QORIQ NETWORKING ARM® 64-BIT PRODUCT AND SOLUTION UPDATE

APF-DES-T2255

JASON WANG

NOVEMBER 16, 2016

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

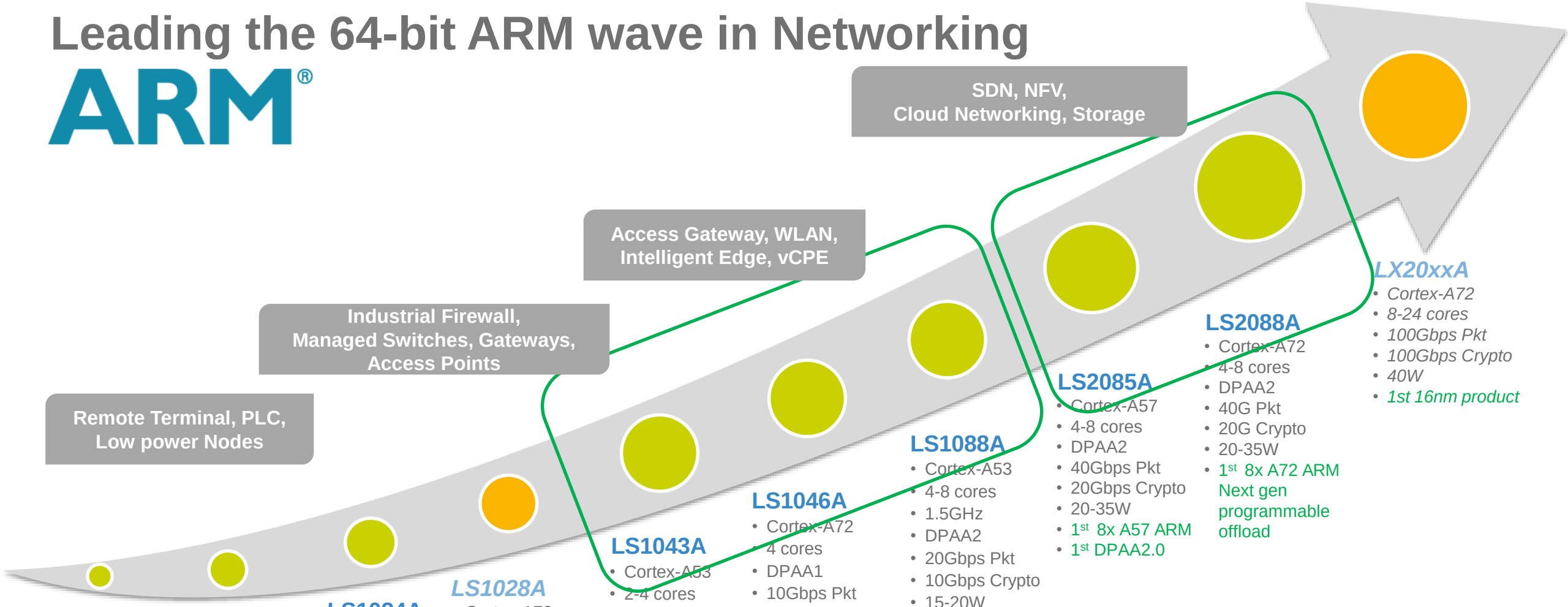
Leading supplier for all major automotive, identification, wireless infrastructure, industrial, mobile, lighting, consumer and computing manufacturers

RF

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

Leading the 64-bit ARM wave in Networking

ARM®



LS1012A
- Cortex-A53
- 800MHz
- 2Gbps Packet
- 1Gbps Crypto
- 1-2W
- Lowest power 64-bit ARM

LS1021A
- Cortex-A7
- 2 cores
- 1GHz
- 2Gbps Pkt
- 1Gbps Crypto
- 2W

LS1024A
- Cortex-A9
- 2 cores
- 1.2GHz
- 2Gbps Pkt
- 2Gbps Crypto
- 3-5W

LS1028A
- *Cortex-A72*
- *2 cores*
- *5Gbps Pkt*
- *5Gbps Crypto*
- 4-9W
- *1st with TSN switch*
- *Integrated GPU*

LS1043A
- Cortex-A53
- 2-4 cores
- 10Gbps Pkt
- 5Gbps Crypto
- 5-10W
- 1st 64-bit ARM processor for gateways and access points

LS1046A
- Cortex-A72
- 4 cores
- DPAA1
- 10Gbps Pkt
- 10Gbps Crypto
- 10-12W
- 1st Value Tier A72 ARM for gateways and routers

LS1088A
- Cortex-A53
- 4-8 cores
- 1.5GHz
- DPAA2
- 20Gbps Pkt
- 10Gbps Crypto
- 15-20W
- 1st 8x A53 ARM Next gen programmable offload

LS2085A
- Cortex-A57
- 4-8 cores
- DPAA2
- 40Gbps Pkt
- 20Gbps Crypto
- 20-35W
- 1st 8x A57 ARM
- 1st DPAA2.0

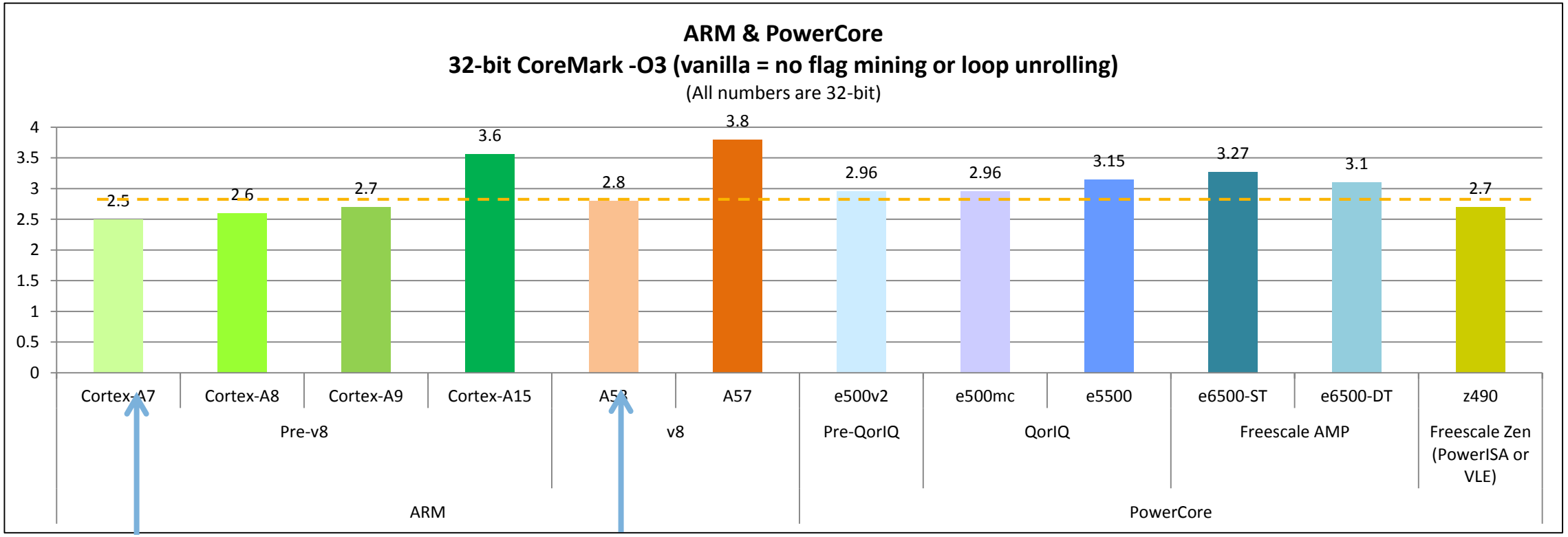
LS2088A
- Cortex-A72
- 4-8 cores
- DPAA2
- 40G Pkt
- 20G Crypto
- 20-35W
- 1st 8x A72 ARM Next gen programmable offload

LX20xxA
- *Cortex-A72*
- *8-24 cores*
- *100Gbps Pkt*
- *100Gbps Crypto*
- *40W*
- *1st 16nm product*

In Concept

Pin Compatible

ARM and PowerPC Core Comparison – CoreMark / MHz



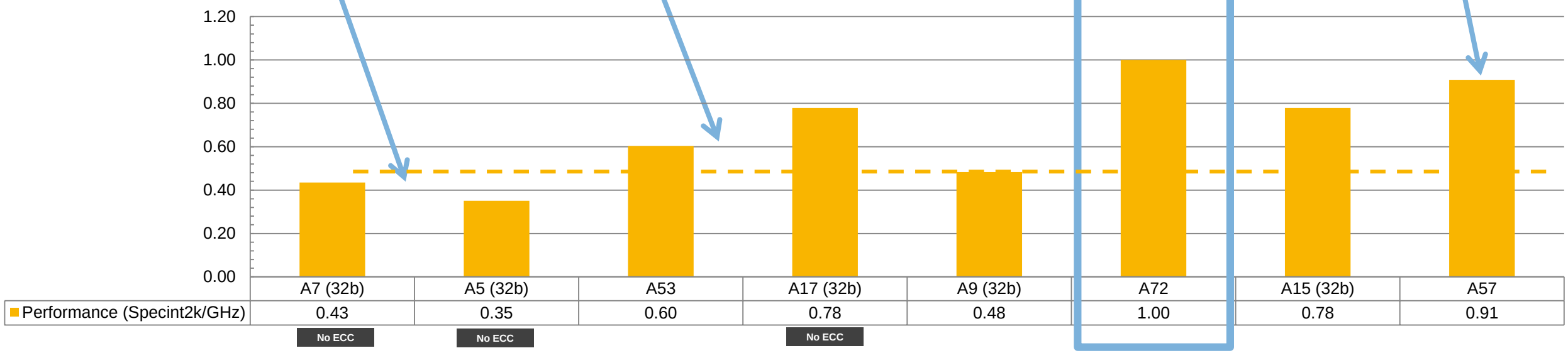
CoreMarks/GHz for Cortex A9 is worse than for A53 and only slightly better than A7

