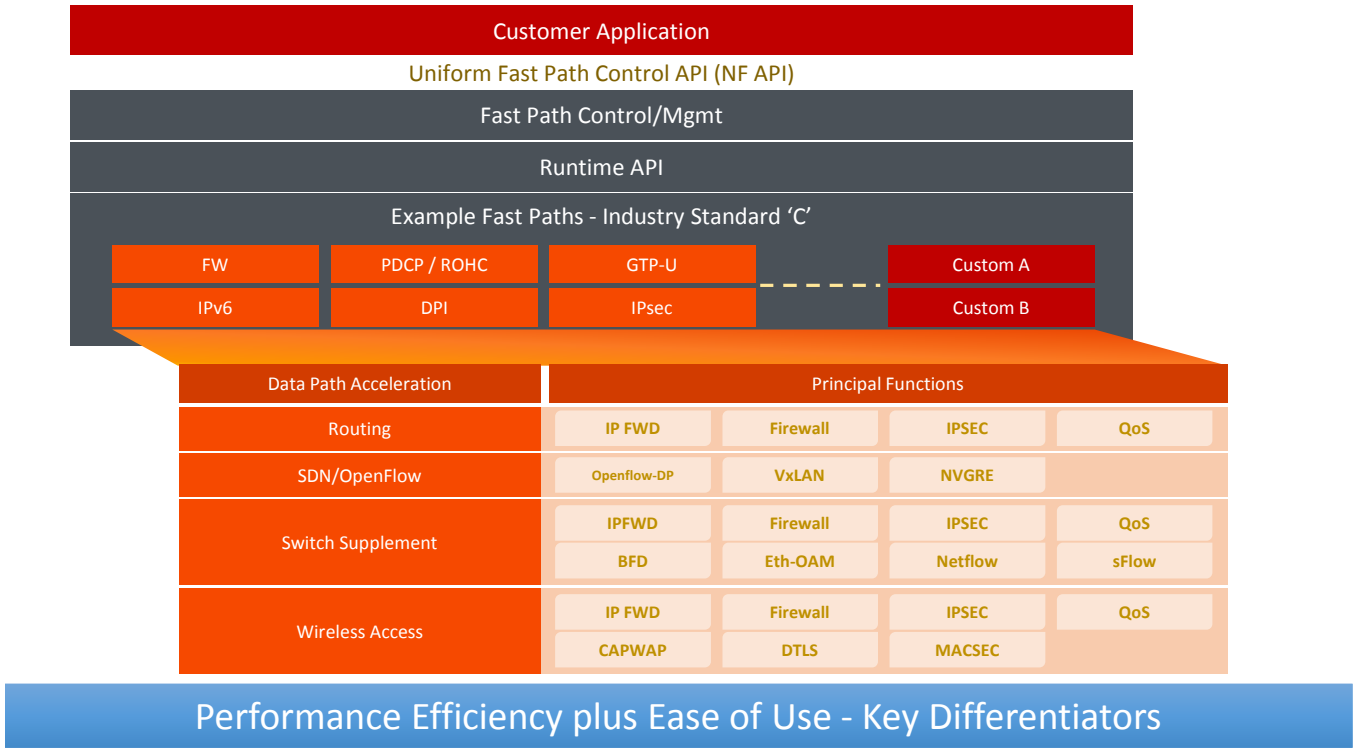
MUST HAVE:

Advance Packet Processing

- Tightly coupled accelerators called as C functions
- H/W preloaded task state, headers, stack frame
- Customer programmable
- Run-to-completion model using standard C (C99)

