

OVERVIEW OF LAYERSCAPE 64-BIT ARM® OFFERING

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SENIOR PRODUCT MARKETING MANAGER

AMF-NET-T2732 | JUNE 2017



SECURE CONNECTIONS
FOR A SMARTER WORLD

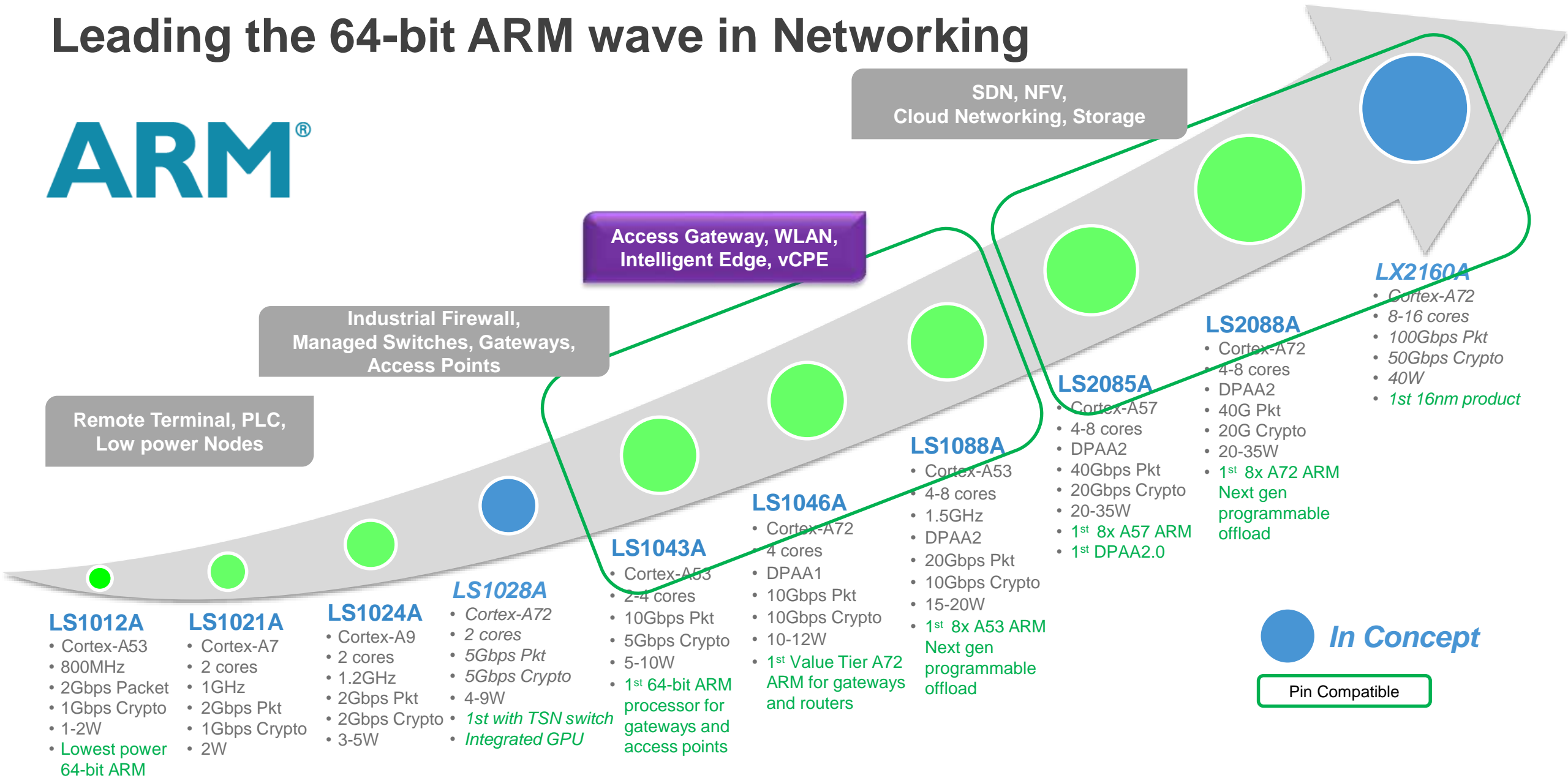
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Agenda

- Layerscape 64-bit ARM based product portfolio overview
- Highlighted products
 - LS1012A
 - LS1043A
 - LS1046A
- Small Business Router solutions offering
- Layerscape collateral access

Leading the 64-bit ARM wave in Networking



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**

LX2160A

- Cortex-A72
- 8-16 cores
- 100Gbps Pkt
- 50Gbps Crypto
- 40W
- **1st 16nm product**

SDN, NFV, Cloud Networking, Storage

Access Gateway, WLAN, Intelligent Edge, vCPE

Industrial Firewall, Managed Switches, Gateways, Access Points

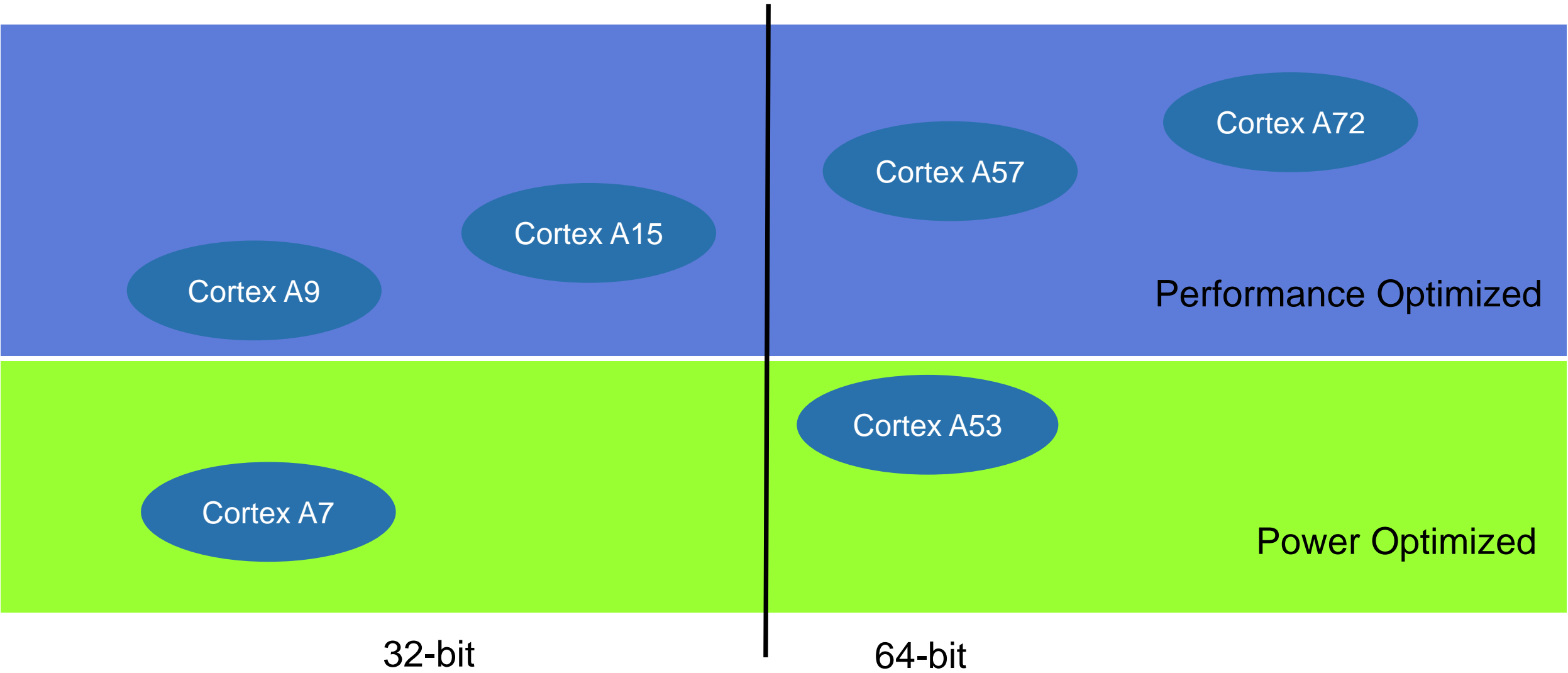
Remote Terminal, PLC, Low power Nodes

In Concept

Pin Compatible



ARM PROCESSOR CORE LINEUPS



EVOLUTION OF NETWORKING SOLUTIONS IN VALUE TIER

TRENDS



- Need for Integrated Services – **Common Platform**
- Shorter design cycles – **Increasing Turn-Key Requirements**
- Highly competitive market space – **Ease of Differentiation**
- Faster adaptation to new technology – **Flexible Outsource and Ecosystem Options**

Our Solutions



- Highly mature, scalable **Turn key solutions** for broad spectrum of market segments
- **Best in class** price/power/performance
- **Leadership** in technology innovation, Security, Virtualization, Software Defined Networking, (vCPE, OP-NFV, ONF)