LS1021A

LS1088A
LS1043A
LS1012A

LS2088A
LS1047A
LS1026A

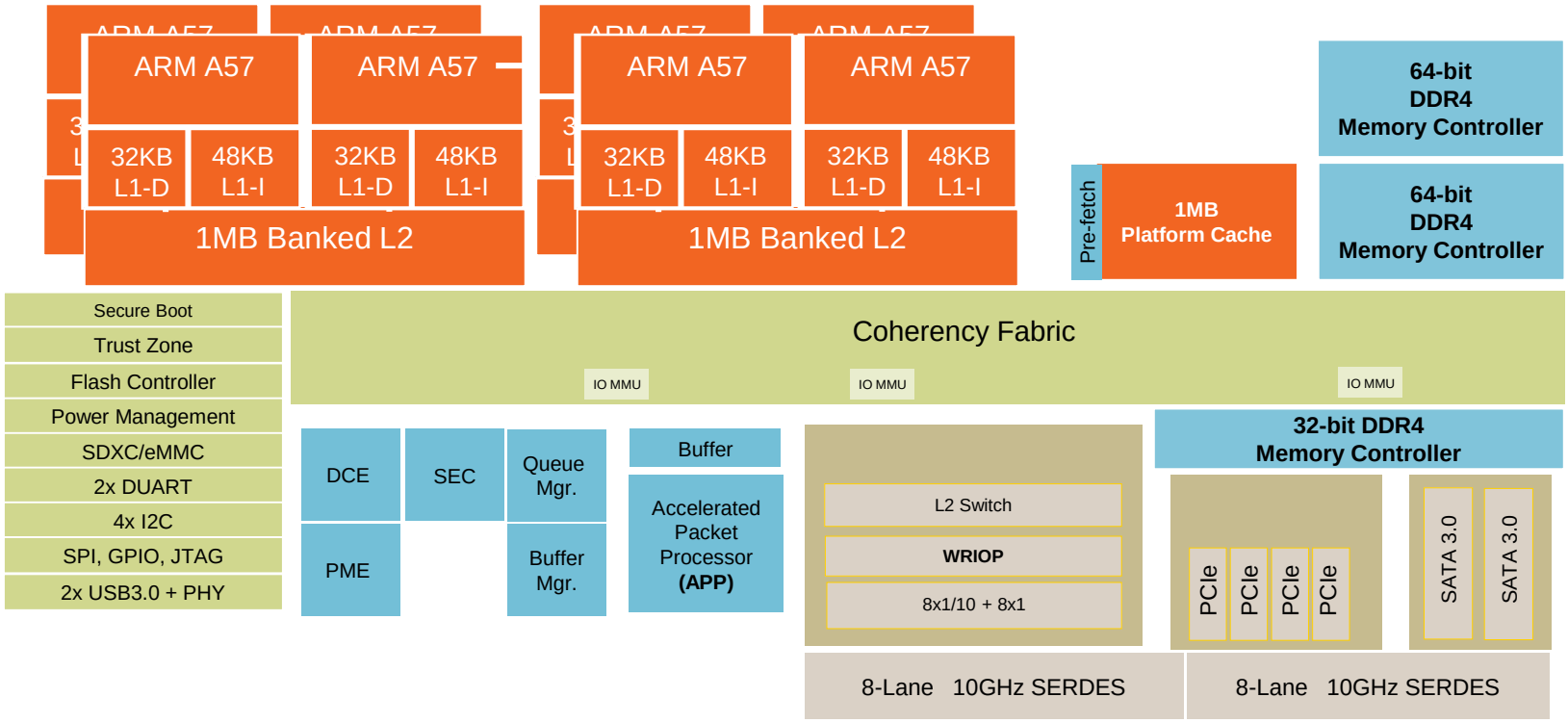
LS2080A



SpecInt2k/GHz for Cortex A9 is worse than A53 and only slightly better than A7

MID-RANGE SOCKET
LS2 FAMILY

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



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

Other Parametrics

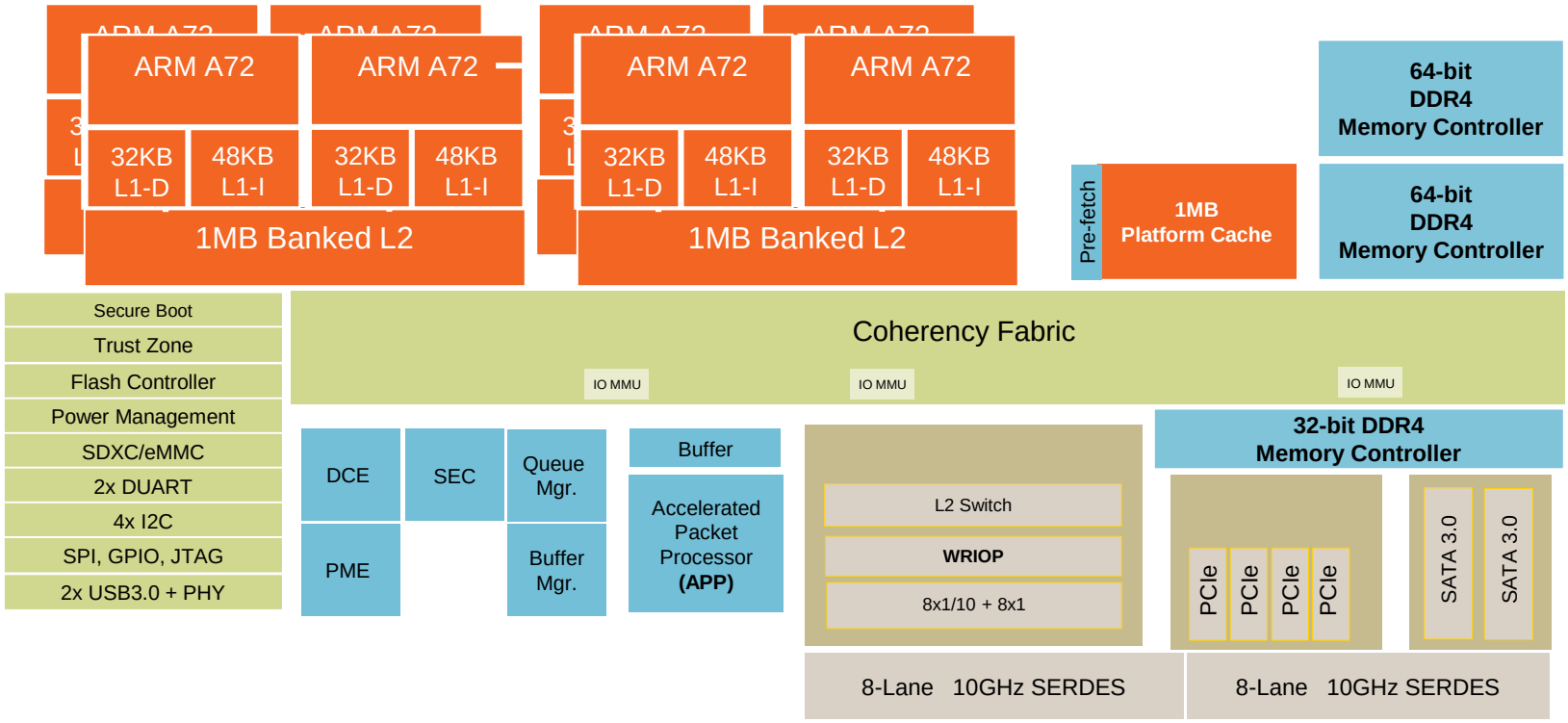
- 37.5x37.5 Flipchip
- 1mm Pitch
- 1292pins

Datapath Acceleration

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

Freescale Delivers Industry's Best Performance Efficiency ARM-64bit Networking Solution

Industry's Leading ARM-64-bit Networking Solution: LS2088A



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Freescale Delivers Industry's Best Performance Efficiency ARM-64bit Networking Solution

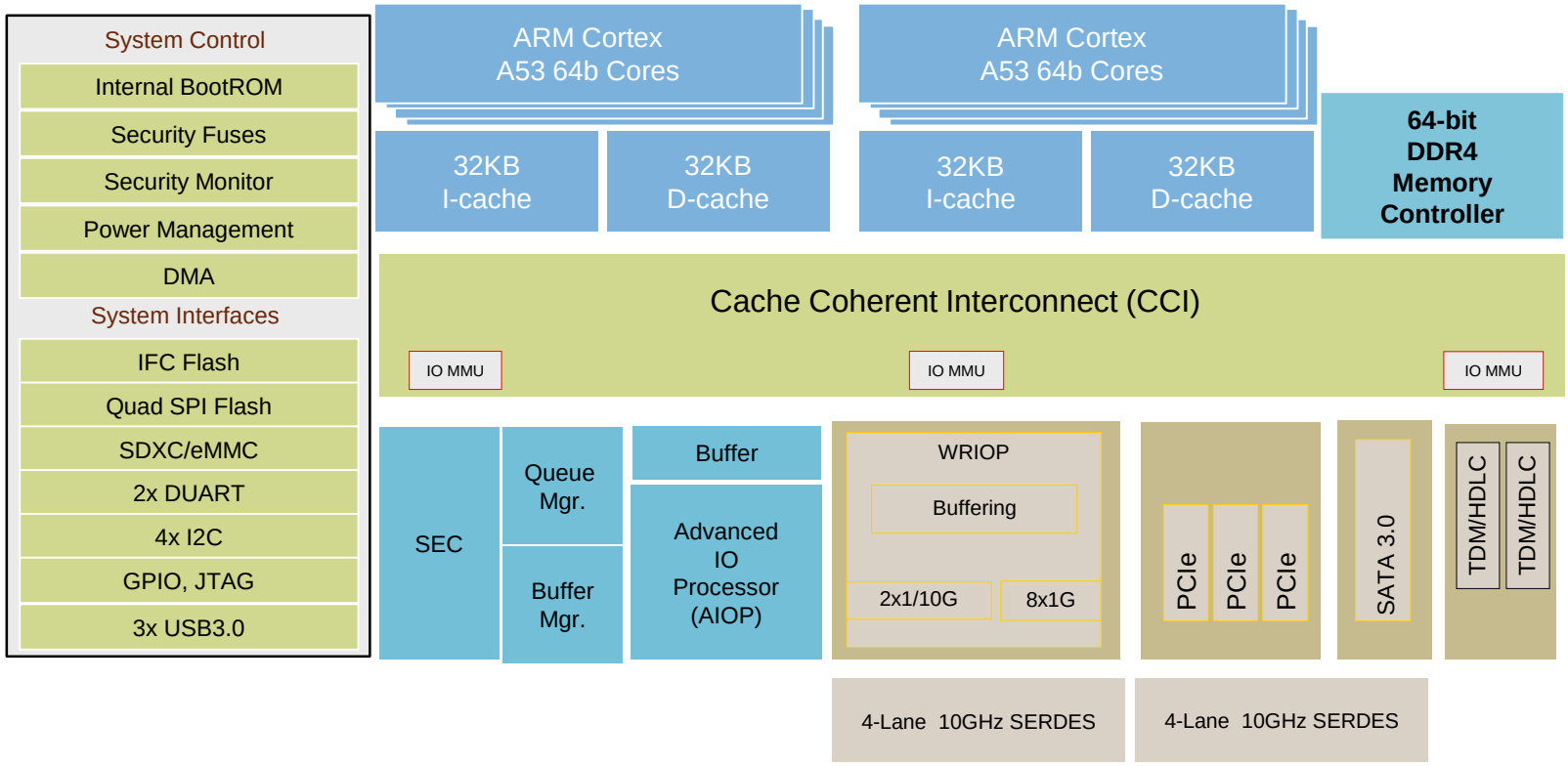
Samples May 2016!

LS2 family Comparison

	LS2088A	LS2084A	LS2048A	LS2044A	LS2085A	LS2080A	LS2045A	LS2040A
CPU	8x A72, 4MB L2	8x A72, 4MB L2	4x A72, 2MB L2	4x A72, 2MB L2	8x A57, 4MB L2	8x A57, 4MB L2	4x A57, 2MB L2	4x A57, 2MB L2
Platform Cache	1MB L3							
DRAM Interface	2x64b DDR4 1x32b DDR (AIOP)	2x64b DDR4	2x64b DDR4 1x32b DDR (AIOP)	2x64b DDR4	2x64b DDR4 1x32b DDR (AIOP)	2x64b DDR4	2x64b DDR4 1x32b DDR (AIOP)	2x64b DDR4
Packet processing (AIOP) & L2 Switch	Yes	No	Yes	No	Yes	No	Yes	No
Accelerators	Security, Pattern Matching, Data Compression				Security, Pattern Matching, Data Compression			
Pin Compatibility	All Pin Compatible							
Production	Sept 2016				Evaluation Only	Now	Evaluation Only	Now

LS1088A: Leadership in Performance Efficiency for the Value Tier

Extending the Performance Continuum from LS208xA into Low Power System Designs



General Purpose Processing Layer

- 8 x ARM A53 CPUs, 64b, 1.5GHz; 2MB L2 cache
- HW L1 & L2 Prefetch Engines
- Neon SIMD in all CPUs
- 1x64b DDR4 up to 2.1GT/s

Interfaces

- Supports x4,x2, x1 PCIe Gen2 controllers
- SATA 3.0, 3x USB 3.0
- SDXC/eMMC
- **Network IO**
- Wire Rate IO Processor:
  - 2x 10G and 8 x 1G; MACSEC on 4x 1G
  - XFI/KR, QSGMII, SGMII/KX, RGMII

Datapath Acceleration

- SEC- crypto acceleration
- Packet processing engine (AIOP)
  - Protocol offload
  - Services

Other Parameters

- 23 x 23mm FCPBGA
- Pin Compatible to LS1043A
- 0.8mm Pitch, 780 Pins

Unprecedented performance/watt and ease of use for smarter, more capable networks

Samples August 2016!