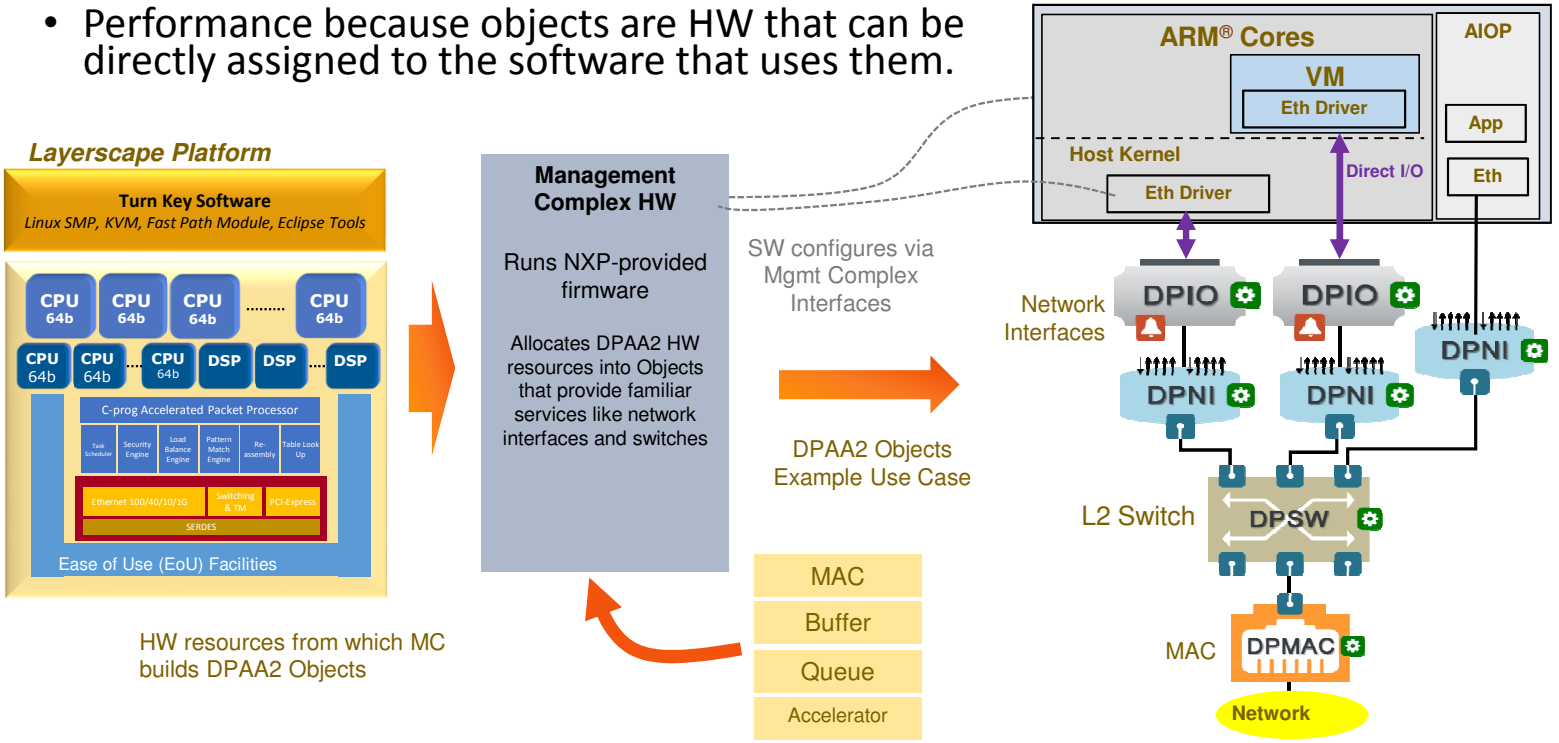
3-4x Performance
over general purpose cores
in a lower power envelope

QorIQ processors: Ease of Use Software Toolkit



Hardware Abstraction: Software Developer's View

- Ease of use through DPAA2 Object Abstraction
- Performance because objects are HW that can be directly assigned to the software that uses them.



Introducing the QorIQ LS1088A Processor

Bringing datapath acceleration
***to the* NETWORK EDGE**

QorIQ LS1048A and LS1088A Processors
Target Applications & Key Features

Intelligent Edge Access

NFV Solutions Virtual CPE

Industrial Control

Intelligent NIC

Performance optimized cores with leading power consciousness

- 8x ARM® Cortex® -A53 cores, 1.5 GHz, 2 MB L2 cache, w Neon SIMD
- DDR4 SDRAM support

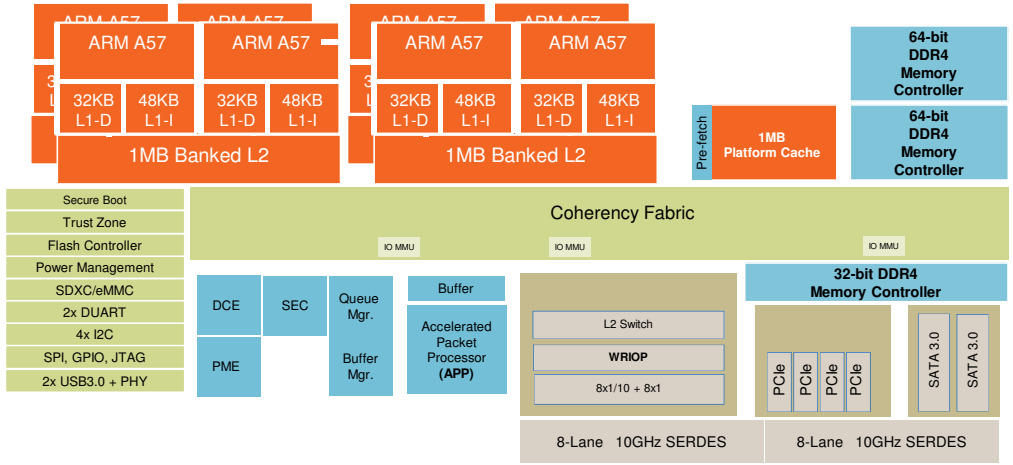
Delivers needed datapath offload with software developers in mind