Key Markets

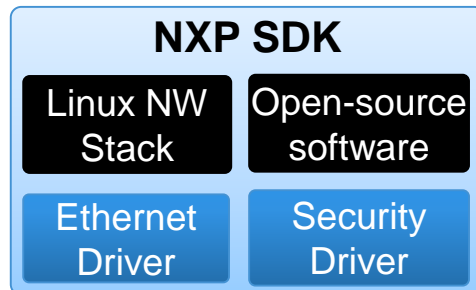


- **IoT** – Smart home, Industrial 4.0
- **Service provider** – BHR, Wireless Hotspot, SMB
- **Consumer** – Network Attached Storage, Wireless Access Point, CPE
- **Business** - SBR, Enterprise access point, Security gateway

QORIQ NETWORKING SOFTWARE

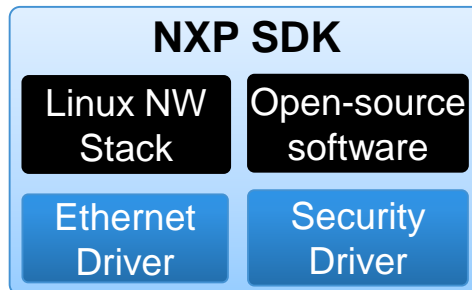
SDK:

- Optimized drivers
- Open-source Linux stacks
- Competitive performance
- Flexibility to add own applications



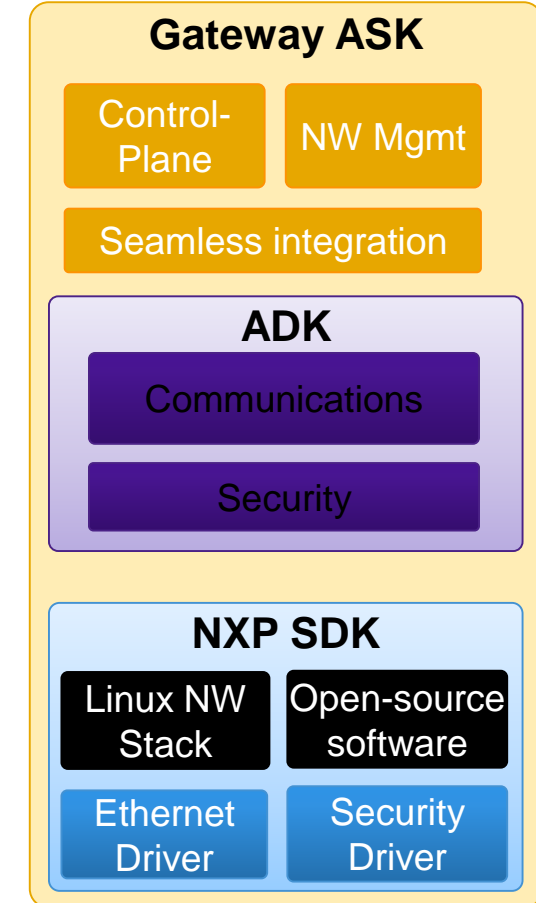
SDK + ADK:

- 4x-8x performance increase
- More headroom in CPU
- Flexibility to integrate own applications
- More features than open-source SW



ASK = SDK + ADK + more:

- All the 4x-8x performance increase +
- Full turnkey solution HW & SW
- Fastest time to market





01.

LS1012A

Introducing the Layerscape LS1012A Processor

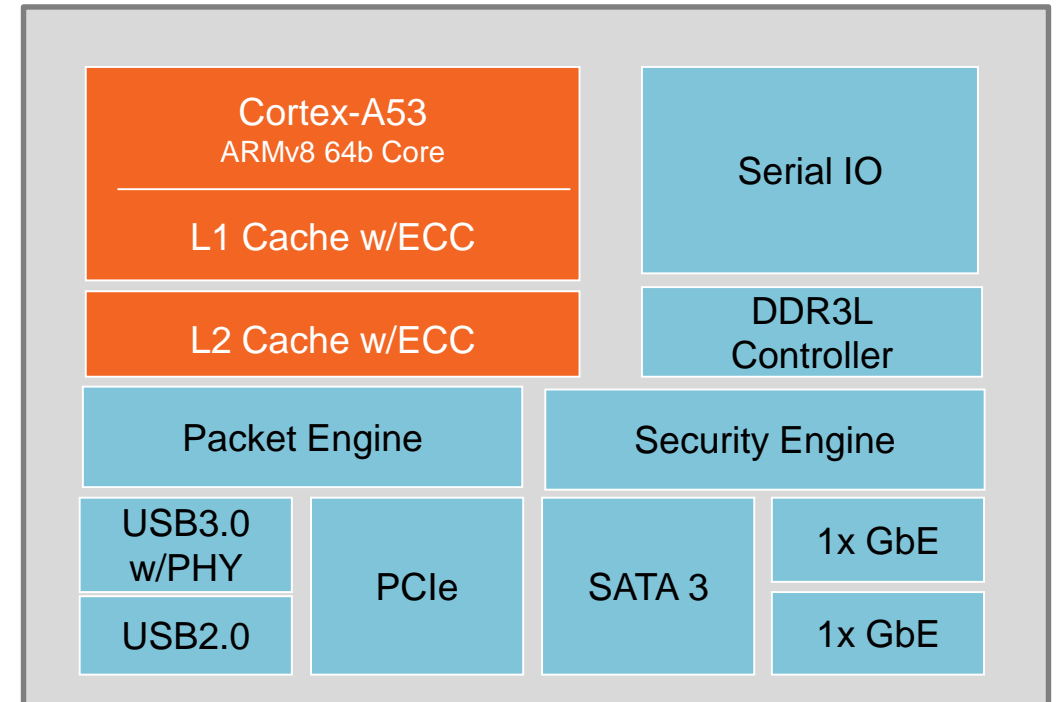
World's Smallest and Lowest-power 64-bit Processor

- 800MHz ARM® Cortex®-A53 core
- Hardware packet accelerator for line-rate networking
- Networking-grade security
- Tiny package measures just 9.6mm on a side
- Typical power consumption of only 1W



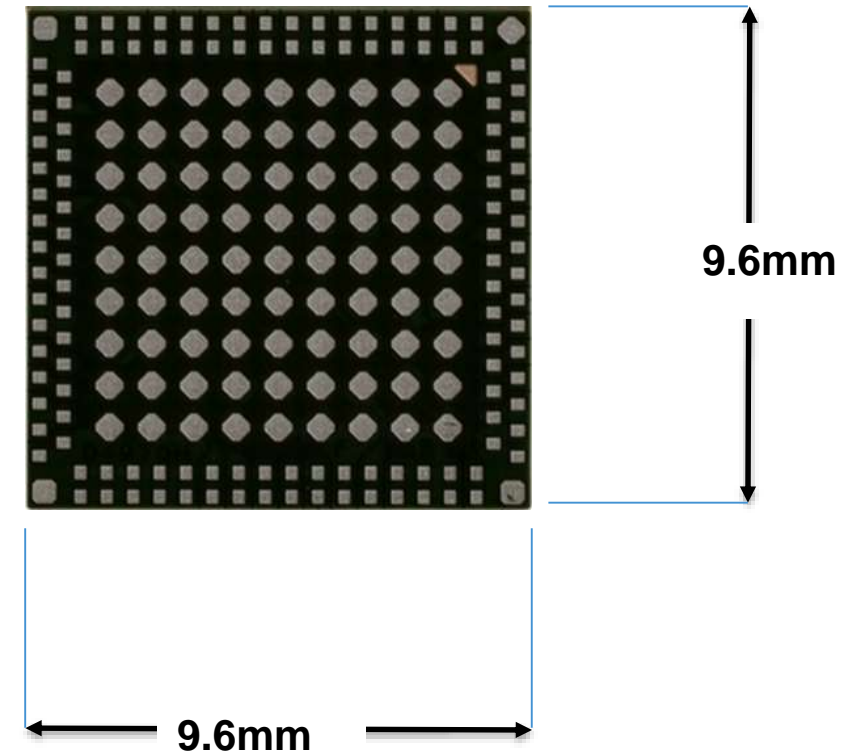
Layerscape LS1012A Key Features

- 64-bit ARM Cortex-A53 core **running up to 800MHz**
- Over **2,000 CoreMark®** of performance at **1W (typical)** power dissipation
- Hardware **Packet Forwarding Engine** for acceleration of **IP packet processing** and reduced CPU load and power consumption
- **Trust and Security acceleration** enables hardware root of trust, high performance encryption & key life-cycle management
- Integrated peripherals include **USB 3.0 with integrated PHY, PCIe, 2.5 Gigabit Ethernet and SATA3** to reduce system costs
- Enables customers to implement **scalable product families** from single to multi-core leveraging a **common 64-bit software platform**
- Supported by **general-purpose SDK** as well as optimized **application-specific software solution kits**



LS1012A ULTRA-LOW FORM-FACTOR PACKAGE

- Innovative Laminate BGA Technology
 - Signal pins in outer two pad rows with 0.5mm pitch
 - Inner balls with 0.8mm pitch used only for power and ground
- Supports cost-effective 4-layer PCB
- Enables designs with severe space constraints