DATACENTER

THIRD PARTY OR CUSTOMER READY PLATFORMS

NXP SDN White Box Switch Solution Platforms Planning 2016

ToR/Edge Switch Box
ONIE Support
Traditional Mgmt Stack

Ethernet Switch
48-Port Switch
(L2-3+ Switch)

PCIe

QorIQ P2041
Mgmt CPU

Classical Ethernet Switch

Established Legacy Embedded Switch

ToR/Edge Switch Box with
Extended SDN Services

Data Plane offload via
10GE/HiGig+

Hybrid Traditional L2/L3
& SDN support

ONIE Support

QorIQ T2080/T4240 PowerPC
(OF-Agent / L4-7)
(opt OF-Controller)
VortiQa
openstack

4x10G

PCIe

40G Ethernet Switch
48-Port Switch Trident-II
(L2-3+ Switch)

64-bit ARMv8
Dedicated AIOP
Data Path Processing
Upgrade Path

2015 to 2016
Upgrade

40G to 100G
SDN Solution
Switch Platform
Upgrade Path

2016 QorIQ LS2088A ARMv8
(OF-Agent / L4-7 NSS Software)
(Dedicated AIOP Packet Processor)
AIOP Packet Engine
SDN Switch supplement

2-4x10G

PCIe

100G Ethernet Switch
48-Port Switch Tomahawk
(L2-3+ Switch)

Network Service Switch (NSS) with L4/L7 SDN Support

NXP SDN White Box Application Switch

WHITE BOX SWITCHING

LS2 White Box Switch Could Service Provider Engagement Kits 2016

2016 NXP Data Center Switch Software Enablement SDK

Open Network Switch Library
Published APIs to map Broadcom SDK to an open north bound interface.
https://github.com/Broadcom-Switch/opennsl

Open Network Linux (ONL)
A Linux distribution contains driver APIs to configure BCRM switches. Latest drop includes BRCM OpenNSL
https://opennetlinux.org/source

ONIE with Secure Boot
White Box OCP Switch OS Loader
http://onie.org/

OCP Switch Hardware Platform
With ONL certification
https://opennetlinux.org/hcl

Data Center Switch Software Solution

3rd Party Switch Software (Proprietary or Open Source)

Broadcom OpenNSL (Open Source)

OpenBMC (Open Source)

NSS Openflow SDN Solution

Openflow Agent

OF-DPA Adaptation Layer

Broadcom OF-DPA –L2, L3

Broadcom SDK, L2, L3

Open Network Linux Based on Kernel-3.18 LTS

LS2 ONIE ONL Loader

LS2088 Secure Boot

ODM 100G Data Center White Box Switch

NXP QorIQ Host Processor LS2088 ARMv8 8x A72-2.0GHz

BRCM 100G Tomahawk Switch

Misc Hardware Fans, LED Controllers, SFP, Sensors, Power Supplies

User Space Application Modules

Kernel Space Driver and Stack Modules

Hardware Platform

OCP Switch

ODM Components

ENTRY VALUE SOCKET LS1 FAMILY

NXP For Wireless Applications Everywhere

Multicore ARM & Power Architectures in the cloud

Enterprise Cloud

Service Provider Cloud

WLAN AP,

Small Cell for Dense Access

Enterprise & Branch

Campus

Airport

Stadium

Full Featured Access Point and Gateway for Next Generation EdgeA

IoT

Home

Shop

Car

Train

Top to Bottom IoT, Security, VM and NFV Enabled and Fast Path Differentiation

What's New

IoT

- Application
  - IoT hub / device connection
  - Thread support
  - AP config
- 802.15.4 (ZigBee etc.)
- Bluetooth Low Energy (BLE)

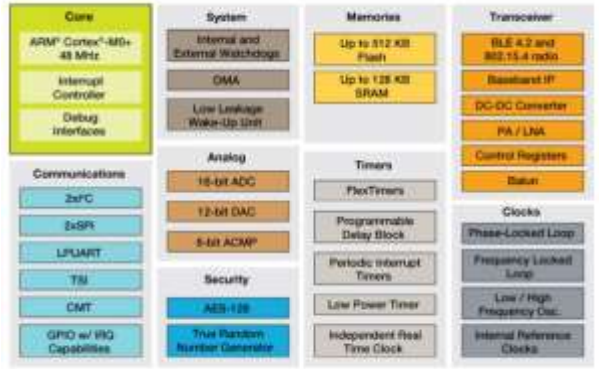
mm Wave

- Application
  - Outdoor backhaul
  - Indoor point-to-point/mesh
- 60GHz Radios
  - WiGig 1.3
  - 802.11ad

Solutions

Thread

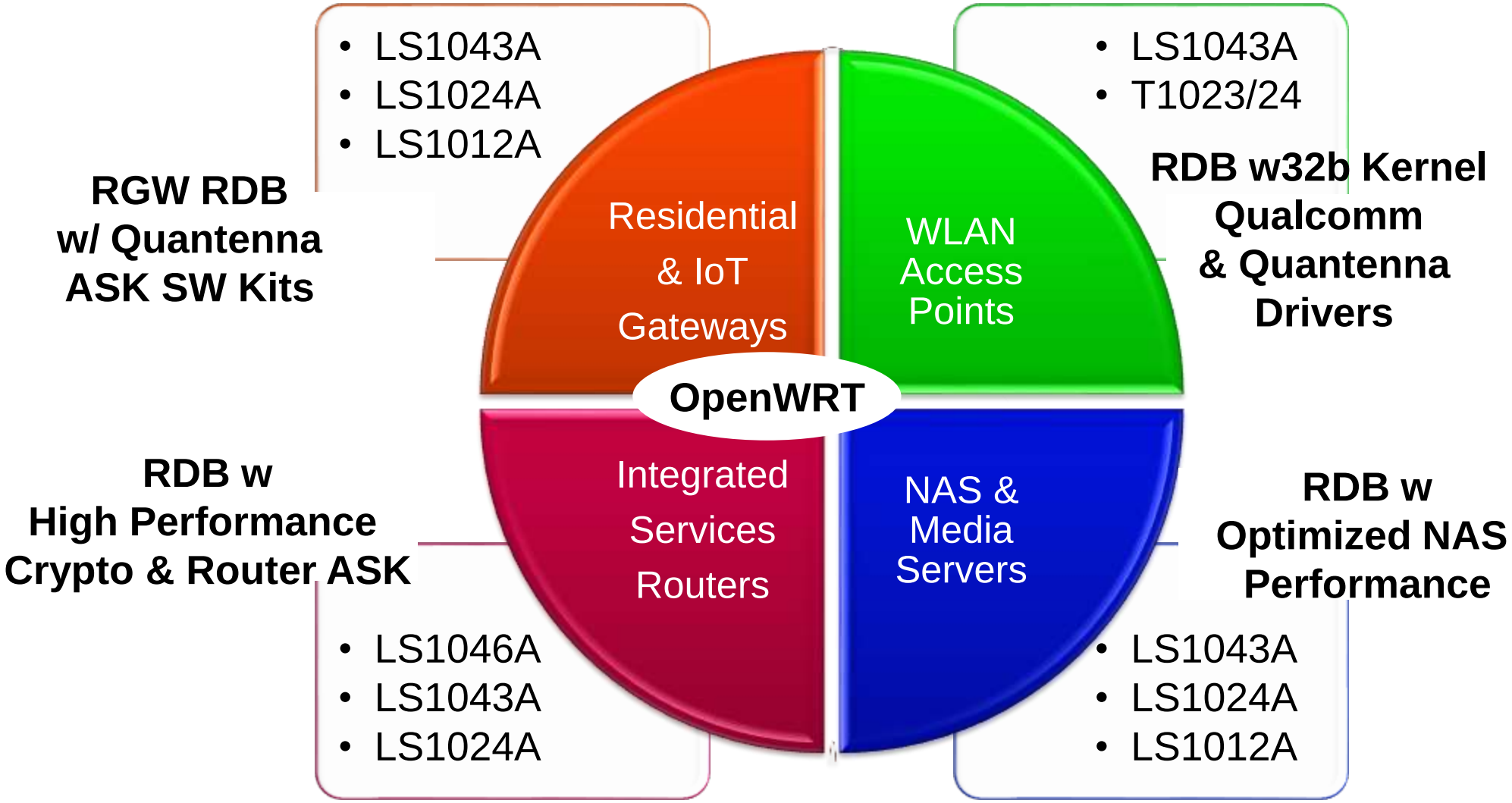
Kinetis W Series KW41Z



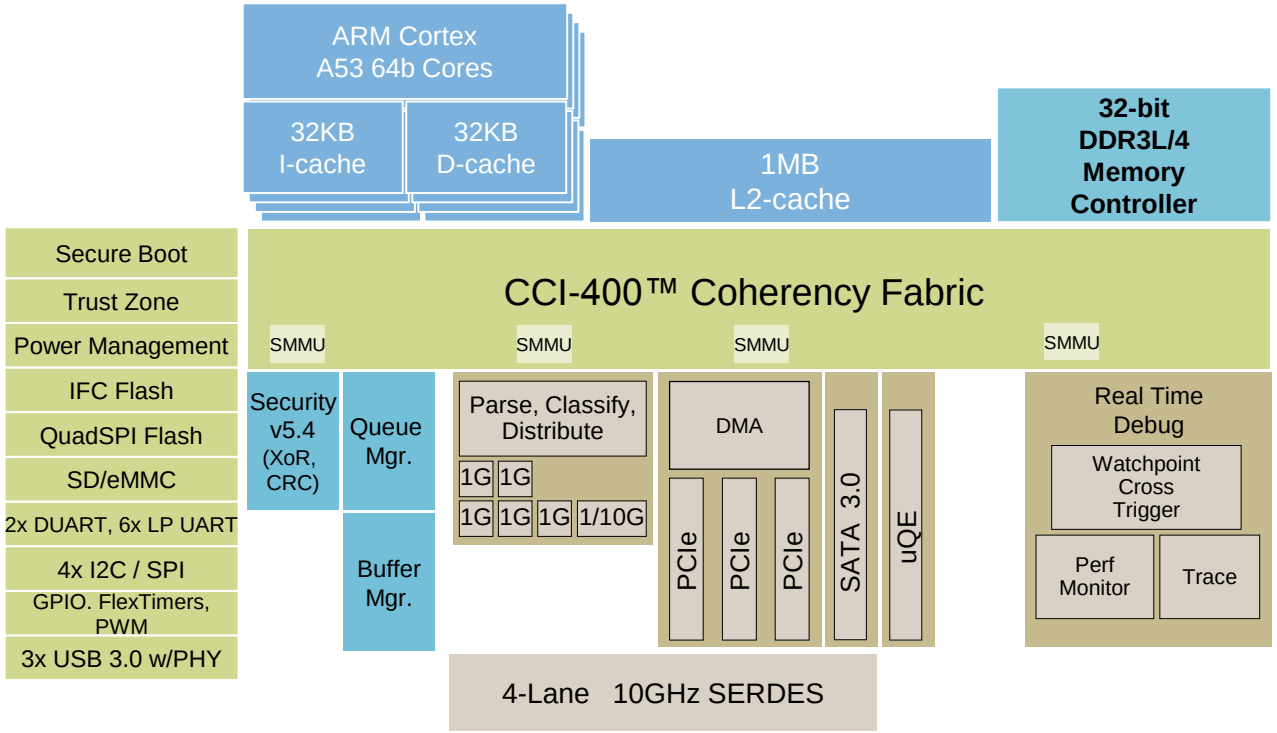
USB Dongle Now, Board Solutions Next

Partner & Product Solutions

QorIQ & Layerscape HW & SW Application Solutions



Leading in the Value Tier: QorIQ LS1043A



Device

- 28HPM Process
- FCBPGA, 0.8mm pitch

Power target

- 4-7W

Data path Acceleration

- SEC- crypto acceleration
- L2/3 & Custom Classification
- Tunnel Header Offload
- Reassembly
- Traffic Management & Shaping