- New datapath hardware and abstracted acceleration that is called via standard Linux objects
- 10 Gbps Packet processing performance with security acceleration

Leading network I/O integration

- 2x10Gb Ethernet and 8x 1GB Ethernet
- PCIe Gen3, Sata3, USB3
- TDM/HDLC support

Industry's Leading ARM® -64bit Networking Solution: LS2085A



Other Parametrics

- 37.5x37.5 Flipchip
- 1mm Pitch
- 1292pins

Datapath Acceleration

- **SEC**- crypto acceleration
- **DCE** - Data Compression Engine
- **PME** – Pattern Matching Engine

General Purpose Processing Layer

- 8x ARM A57 CPUs, 64b, 2.0GHz
  - 4MB Banked L2 cache
- HW L1 & L2 Prefetch Engines
- Neon SIMD in all CPUs
- 1MB L3 platform cache w/ECC
- 2x64b DDR4 up to 2.4GT/s

Accelerated Packet Processing Unit

- 40Gbps Packet Processing
- 20Gbps SEC- crypto acceleration
- 15Gbps Pattern Match/RegEx
- 20Gbps Data Compression Engine
- 4MB Packet Express Buffer

Express Packet IO Layer

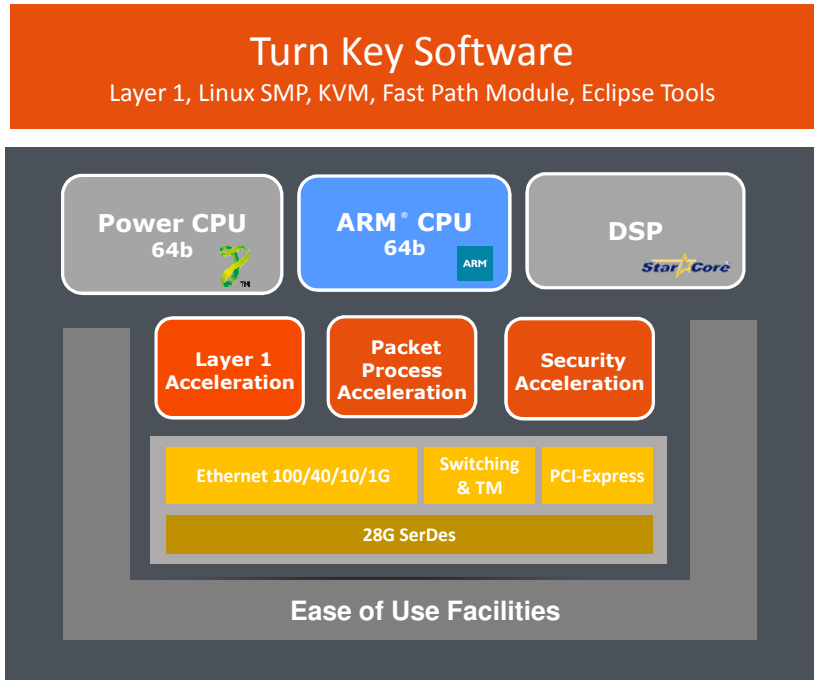
- Supports1x8, 4x4, 4x2, 4x1 PCIe Gen3 controllers
- 2 x SATA 3.0, 2 x USB 3.0 with PHY

Network IO

- Wire Rate IO Processor:
  - 8x1/10GbE + 8x1G
  - XAUI/XFI/KR and SGMII
  - MACSec on up to 4x 1/10GbE

NXP Delivers Industry's Best Performance Efficiency ARM® -64bit Embedded Solution; in production

New Networks Demand a New, Open Engagement Model



Core Agnostic (ARM®, Power, StarCore)
- ARM V8 product roadmap
- Power Architecture e6500
- StarCore SC3900 DSP
- Small / Large footprints

Scalable Acceleration Elements
- Sized to application needs
- Turn key or C-programmable

Ease of Use
- Real Time Monitoring / Debug
- SW management utility
- I/O virtualization

Turn-key Software
- Fast path modules
- Linux / BSP
- Hypervisor: KVM
- Eclipse-based tools
- Layer 1

16nm FinFET foundation and industry's largest selection of acceleration and I/O building blocks

Help customers take on a higher level of SoC design by mixing NXP IP and their own proprietary IP

Summary

- We Provide **Differentiated Applications** to key Markets
- Enabling Customers with **Software & Solutions**
- **Power & ARM®** : Broadest and Most Scalable Portfolio
- Building the **Largest Networking Ecosystem**

THANKS