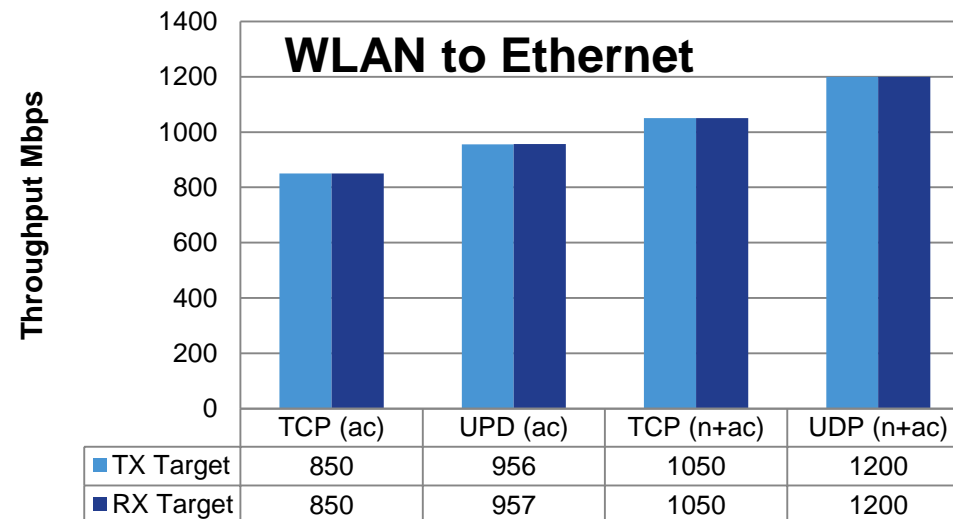
LS1012A Application Performance

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	<5%	2000	<5%
128	2000	<5%	2000	<5%
256	2000	<5%	2000	<5%
512	2000	<5%	2000	<5%
1024	2000	<5%	2000	<5%
1280	2000	<5%	2000	<5%
1518	2000	<5%	2000	<5%

Security Applications (3DES/SHA1)

Frame size (B)	Bi-dir throughput (IPv4) - Mbps	CPU utilization
256	517	<5%
512	904	<5%
1024	1374	<5%
1280	1378	<5%
1400	1424	<5%
1518	1193	<5%



New Applications Made Possible With the LS1012A



Better home automation & security
Higher performance, battery-backed aggregation



Portable Wireless Storage
On the go access to Terabytes of data



Mobile Wi-Fi routers
Enable gigabit-class portable Wi-Fi

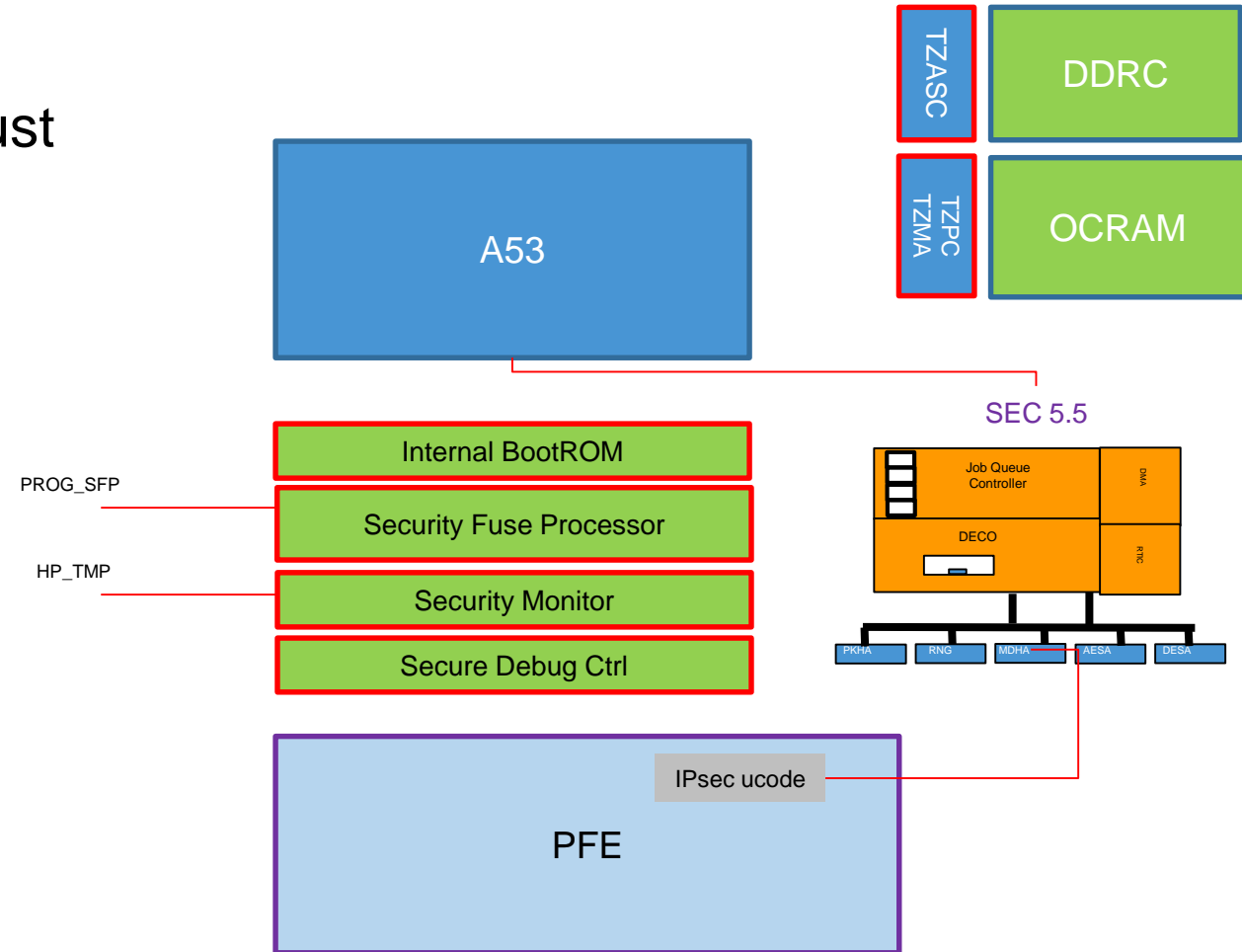


Industrial IoT
Making high-speed low-power networks pervasive

LS1012A SECURITY & TRUST ARCHITECTURE FEATURES

- Security Capabilities Supported

- Secure boot – hardware root of trust
- Secure key handling
- Tamper detection
- Secure manufacturing
- Secure debug
- ARM TrustZone
- Cryptographic acceleration