Processor

- 4x A53, 64b, up to 1.5GHz
- 1MB L2 cache shared by all cores (and platform elements)

Memory Subsystem

- 32b DDR3L/4 Controller up to 1600MHz

CCI-400 Switch Fabric

- Advanced VM hardware support

High Speed Serial IO

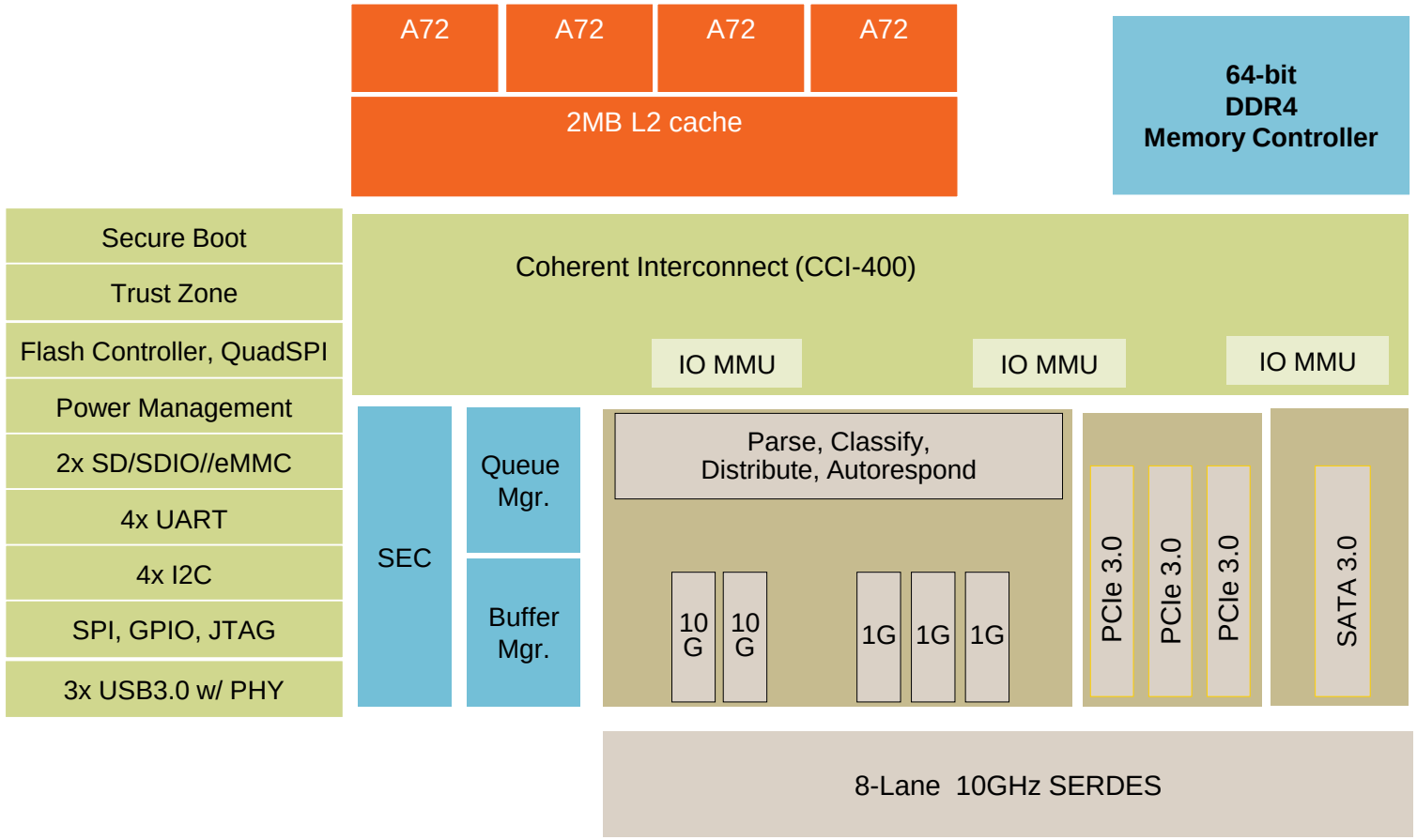
- 3x PCIe Gen2 Controllers
- 1x SATA 3.0, 6Gb/s
- 3x USB 3.0 with PHY

Network IO

- 1x10G + QSGMII or 3x 1/2.5G SGMII + 2x 1G RGMII
- Proven Packet Parse/Classify/Distribute
  - Up to 2.5Gbps IMIX
  - IPSec, GRE, CAPWAP, DTLS Offload
  - Lossless Flow Control

Industry's most efficient quad core communications SoC solution

LS1046A: Quad ARM Cortex A72 Processor



Leading Quad A72 processor with two 10GbE ports

Core & Memory Subsystem

- 4x ARM Cortex A72 up to 1.6GHz
- 2MB total L2 cache
- 64-bit DDR4 up to 2.1GT/s

Interfaces

- Three PCIe Gen3 controllers (x4, x2 and x1)
- 1x SATA 3.0
- 3x USB 3.0 with PHY
- 2x SD3.0/SDIO/eMMC 4.5

Network IO

- 2x 10GbE
- 3x 1GbE

Datapath Acceleration

- SEC- crypto acceleration
- Datapath Acceleration Architecture 1.x

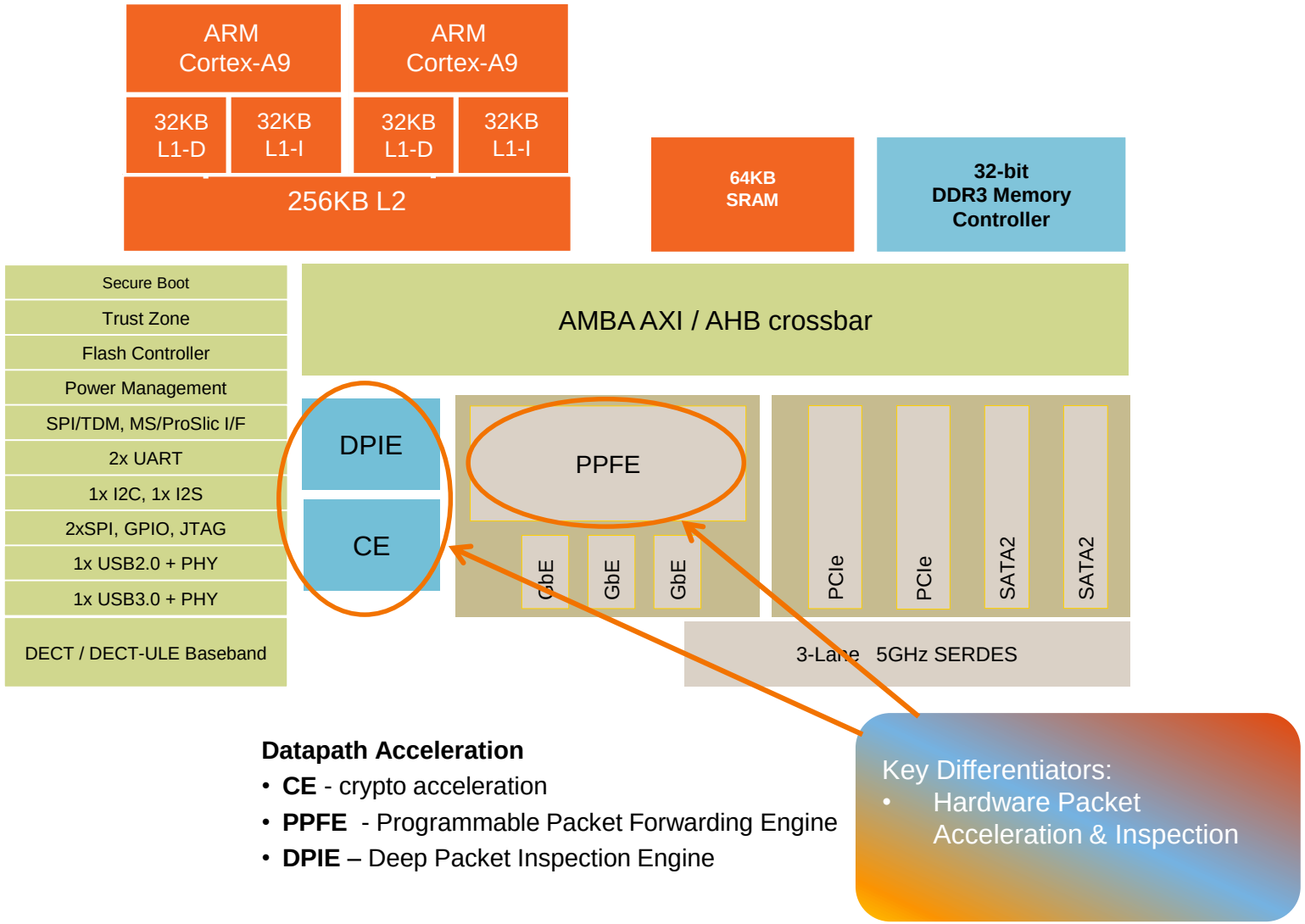
Other Parameters

- Package:
  -23x23mm, Lidless FCBGA

Samples	Production
June 2016	Dec 2016

Samples June 2016!