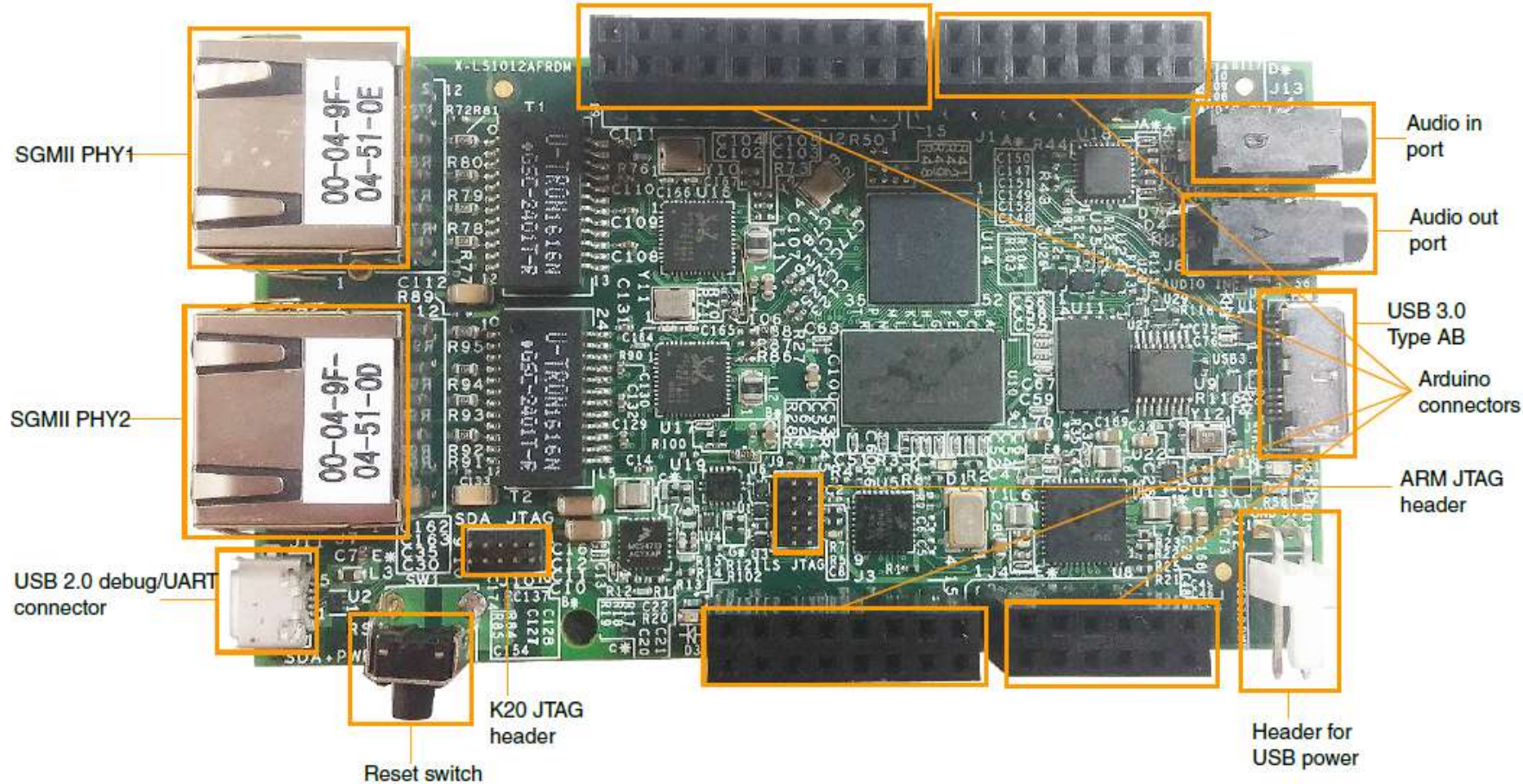


Enablement to Help to Speed Time-to-Market

- **Feature-rich Reference Design Board** for customer evaluation and proof of concept
- **Software Development Kit (SDK)** – rich Linux development environment
 - Enables General Applications Including Industrial & Networking
- **Application Solution Kits (ASKs)** – based on OpenWRT
 - Vertically integrated solution speeds time-to-market
 - Optimized Linux-based software platforms with hardware acceleration
 - Broadband IoT Gateways & Routers
 - Networked Storage
- **Plus...** a variety of tools, boards and operating systems from **3rd party partners**



FRDM-LS1012A board – get started with Layerscape for \$49.95



- **Key features**
 - Credit-card size
 - 4-layer PCB
 - USB-powered
 - 2x GbE
 - 1x USB3.0 OTG
 - Arduino Expansion header:
 - SPI
 - I2C
 - UART
 - GPIO
 - Headphone output
 - Microphone input
 - Layerscape SDK

LS1012A Software Offering

Software Platform	Description	Pricing	Enables
SDK (Yocto-based)	<ul style="list-style-type: none"> • General-purpose Linux SDK, supporting all QorIQ processors • Yocto build environment 	<ul style="list-style-type: none"> • Free of charge 	<ul style="list-style-type: none"> • Scalable networking, industrial and consumer applications • Migration from older QorIQ devices
Application Solution Kit (BHR)	<ul style="list-style-type: none"> • Optimized Linux networking solution with hardware packet acceleration • OpenWRT build environment 	<ul style="list-style-type: none"> • \$10,000 for source code 	High performance and fast time to market for broadband networking applications such as gateways & routers
Application Solution Kit (NAS)	<ul style="list-style-type: none"> • Optimized Linux networking solution with hardware packet acceleration • OpenWRT build environment 	<ul style="list-style-type: none"> • \$10,000 for source code 	High performance and fast time to market for consumer network attached storage & other HDD or SSD based applications



02.

LS1043A

QorIQ LS1043A at a Glance

Advanced 64b Quad Core ARM A53 Supporting Network Edge Services



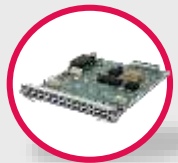
Smart Edge Access

- Leading headroom for branch router & WLAN services
- Multicore for VM services
- Hardware offload for secure edge tunneling
- Glueless HDLC & TDM support



Industrial Automation

- Industrial protocol support
- 10yr life & extended temp



Line Cards & Control

- 64bit ISA & high performance memory for fast computing
- 10G Base-KR backplane I/O

**Best CPU headroom in its class
for Smart Edge, virtual Branch
Router & WLAN applications**

Performance Leading SoCs

- Quad ARM A53 CPUs, 64b, up to 1.6GHz
- Future Proof, Low Power Memory DDR4
- Extensive Hardware Virtualization
- Secure Boot

Advanced Packet Processing

- Packet Parse/Classify/Distribution engines
- flow control & granular traffic management
- Leading 2.5Gbps IMIX Single-pass en/decryption engine

Fast, Flexible Network Interfaces

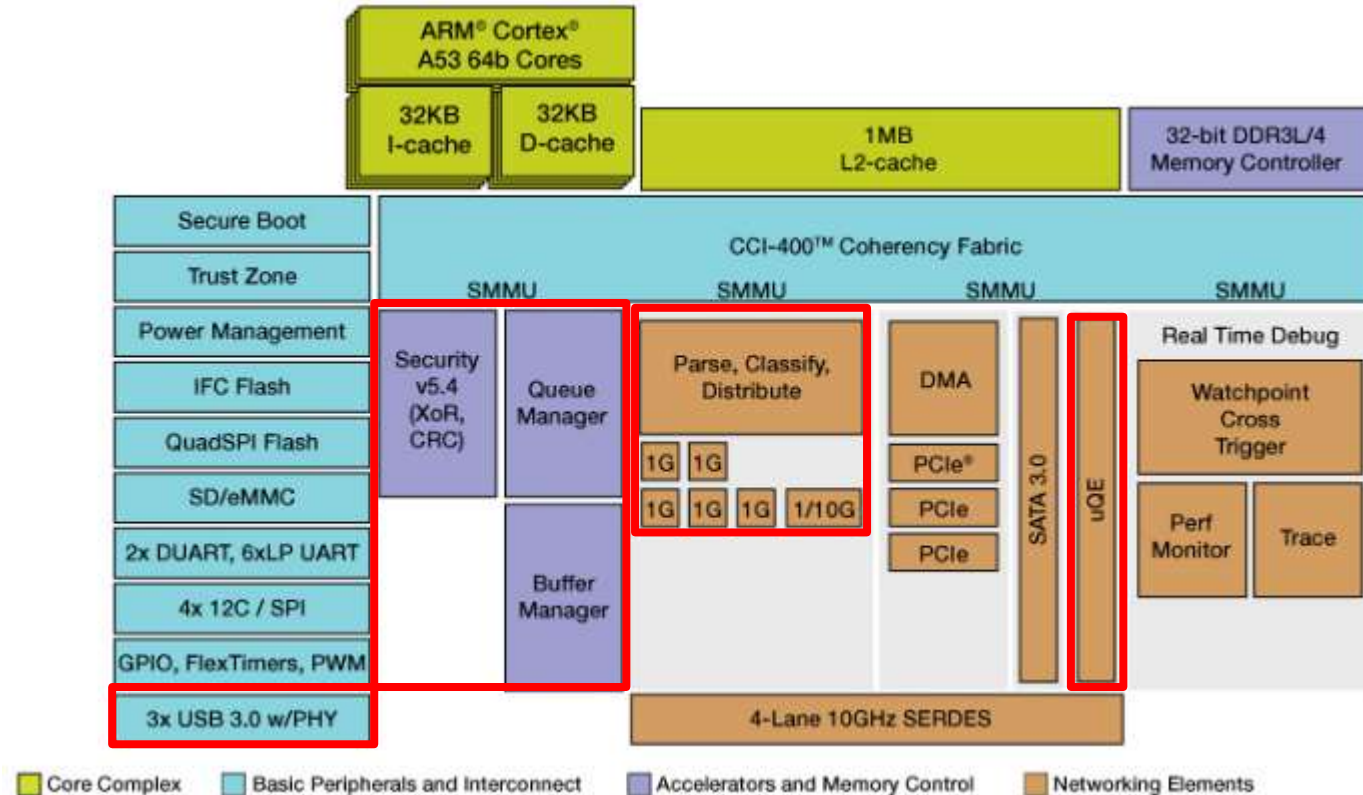
- Up to 6x GbE with 2.5G options plus 10GbE XFI
- Integrated QUICC Engine for glueless HDLC, TDM, Industrial Protocols
- 3x USB 3.0 interfaces for highest speed LTE, Storage & Peripheral options

Highest Processing Efficiency

- Up to 16K Coremarks at 8 watts

LS1023/43A: Solution for Smart Edge, Access Industrial and WLAN

Industry's most efficient quad core SoC communications processor solution



Core complex

- 4x 64-bit Cortex-A53 with Neon SIMD engine
- Speed up to 1600 MHz
- Parity and ECC protected 32 KB L1 instruction and 32 KB L1 data cache
- 1 MB L2 cache with ECC protection

Basic peripheral and Interconnect

- 3x USB 3.0 controllers with integrated PHY
- 2x eSDHC controllers supporting SD 3.0, eMMC 4.4 and eMMC 4.5 modes

Networking elements

- Packet parsing, classification, and distribution
- Queue Management for scheduling, packet sequencing and congestion management
- Hardware buffer management for buffer allocation and de-allocation
- Up to four SGMII supporting 1 Gbps
- Up to two SGMII supporting 2.5 Gbps
- Up to one XFI supporting 10 Gbps
- Up to one QSGMII
- 3x PCI Express Gen 2 controller
- 1x SATA Gen 3.0 controller