LS1024A Block Diagram



Datapath Acceleration

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

Key Differentiators:
- Hardware Packet Acceleration & Inspection

General Purpose Processing

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

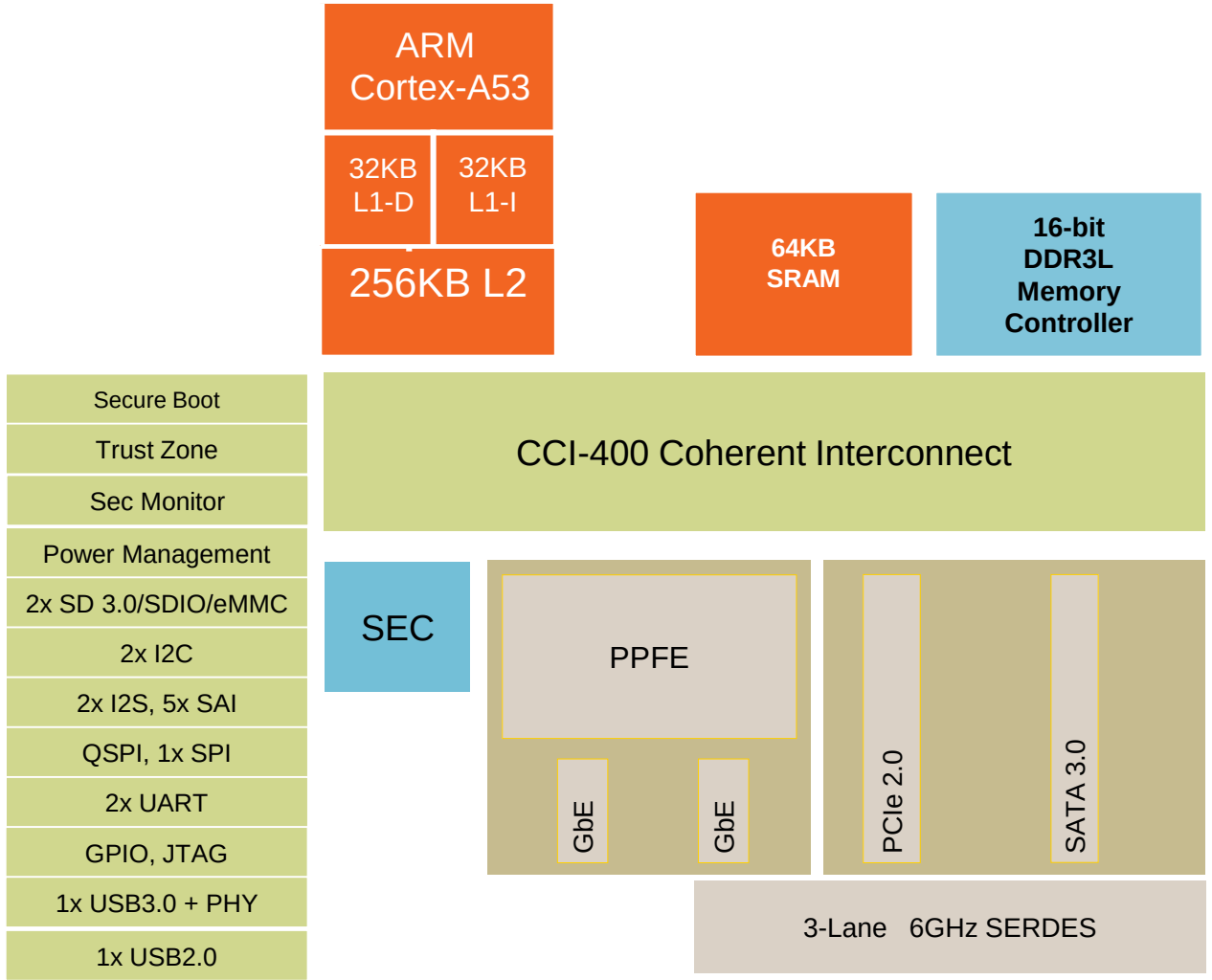
High-speed Interfaces

- 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)

LS1012A Block Diagram

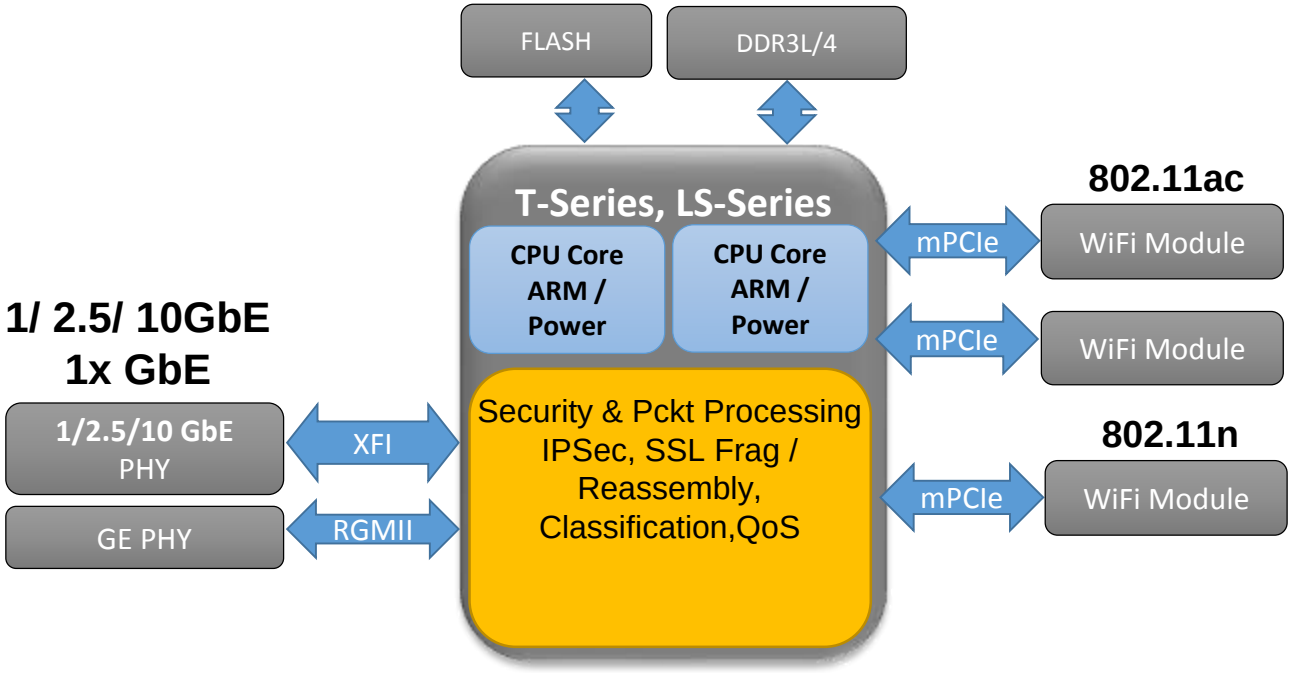
NEW

- Single ARM 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: 10x10mm, routable in 4-layers



Samples April 2016!

Digital Networking Processors: Leading Solution for Enterprise WLAN Access Point



Processor:
- Single / Dual / Quad Core 64b, up to 1.6GHz
- 256 KB L2 cache per CPU core
- 256KB Shared Platform Cache w/ECC

Memory Subsystem:
- 36/72b DDR3L/4 Controller up to 1600MTs

High Speed Serial IO:
- 3x PCIe Gen2 Controllers

Network IO & Offload:
- Packet Parse/Classify/Distribute
- Single pass Security Offload
- First 2.5G, 5G & 10GE in low power design
- MACsec on Ethernet

Secure tunnel offload in hardware via proven offload architecture
Best in class 802.11ac low over head TCP/UDP throughput

Multiple SoC solutions to Enable 802.11ac-Wave-II Market Requirements

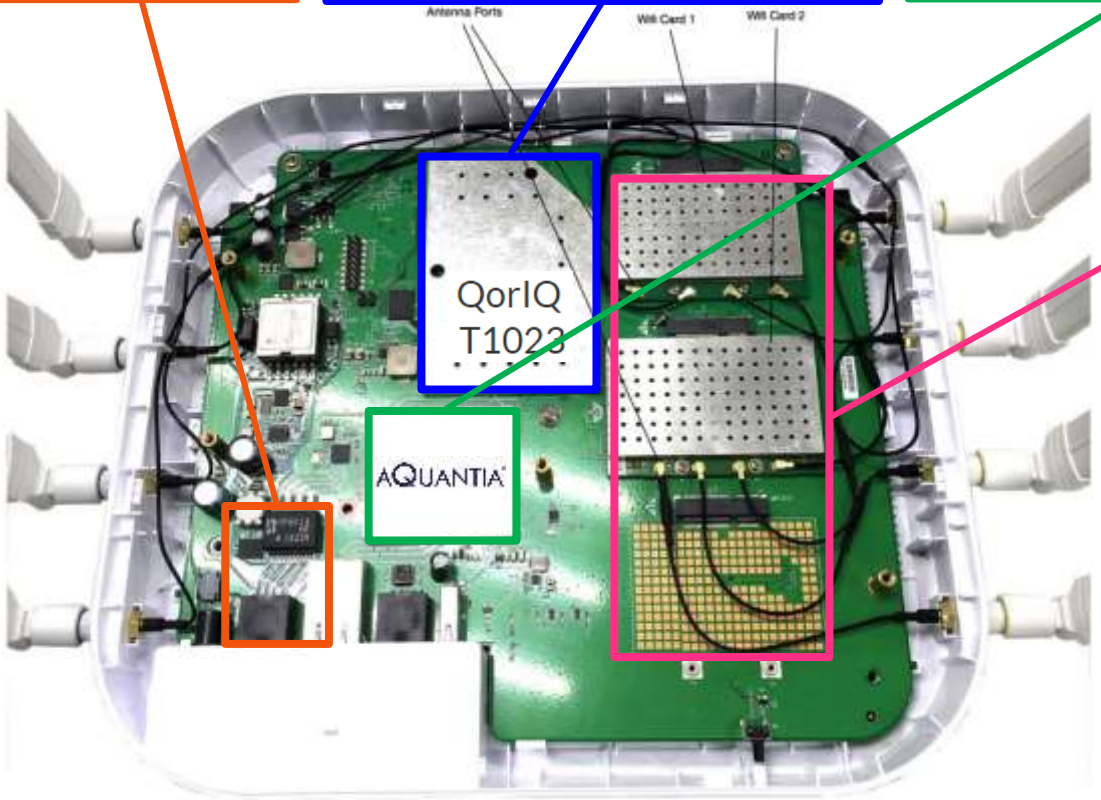
QorIQ T1023WLAN Wi-Fi Wave2 EAP Reference Solution

PoE Plus 3at
- System can sustain 25.5W PoE mode in 11ac + 11n dual radio mode

T1023 dual-core 1.2GHz
- QorIQ dual-core e5500 up to 1.4GHz top bin
- DPAA v1.1 support 4Gbps IPsec and CAPWAP/DTLS hardware offloading

Aquantia 10G/2.5G
- AQR105 with direct connect to T1023 fully validated on the system
- support 10G/2.5G/1G full auto-negotiation

Wi-Fi 3-radio Available
- 3x mini-PCIe on-board sockets
- Support 2x QCA Beeliner by default



Available in Feb

T1023WLAN Reference Evaluation Kit Available for ordering in Feb 2016

WLAN Leadership: QorIQ T1023/24 QCA Beeliner 2.4 + 5GHz
High Performance with Lower Power Consumption

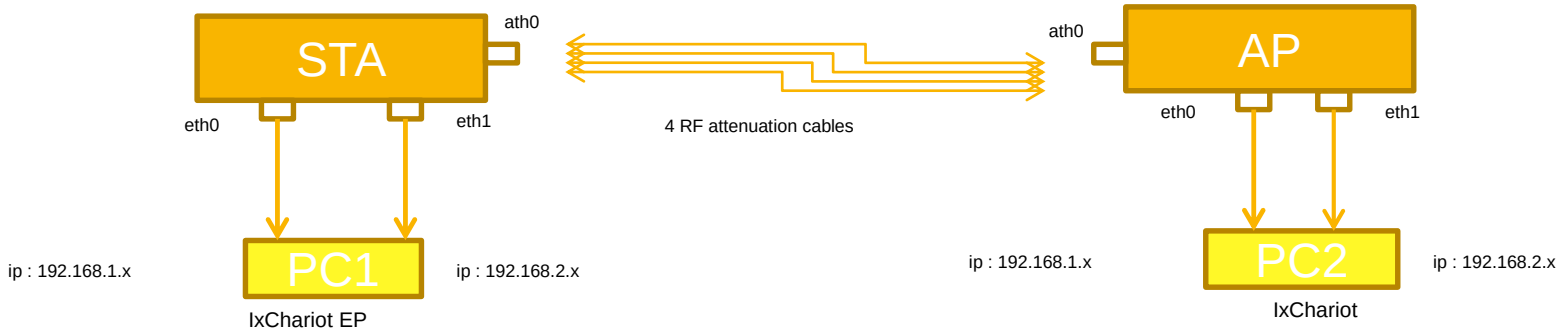
QCA wave-II radio driver ported with QCA **Atheros 4x4 on 10.4_C1_target and 3x3 in 10.1.467. on sdk1.7** AC+N performance achieved > 1800Mbsp

Industry Only: wave2 AC+N consumes average 35% (2-core) With NXP optimized unique Wi-Fi Offload-forwarding for ALL wave1 and wave2 11AC

QCA 4x4 80MHz	TCP Bidirectional	T102x clock=1.2GhzCPU
	Throughput Mbps	CPU Utilization
CU239 - 5Ghz 4x4 (AC)	1290	20% total CPU utilization
CU239 + CU260 : (AC+N) 5Ghz + 2.4Ghz 4x4	1822	35% total CPU utilization
CU239 + CU239 (AC+AC) 5Ghz*2	2350	53% total CPU utilization

AQUANTIA

Support NBASE-T 2.5G SGMII PHY



Industry unique: single-core T1 delivers AC+N wave2, >1800Mbps, 65% cpu of single-core

QorIQ LS1043 Quad Core A53 Wave-2 Wi-Fi 32b Test Result

Single-card Cascade IxChariot TCP Mode

Updated Jan 29

Single 5GHz With QCA Cascade

Core Speed (MHz)	Traffic	Throughput (Mbps)	Average CPU %	CPU0 %	CPU1 %	CPU2 %	CPU3 %
1000	DL	**1132**	**28**	16	51	25	18
	UL	**1176**	**22**	8	64	8	7
1200	DL	**1115**	**23**	16	46	13	18
	UL	**1162**	**19**	6	56	6	7

LS1043A Power at 105C Tj & 0.9V

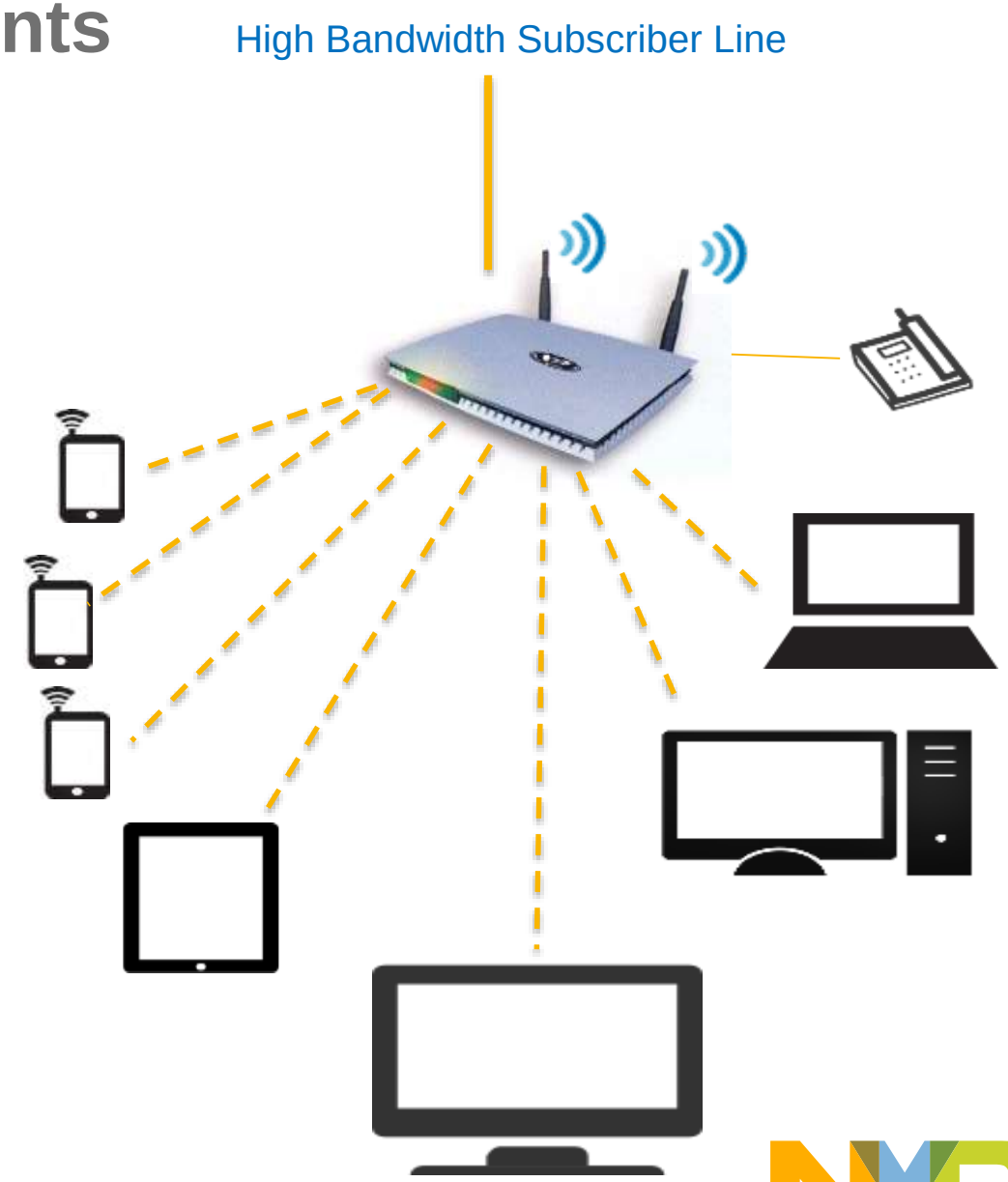
- Dual & Quad Core Options tested WLAN use case CPU Dhrystone load test
- Power tested with I/O at 105C Tj
- Dual core at 1200MHz 3W
- Quad core 4W

105C Tj Power Test	Power Test with I/O at 0.9V				
Platform	LS1023A	LS1023A	LS1043A	LS1043A	T1023
Cores	2	2	4	4	2
Frequency (Core)	1000MHz	1200MHz	1000MHz	1200MHz	1200MHz
Frequency (Platform)	300MHz	300MHz	300MHz	300MHz	400MHz
DDR 4	x16b	x16b	x16b	x16b	x16b
Frequency	1300Mt/s	1300Mt/s	1300Mt/s	1300Mt/s	1300Mt/s
PCI	Gen 2 x3	Gen 2 x3	Gen 2 x3	Gen 2 x3	Gen 2 x3
Eth	1x SGMII 2.5	1x SGMII 2.5	1x SGMII 2.5	1x SGMII 2.5	1x SGMII 2.5
Eth	1x RGMII	1x RGMII	1x RGMII	1x RGMII	1x RGMII
USB	1x USB 3.0	1x USB 3.0	1x USB 3.0	1x USB 3.0	1x USB 3.0
I2C	2	2	2	2	2
DUART	1	1	1	1	1
SPI	1	1	1	1	1
LPUART	1	1	1	1	1
I/O	0.526W	0.526W	0.526W	0.526W	0.526W
Total Power (W)	**3.62**	**3.64**	**4.02**	**4.07**	**4.01**

Next Generation Gateway Requirements

- Residential Customers demanding ever **higher bandwidth up to 10G PON**
- Support for **latest WiFi formats** and data-rates is critical for 802.11ac and beyond
- Video via OTT / IP delivery
- Video playback on **multiple device formats** around the home:

  – Smartphone, tablet, smartTV, PC
- UHDTV deployment, managing **bandwidth & QoS** will be challenging
- Set-Top-Box will be replaced by **headless gateway** with **wireless distribution** of content in the home
- **IoT services** such as security monitoring & home automation increasingly important
- Open platform for **SDN and NFV services**



T1023 & LS1043 Enterprise Access Point with IoT Demonstration

T1023WLAN & LS1043RDB Wi-Fi Access Point with IEEE 802.15.4 IoT connectivity
NXP Enterprise Gateway SDK support OpenWRT with Google Thread integration

- T1023WLAN board with NXP KW20/40 IoT dongle connects to Thread Eligible End Point
- T1023WLAN board with NXP KW20 IoT dongle connects to PHILIPS Hue Fun Lighting

- **NXP QorIQ T1023WLAN EAP** with IoT gateway enabled solution featuring NXP MCU (Google Thread supported)
- **NXP MCU MKW40Z/30Z/20Z:** A Bluetooth® Low Energy and IEEE® 802.15.4 System on a Chip (SoC)

BACK UP
LS1024A DEEP DIVE

LS102MA and LS1024A Target Applications

Broadband Home Router

OKI
MITSUBISHI
NEC
HITACHI
Deutsche Telekom
NTT
Telstra

Smart Home Gateway

ZyXEL
technicolor
SAMSUNG
CISCO
at&t

Synergy with Existing FSL customer relationships

Networked Attached Storage

WD Western Digital
I-O DATA
Synology

Mobile LTE Router

technicolor
FOXCONN
ADB
SoftBank
verizon

LS102MA and LS1024A already have strong traction in target applications

CCP customers – Home Router market

Operators Served

NTT, at&t, kpn, Telstra, verizon, TELECOM ITALIA, KDDI, Charter COMMUNICATIONS, Deutsche Telekom, SoftBank, CenturyLink, telenor

Customers

OKI, MITSUBISHI, HITACHI, CISCO, technicolor, SAMSUNG, ZyXEL, NEC, FOXCONN, ADB, GENEXIS

CCP is established with market leading customers and operators

CCP customers – NAS and VoIP

Network Attached Storage

Western Digital

I·O DATA

Synology

VoIP Gateways

ooma

saxa

ERICSSON

LG

CCP is established with leading customers in Networked Storage and VoIP

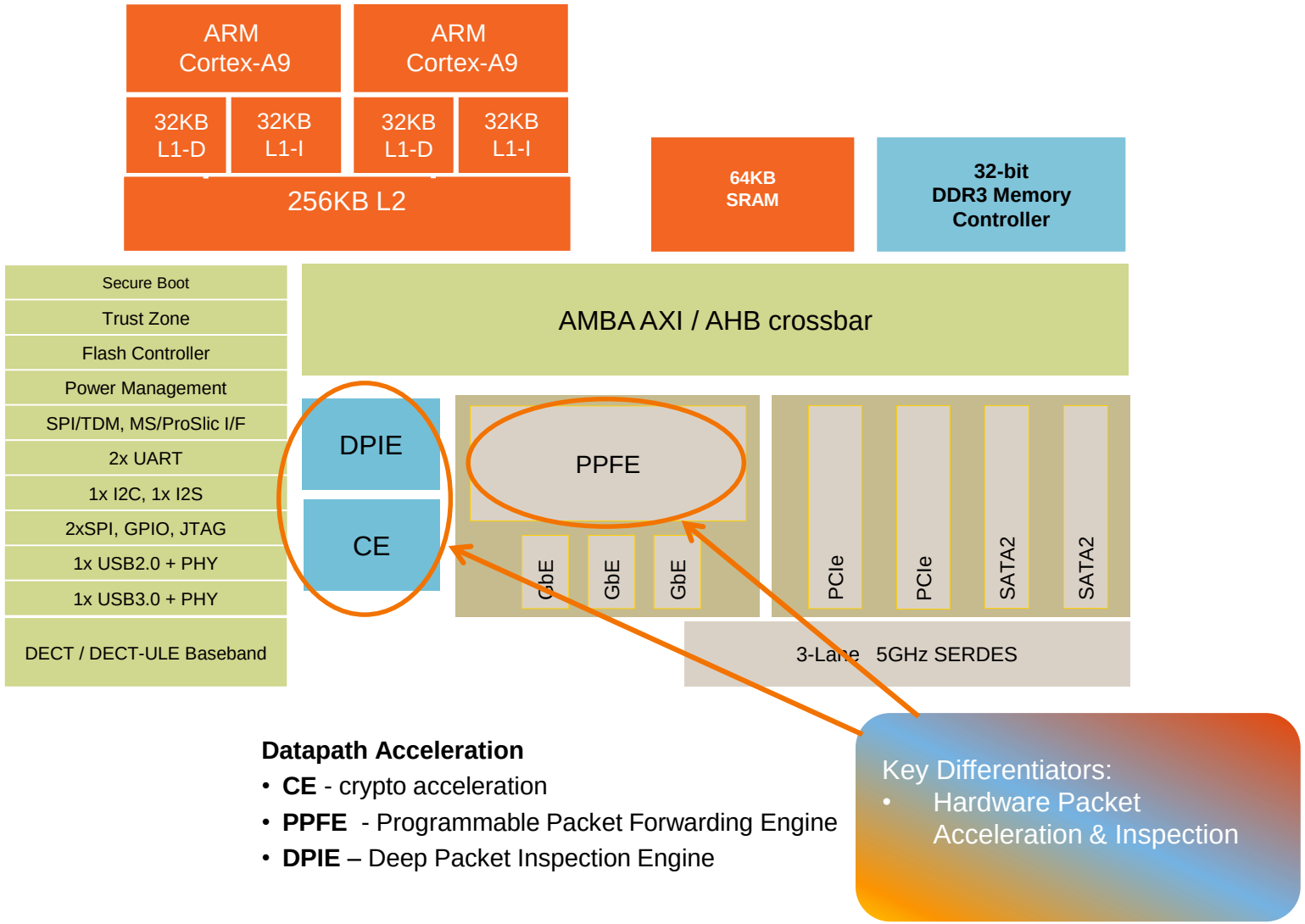
Software partners and ecosystem

- The following vendors have developed software for LS102MA and LS1024A:

Vendor	Software
DigiOn	DLNA
JetHead	RVU server
Jungo	Residential gateway
Lionic	Deep Packet Inspection software
Prosyst	OSGI framework
RocketHome	Home Automation Application
Skelmir	Java Virtual Machine (JVM)
TeamF1	SMB Security Router
Windriver	Residential gateway

LS1024A (AKA COMCERTO2000)

LS1024A Block Diagram



Datapath Acceleration

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

Key Differentiators:
- Hardware Packet Acceleration & Inspection

General Purpose Processing

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

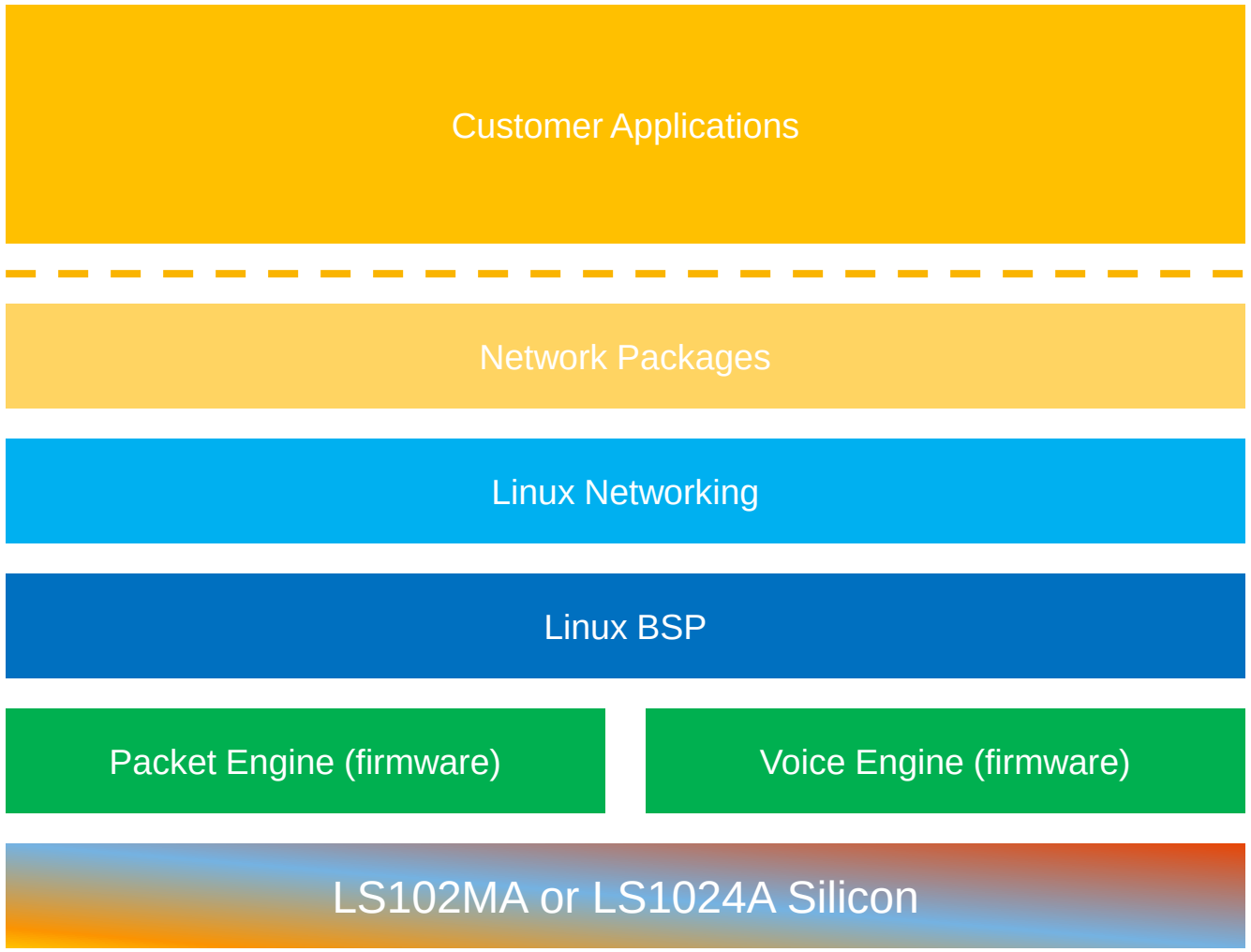
- Integrated DECT and DECT-ULE baseband processor

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)

LS102MA/LS1024A SOFTWARE

High-level System Architecture & Development Model



- Customers interface with system at API level
- Changes/New features requests submitted to Freescale for support
- SDK includes firmware & optimized network and Linux packages
- Hardware details abstracted by SDK for rapid product development

LS102MA/LS1024A SDKs: BHR

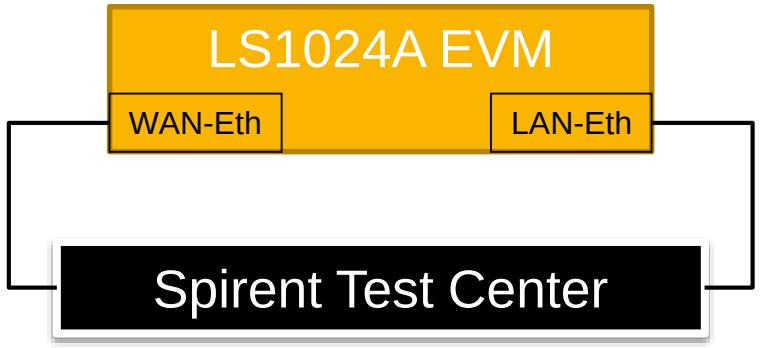
- OpenWRT SDK, targeted at BHR/HGW application
  - Complete OpenWRT build environment and BSP
  - Typical WiFi router application
    - Includes all needed features, e.g. DHCP, DNSMASQ, iptables, WebIf
  - Binaries for QCA, BRCM, RTL WiFi and L2SW
  - Binaries for Microsemi, Proslic SLICs
  - Binaries for FPP/PFE and MSPvoip, sources for cmm
  - Security engine APIs integrated into SDK
    - openswan, openssl
  - Asterisk Channel Module as demo-level example
    - Uses MSPvoip & VAPI library
  - WebIf or command line control
    - Usually customized by customer, e.g. own branding
  - Board configs for LS102MA and LS1024A EVMs
    - Docs show how to modify config for customer board
  - u-boot, barebox (LS1024A)
  - kernel 2.6.33.5 (LS102MA), 3.2.26/3.2.54 (LS1024A)
  - jffs2, ubifs filesystem. nfs available with LS102MA

NAS SDK: LS1024A only

- OpenWRT (Attitude Adjustment) SDK, targeted at NAS application
  - Complete OpenWRT build environment and BSP
  - Typical NAS application
    - Includes all needed features, e.g. DHCP, DNSMASQ, iptables, WebIf, samba
  - Binaries for QCA, BRCM, RTL WiFi and L2SW
  - Binaries for PFE (NAS-specific) and MSPvoip, sources for cmm
  - Security engine APIs integrated into SDK
    - openswan, openssl
  - WebIf or command line control
    - Usually customized by customer, e.g. own branding
  - Board configs for LS1024A EVMs
  - barebox
  - kernel 3.2.32/3.2.54
    - Kernel options tuned for NAS
  - jffs2, ubifs filesystem

LS1024A PERFORMANCE

Ethernet WAN-LAN performance



IP forwarding

Frame size	Bi-dir throughput (IPv4)	CPU utilization	Bi-dir throughput (IPv6)	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%

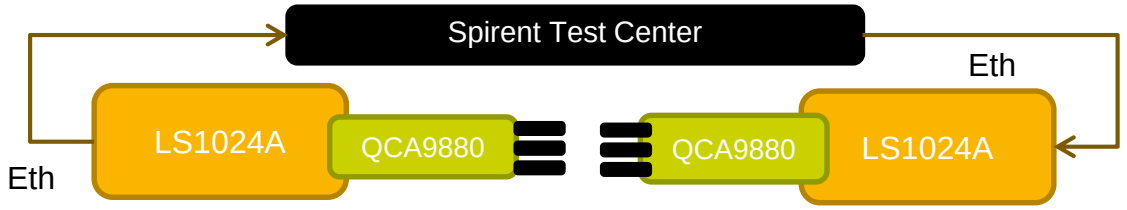
NAT routing

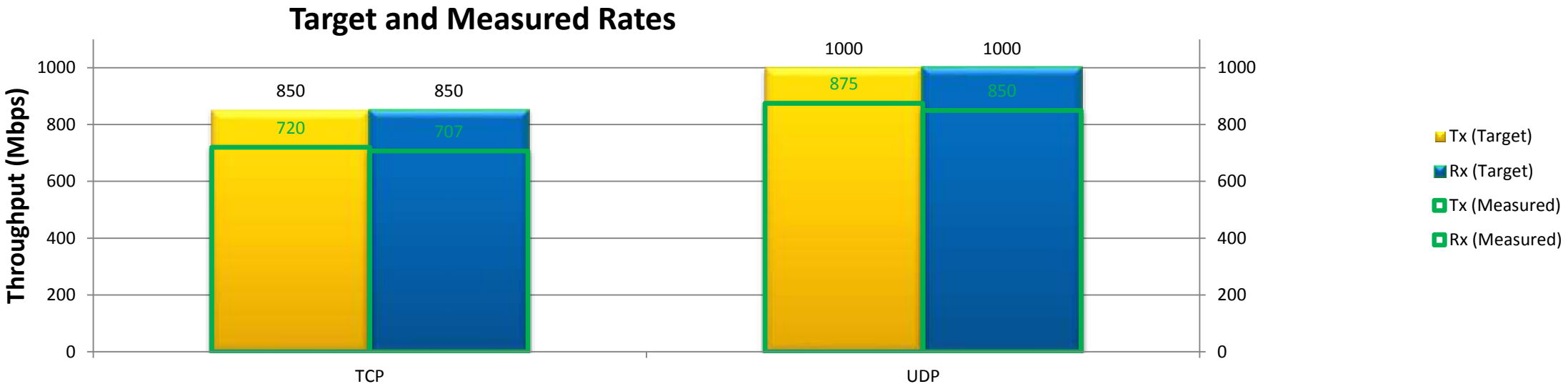
Frame size	Bi-dir throughput (IPv4)	CPU utilization	Bi-dir throughput (IPv6)	CPU utilization
64	2000	<2%	2000	<2%
128	2000	<2%	2000	<2%
256	2000	<2%	2000	<2%
512	2000	<2%	2000	<2%
1024	2000	<2%	2000	<2%
1280	2000	<2%	2000	<2%
1518	2000	<2%	2000	<2%