Accelerators and Memory Control

- 1x 32-bit DDR3L/4 Controller with ECC support up to 1.6 GT/s
- Security Engine (SEC)
- QUICC Engine supports TDM and HDLC
- QorIQ Trust architecture: Secure boot, ARM Trust zone and security monitor

Qualification

- Commercial and extended temperature PUBLIC | 18

Target Applications:

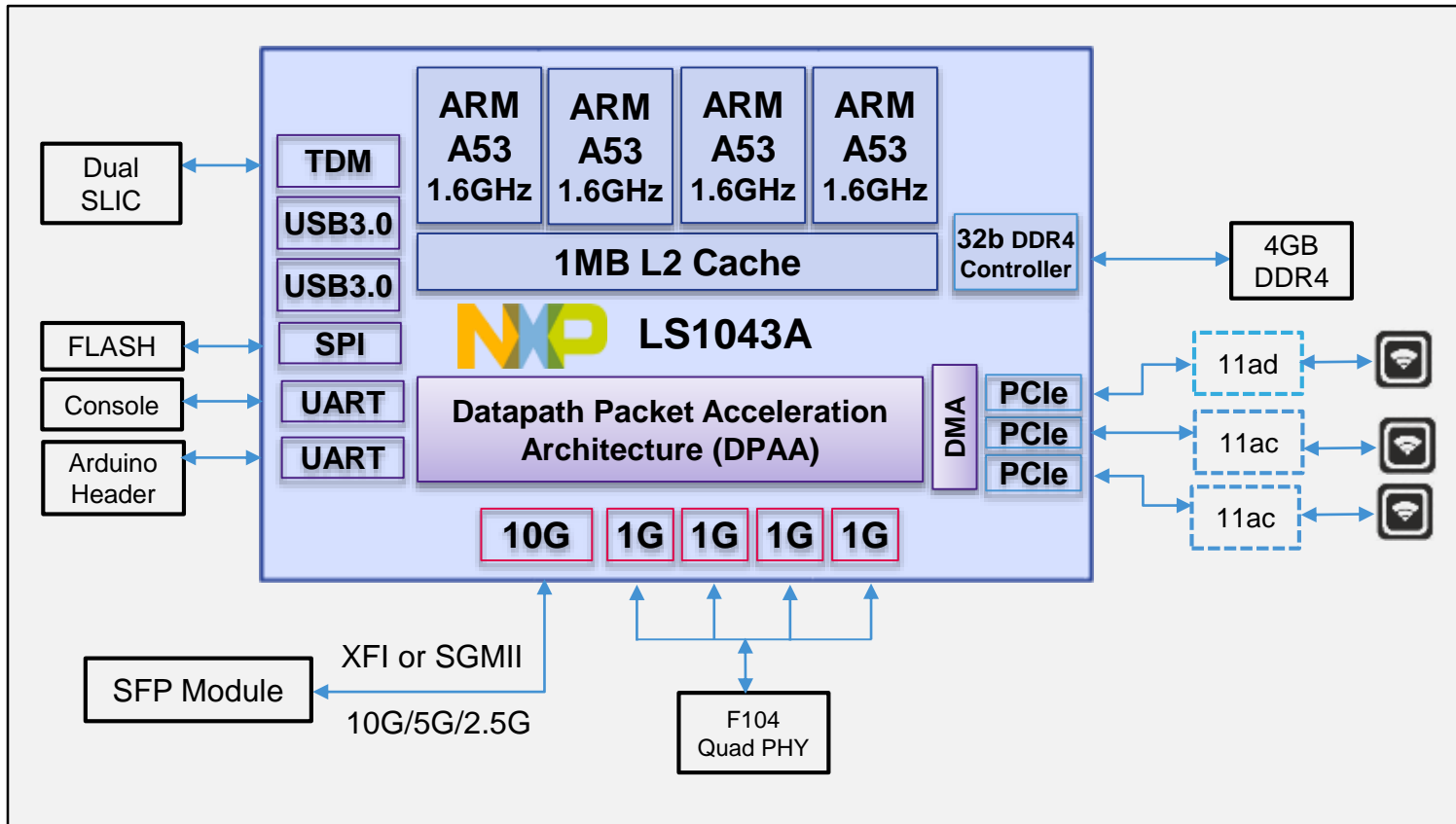
- Integrated services
- Branch office routers
- vCPE and other edge equipment

- Multi-protocol IoT gateways
- Industrial PLC and control
- Security appliances

Development platforms:

- [LS1043A-RDB](#)
- [LS1043A-RGW](#)

LS1043A Residential Gateway Reference Design



- LS1043A – 4x A53 @ 1.6GHz
- 4GB DDR4 DRAM with ECC
- 2GB NAND Flash
- SFP+ Cage for WAN upto 10G
- 4x 1GbE LAN ports
- 1x 1GbE for console
- 2x RJ11 for POTS
- 2x RJ11 for bonded xDSL
- 1x SD Card slot

Application Software

- OpenWRT based Linux
- Wifi offload with virtual wifi driver
- Data path offload for packet forwarding
- Available with BHR ASK

Available on
www.nxp.com/ls1043a-RGW





03.

LS1046A

QorIQ LS1046A at a Glance

High Performance A72 Cores for Broad Applications Across the Embedded Networking Space



Enterprise Access Points

- ✓ 3xPCIe 3.0 + 3xUSB 3.0
- ✓ Proven with variety of radio partners
- ✓ Maximum headroom (upto 70%) for 11ac, 11ad (60GHz) wifi



Industrial Automation

- ✓ High performance/watt at 1.8GHz
- ✓ Spread of compute performance b/w pin compatible LS1023/43/26/46A
- ✓ 3xPCIe 3.0 + 3xUSB 3.0 and I/Os for sensors



Virtualized CPE (vCPE)

- ✓ 2x 10GbE + 1x 2.5GbE + 5x 1GbE
- ✓ 8W fanless design
- ✓ DPDK support, UEFI installation
- ✓ KVM, Docker container support

Best CPU headroom in its class for Smart Edge, virtual Branch Router & WLAN applications

High Performance Power Efficient SoC

- Quad ARM A72 CPUs, 64b, up to 1.8GHz
- Future Proof, Low Power Memory DDR4 64b support
- Extensive Hardware Virtualization
- Secure Boot

Advanced Packet Processing

- Packet Parse/Classify/Distribution engines
- Lossless flow control & granular traffic management
- Upto 7.9Gbps of crypto acceleration

Fast, Flexible Network Interfaces

- Up to 4x GbE with 2.5G options and dual 10GbE XFI for extreme connectivity
- 3x USB 3.0 interfaces for highest speed LTE, Storage & Peripheral options

Highest Processing Efficiency

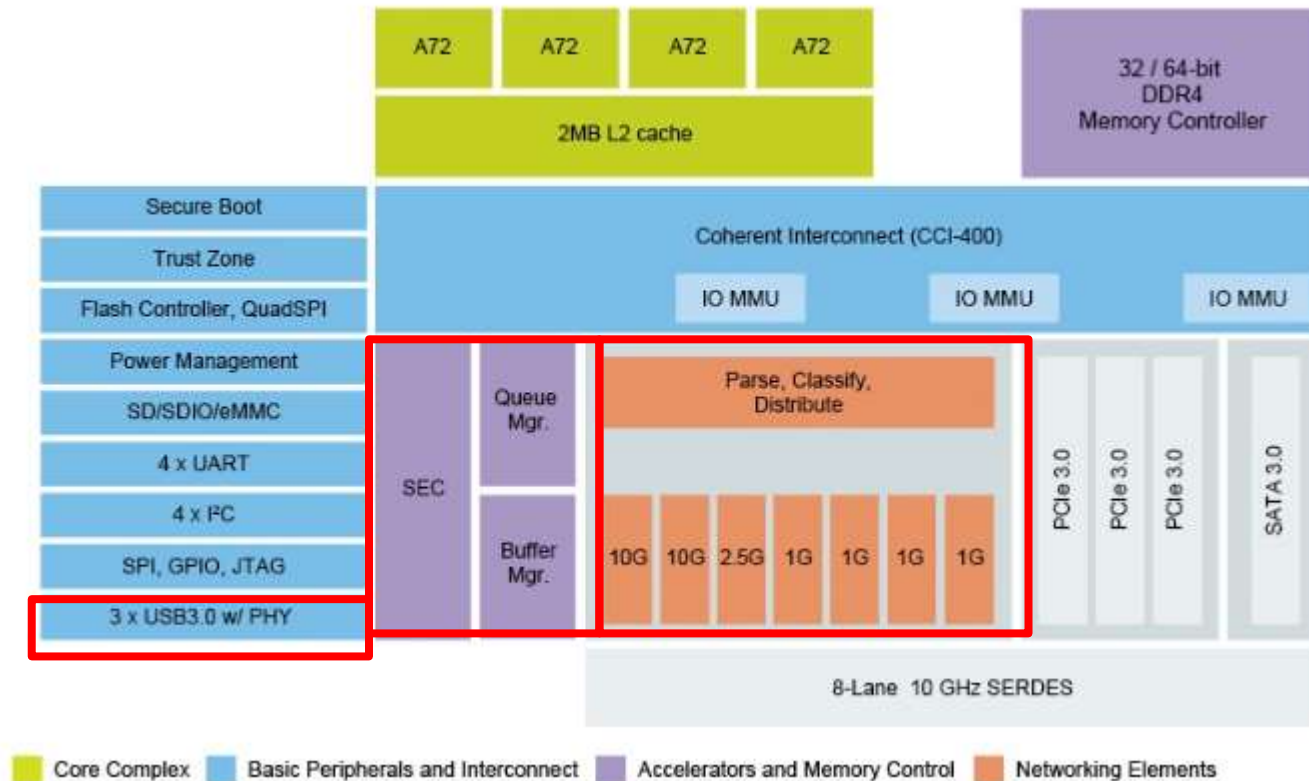
- Up to 45K Coremarks at 8 watts typical
- Upto 20Gbps of IP Forwarding

Scalable and Portable

- Pin compatible with the LS1 family of processors (LS1043A/LS1088A)
- Software portability with same offload architecture

LS1026/46A: Dual/Quad ARM Cortex A72 Processor

High Performance SoC for Virtualization



Target Applications:

- Enterprise routers and switches
- Linecard controllers
- Network attached storage
- Security appliances
- Virtual customer premise equipment (vCPE)
- Service provider gateways
- Single board computers

Development platforms:

- [LS1046A-RDB](#)

Core complex

- 4x 32/64-bit Cortex-A72 with Neon SIMD engine
- Speed up to 1800 MHz
- Parity and ECC protected 48 KB L1 instruction and 32 KB L1 data cache
- 2 MB L2 cache with ECC protection

Basic peripheral and Interconnect

- 3x USB 3.0 controllers with integrated PHY
- 1x eSDXC controllers supporting SD 3.0, and eMMC 4.5 modes

Networking elements

- Packet parsing, classification, and distribution
- Queue Management for scheduling, packet sequencing and congestion management
- Hardware buffer management for buffer allocation and de-allocation
- Up to five SGMII supporting 1 Gbps
- Up to three SGMII supporting 2.5 Gbps
- Up to two XFI supporting 10 Gbps
- Up to one QSGMII
- 3x PCI Express Gen 3 controller
- 1x SATA Gen 3.0 controller

Accelerators and Memory Control

- 1x 32-bit DDR4 Controller with ECC support up to 2.1 GT/s
- Security Engine (SEC)
- QorIQ Trust architecture: Secure boot, ARM Trust zone and security monitor

Qualification

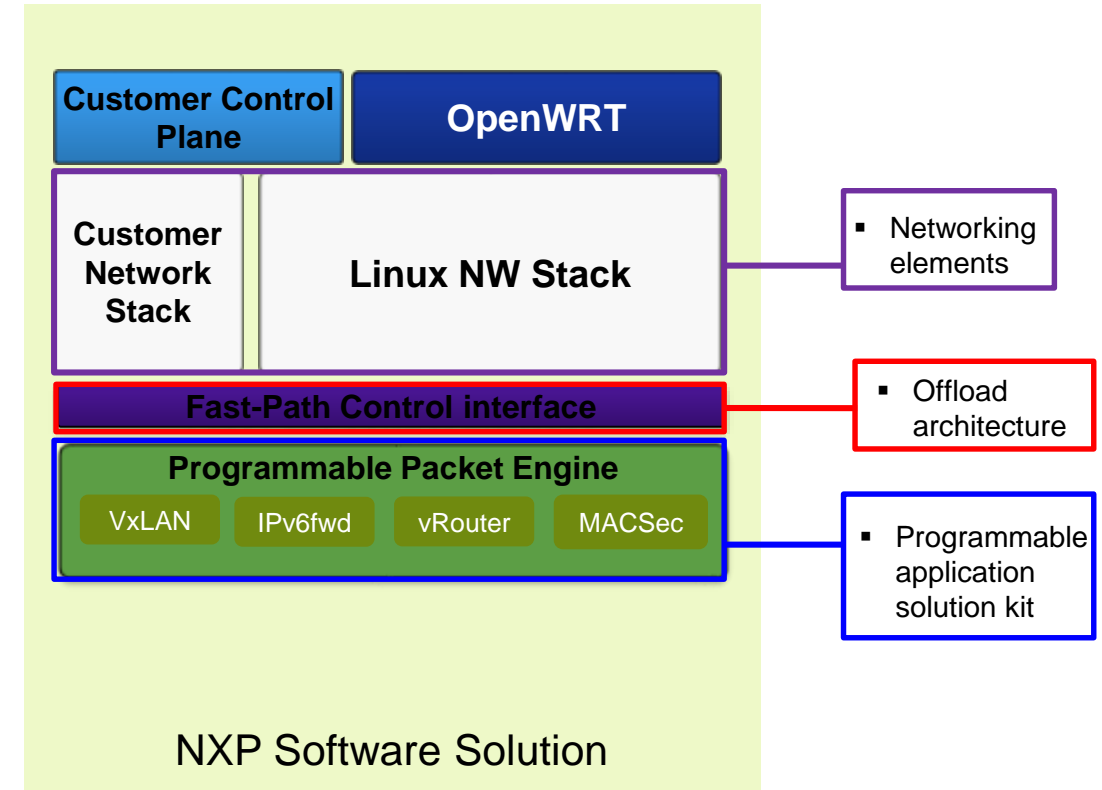
- Commercial and extended temperature

LS1046A COMPLETE SOLUTION

Available Now!



Fully integrated turnkey solution to enable faster time to market



Order now on - www.nxp.com/ls1046ardb

Turnkey software packages
BHR ASK, **NAS ASK**



04.

Small Business Router solutions

Why NXP solutions for SMB Market?

✓ *Harmonized silicon & software*

- Widest portfolio of 64 bit ARM
- Feature rich commercial software stack
- H/W Data path acceleration for efficient performance

✓ *Portfolio of scalable solutions*

- Wider market coverage
- Seamless migration



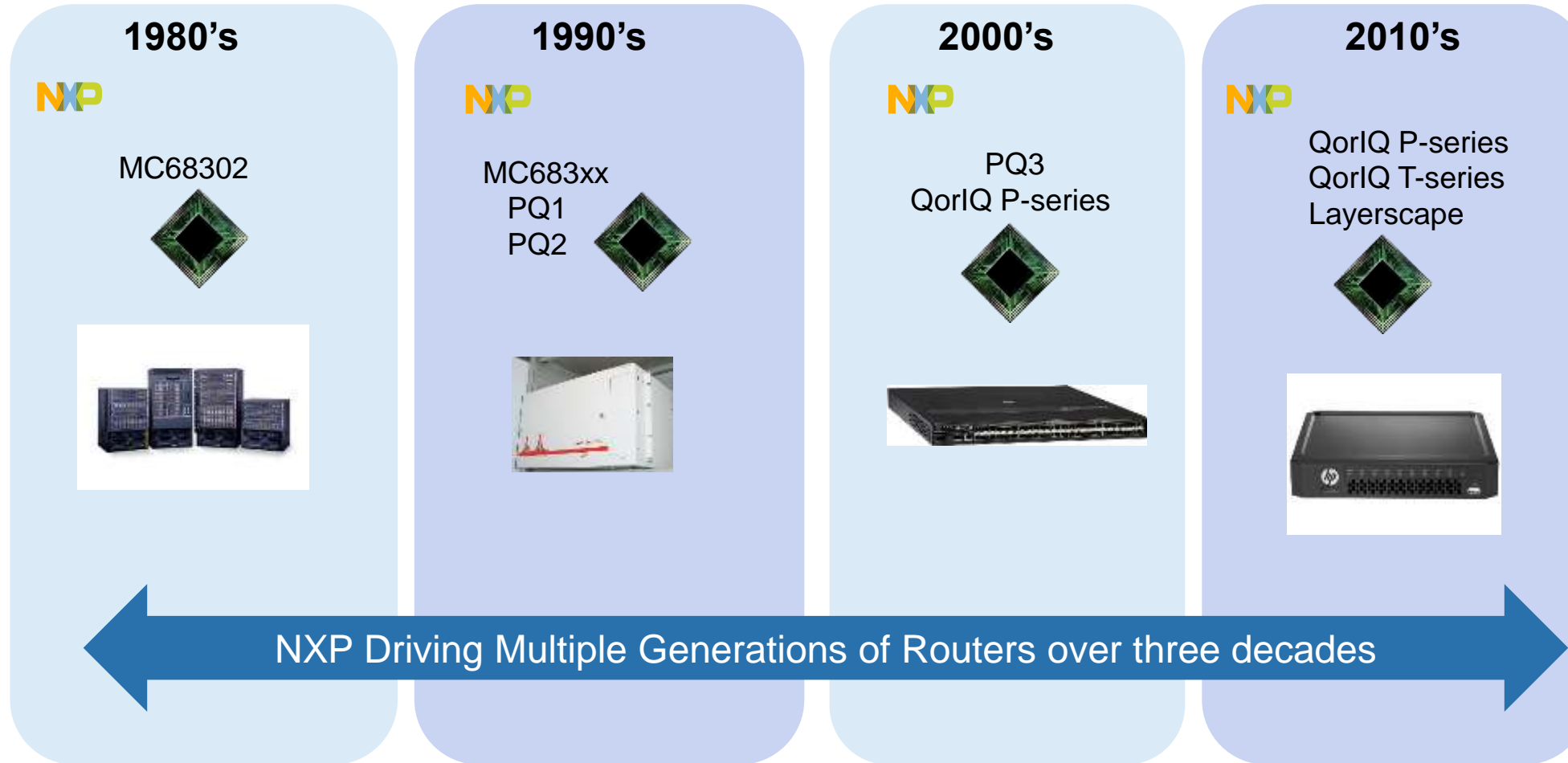
✓ *Rich partner eco system*

- “Ready to ship” ODM platforms
- Pre integrated & optimized DPI stack from partners
- Quick Time to Market