LS1024A delivers wirespeed performance for 64B packets without utilizing Cortex A9 CPU

LS1024A Wi-Fi 802.11ac Performance

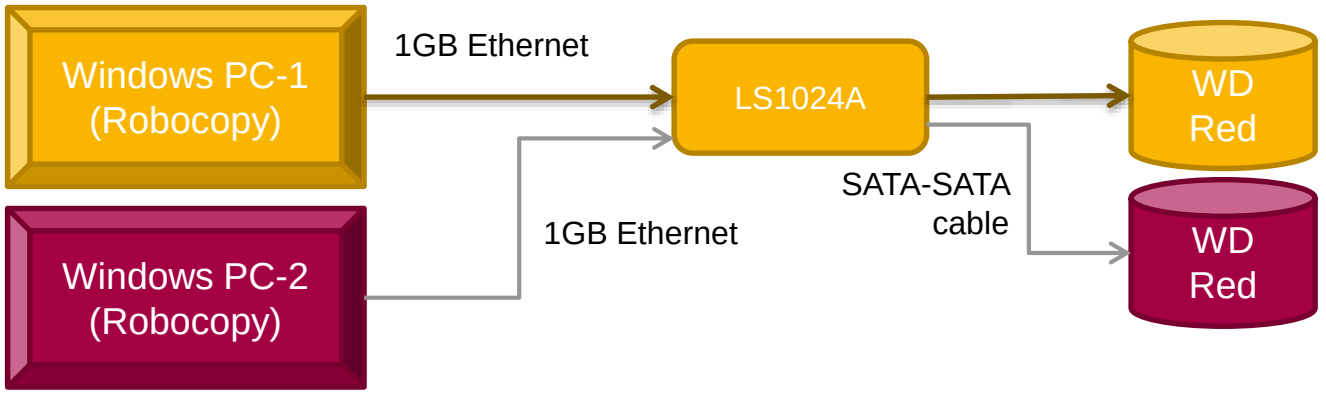
Wi-Fi :
- QCA9880 for 802.11ac 3x3



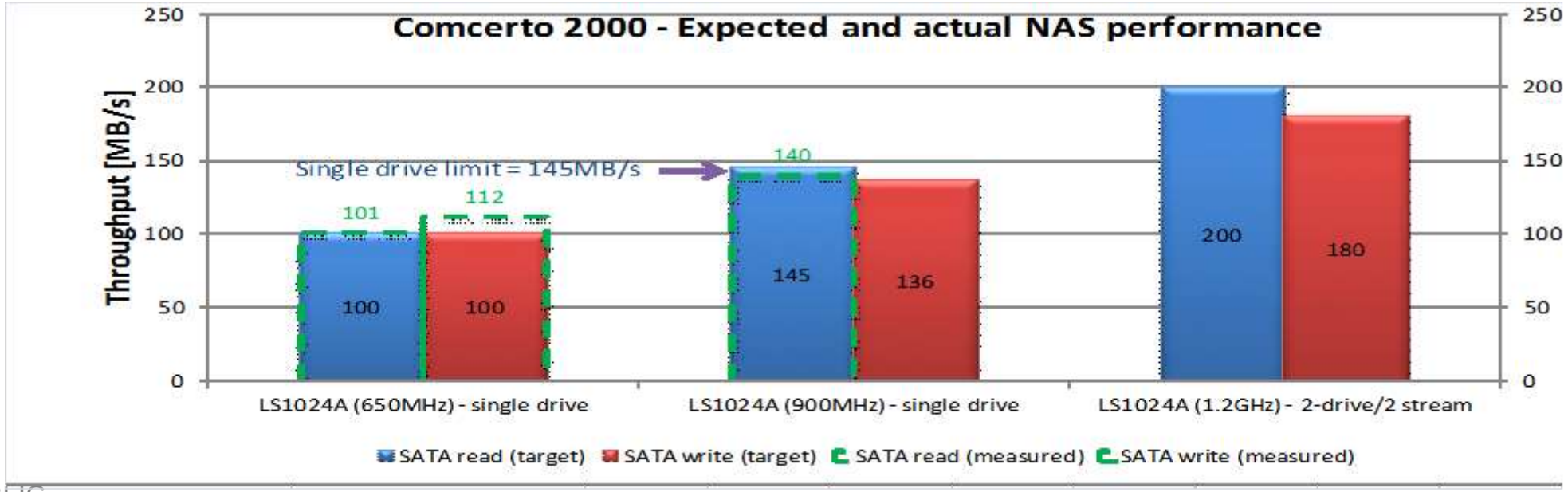


LS1024A achieves full rate 802.11n
802.11ac performance currently limited by WiFi chipset

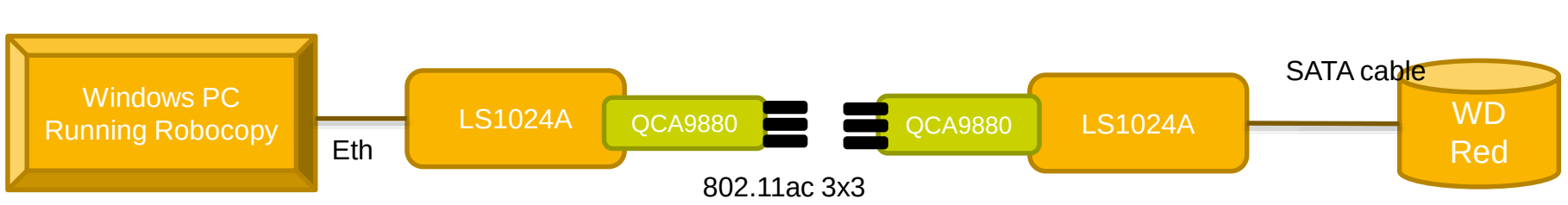
NAS Performance



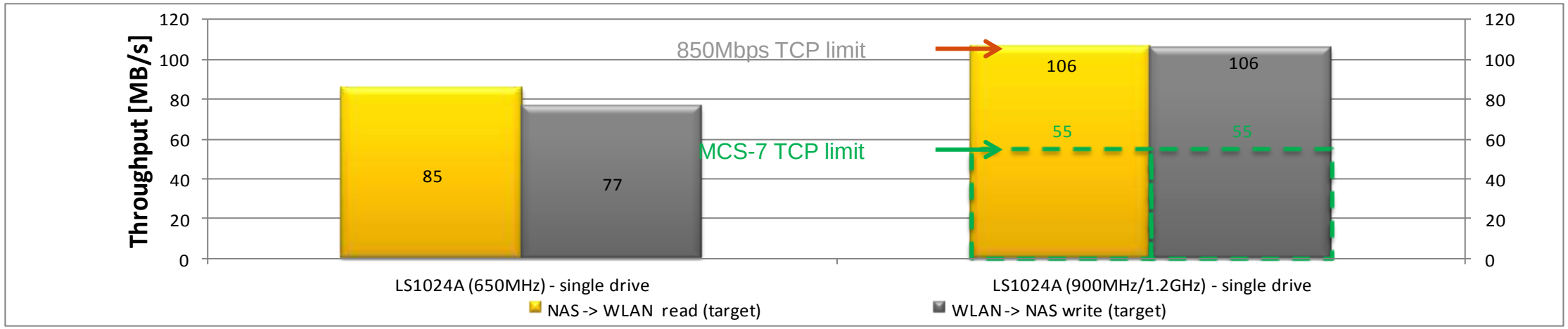
Test setup
- WD Red drives
- 4GB file copy
- Robocopy
- SMB2
- Intel i7 PC
- Second PC for 2-stream test



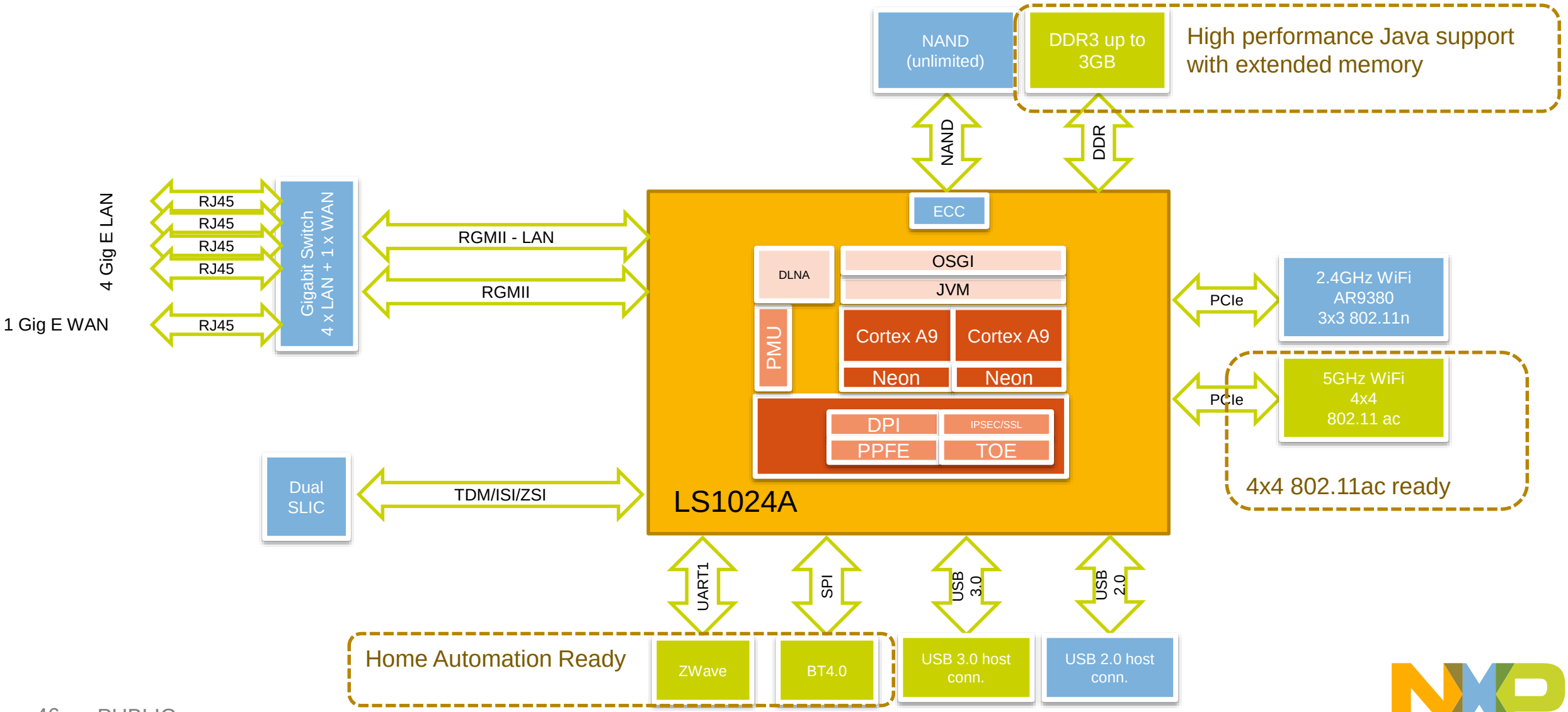
Wi-Fi NAS performance



Test setup
- WD Red drives
- 4GB file copy
- Robocopy
- SMB2
- Intel i7 PC



LS1024A BHR Typical Example



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