✓ *Best in class support & services*

- Customizable software for tailor made needs
- Un matched support with guaranteed response time

Market Leadership in SMB and Enterprise Multiservice Routers

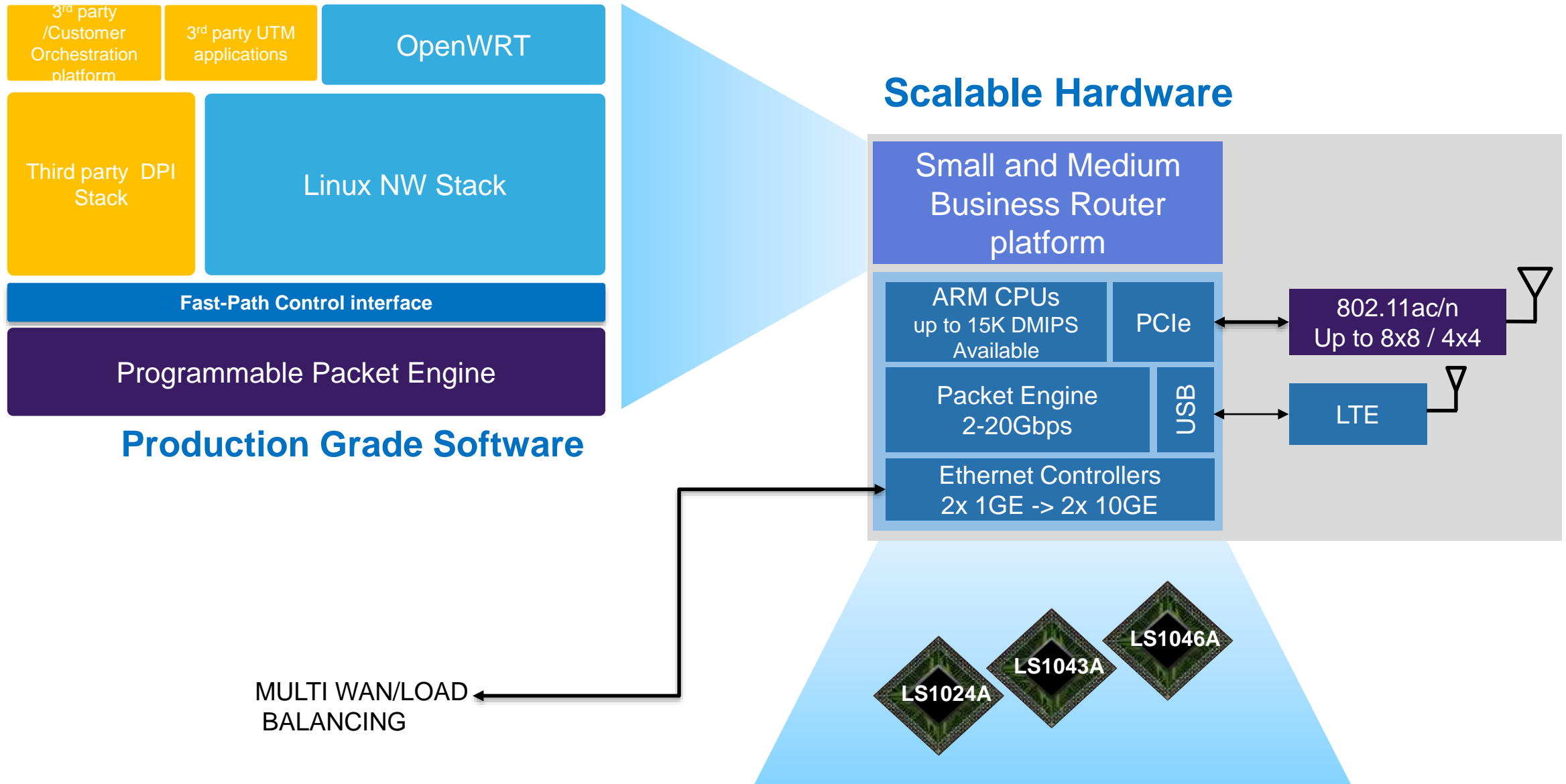


NXP communications processors are in over 80% of SMB Routers currently in the market

Note: **NXP** includes Motorola SPS & Freescale products

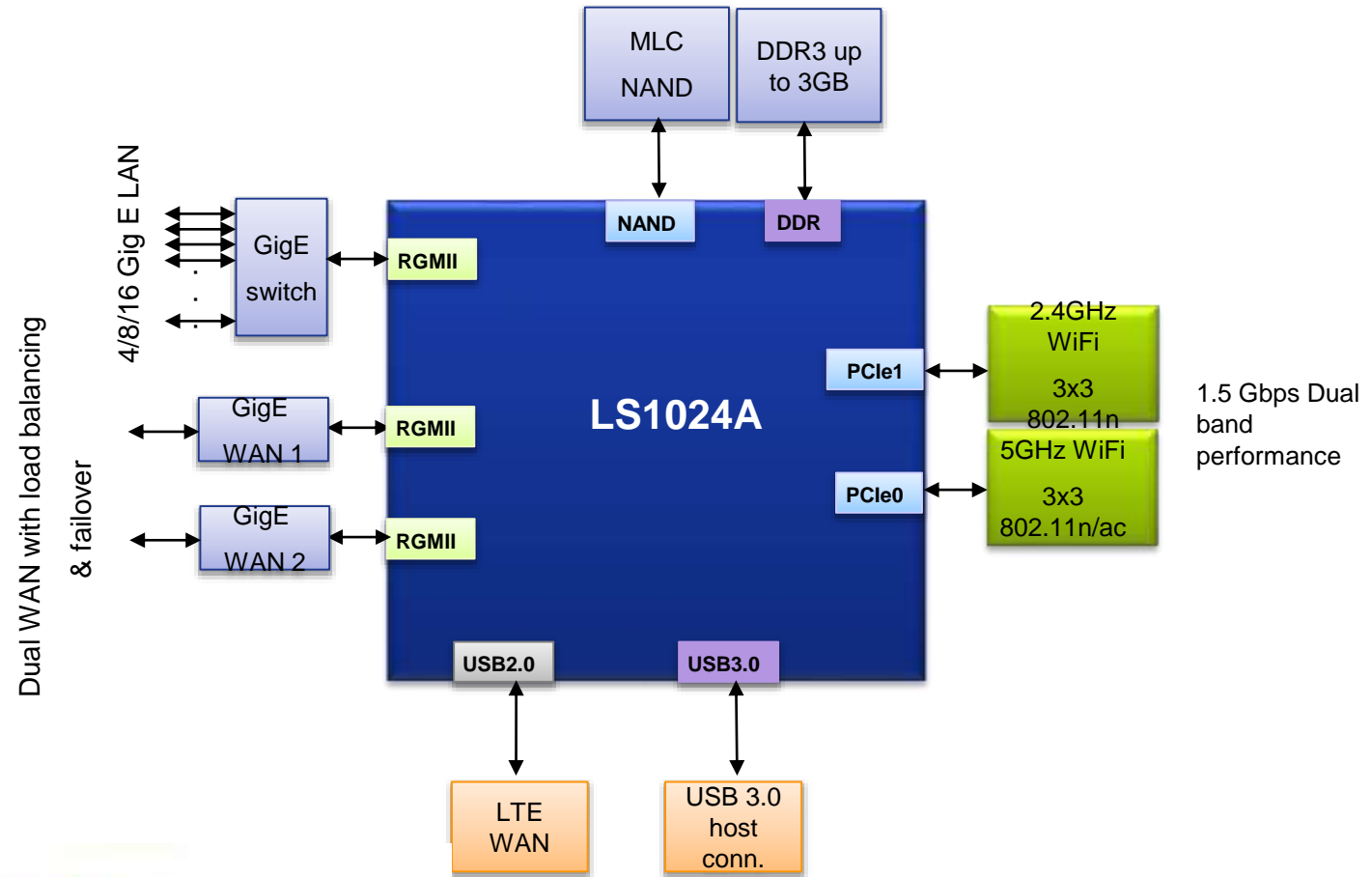


Scalable Small & Medium Business Router solutions



LS1024-based High Performance Multi WAN SMB Gateway with Dual-band Wi-Fi Support

- Production Grade Software platform
- Pre-integrated layer 7 security applications
- Advance VPN features
- Dual WAN with load balancing and redundancy capabilities
- Best in class performance
- In production, available now



Small Business Router ASK features overview

WAN	LAN	VPN	NAT & Firewall	Routing & QoS	IPv6
All BHR ASK features	All BHR ASK features	All BHR ASK features	All BHR ASK features	All BHR ASK features	Prefix delegation
*L2TP	Dynamic DNS	VPN Redudancy	Soft DMZ	RIP v1/v2	Stateless address configuration
*PPTP	802.1x, AAA	VPN failover	*NAT Hairpin	OSPFv3	DHCPv6
*USB as WAN	IP & MAC Binding	*Hub and Spoke VPN	DoS Prevention	BGP	IPv6 CP
WAN Failover	MAC filtering	IKE v2	**Layer 7 security (application visibility & control)	*Application based QoS	*Dual Stack (RFC4213)
WAN Load balancing	Management	*NetBIOS over VPN	**Web and content filtering	Ingress Rate limiting	*PPTPv6
*VLANs on WAN	All BHR features	*Multicast over VPN	**Anti virus & IPS		*6to4 Tunneling
	stream/tunnel/inte rface stats	*GRE over IPsec	*Time based Scheduling	Wireless LAN	RADVD
	SNMP	PPTP VPN Server	HTTP Proxy	All BHR ASK features	*6in 4 Tunneling
	LLDP	L2TP VPN server		App based QoS	*6RD
	Email Alerts	*SSL VPN		Captive portal	*NAT-PT
	Dual Firmware			WPS	*IPv6 Firewall
	Remote recovery			WDS	
				Rouge AP detection	

* Data path acceleration by dedicated packet forwarding & crypto engines

** pre integrated 3rd party partner features

SMB Solutions Summary

- Commercial SBR stack with value added features
- Optimized HW data path acceleration
- Pre integrated & optimized DPI/security features
- Supported on a portfolio of products
- Fast Time to Market with clear differentiation
- ODM reference designs **available now**



- **You can also contact the following Product Managers for details on SMB Routers-**
- **Jim Bridgwater:** jim.bridgwater@nxp.com
- **Naveen Vyakaranam:** naveen.vyakaranam@nxp.com



05.

Common collateral

FINDING THE RIGHT COLLATERAL

- All information is available on NXP.com
- [Product page](#)
- [Reference design board](#)
- [Collateral needed](#)
 - Data Sheet
 - Reference Manual
 - Application Notes
 - Design Checklist
 - AN5012 –LS1043A, AN5192 –LS1012A
 - AN5097, Hardware and Layout Design Considerations for DDR4 SDRAM Memory Interfaces - Application Note (REV 0)

SOFTWARE



Linux OpenWRT

- U-Boot
- BSPs
- Linux Kernel 4.1
- Linux file system
- Application drivers
- Crypto Acceleration Engine

AVAILABLE
NOW



BHR ASK

- Small Business Router
- Next Gen Broadband Router
- Integrated services
- Enterprise Access Point
- Security Gateway

AVAILABLE
NOW



NAS ASK

- Personal Storage
- Wireless Personal Storage
- Chip on Drive
- NAS

Early Access Release
Available NOW

Learn More at [SOFTWARE SOLUTIONS](#)

CodeWarrior Development Suites for Networked Applications

- **Overview**

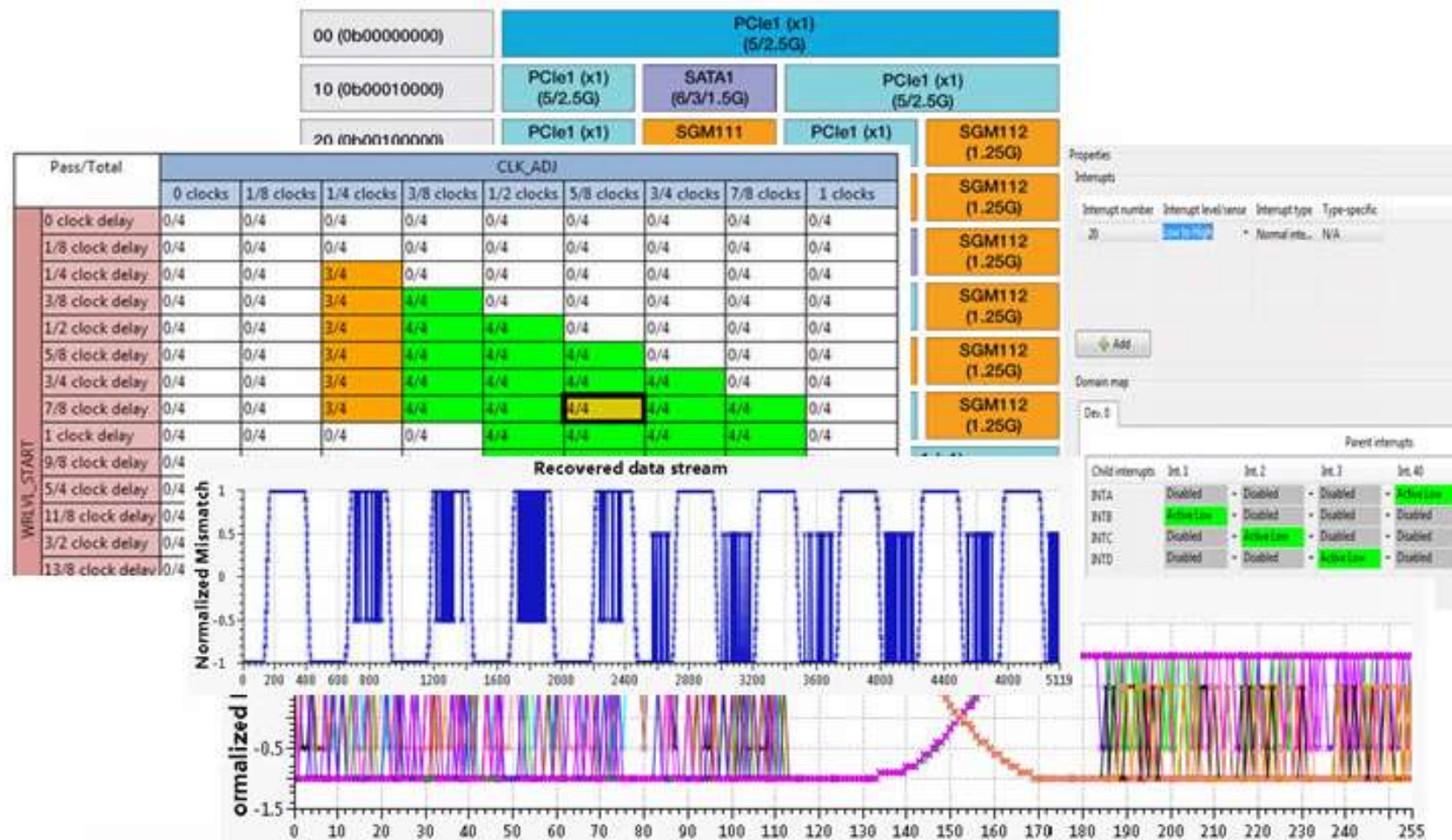
- Enhance the success of your networked design by utilizing one of the suites from the CodeWarrior Development Suites for Networked Applications. The following are the benefits you will gain from our networking-focused suites

- **Benefit**

- The development suites support ARM® technology
- Merges the best aspects of Eclipse, GDB, GCC & NXP into a single IDE
- Use the tools that NXP uses to simplify & speed support
- Far easier bring-up than uboot brute force
- Registers name/info from users manual by reg/bit field available in debugger
- Continuity with all NXP QorIQ processors using CW
- Multiple debug configs possible to fit every situation

- For more information please visit <http://nxp.com/cw4net>

Processor Expert Software: QorIQ Configuration and Validation Suite



- http://www.nxp.com/products/software-and-tools/software-development-tools/codewarrior-development-tools/suite-for-networked-applications/qorIQ-configuration-and-validation-suite:PE_QORIQ_SUITE#

CodeWarrior Debug

- Create a RCW override file using information in the video link below
 - <http://www.nxp.com/video/how-to-create-a-rcw-override-configuration-file-for-use-in-a-CodeWarrior-qorIQ-debugger:RCW-QORIQ-DEBUGGER>
- Use the RCW override file to override the RCW using CodeWarrior
 - <http://www.nxp.com/video/how-to-use-qorIQ-rcw-override-feature-in-codewarrior:HOW-TO-USE-QORIQ-RCW-CODEWARRIOR>
- More details can be found in the User guide for CodeWarrior ARM v8
 - http://cache.nxp.com/files/soft_dev_tools/doc/user_guide/CWARMv8TM.pdf?fpsp=1&WT_TYPE=Users%20Guides&WT_VENDOR=FREESCALE&WT_FILE_FORMAT=pdf&WT_ASSET=Documentation&fileExt=.pdf



SECURE CONNECTIONS
FOR A SMARTER WORLD