

DIGITAL NETWORKING SOLUTIONS PORTFOLIO AND ROADMAP

LEO GAO
APAC MARKET

MAR 2017



SECURE CONNECTIONS
FOR A SMARTER WORLD

A NEW POSITION OF STRENGTH TO BETTER SERVE OUR CUSTOMERS

- ✓ #1 Automotive
- ✓ #1 Broad-Based MCUs¹
- ✓ #1 Secure Identification
- ✓ #1 Communications Processors
- ✓ #1 RF Power Transistors
- ✓ #1 Small Signal Discretes



SECURE CONNECTIONS
FOR A SMARTER WORLD

- ✓ **5th Largest** semiconductor company²
- ✓ **45,000** employees
- ✓ **11,000** engineers
- ✓ **9,000** patent families
- ✓ **50+** year history
- ✓ **\$9.8B** annual revenue³

Sources for market data: HIS, ABI Research, Strategy Analytics, The Linley Group

¹MCU market excluding Automotive

²Excludes memory

³Pro forma revenue resulting from Dec 2015 acquisition of Freescale Semiconductor and Nov 2015 divestiture of Bipolar Power business

Accelerating Secular Trends Drive Growth Opportunities

Everything Smart



40B+ devices with
intelligence shipped in 2020

Processing

Everything Connected



1B+ additional consumers online,
30B+ connected devices

Connectivity

Everything Secure



Potential economy savings
up to half trillion dollars

Security

Digital Networking Purpose

Vision

Deliver **Advanced Solutions**
that Enable **Secure Infrastructure**
For a Smarter World



Mission

Solve **Customer's Communication Problems**
with **Cost & Power Efficient**
Silicon & SW Solutions



Focus

Defend **Service Provider & Enterprise**
Grow **Cloud Edge, IOT Infra & Home Gateway**
Dominate Industrial

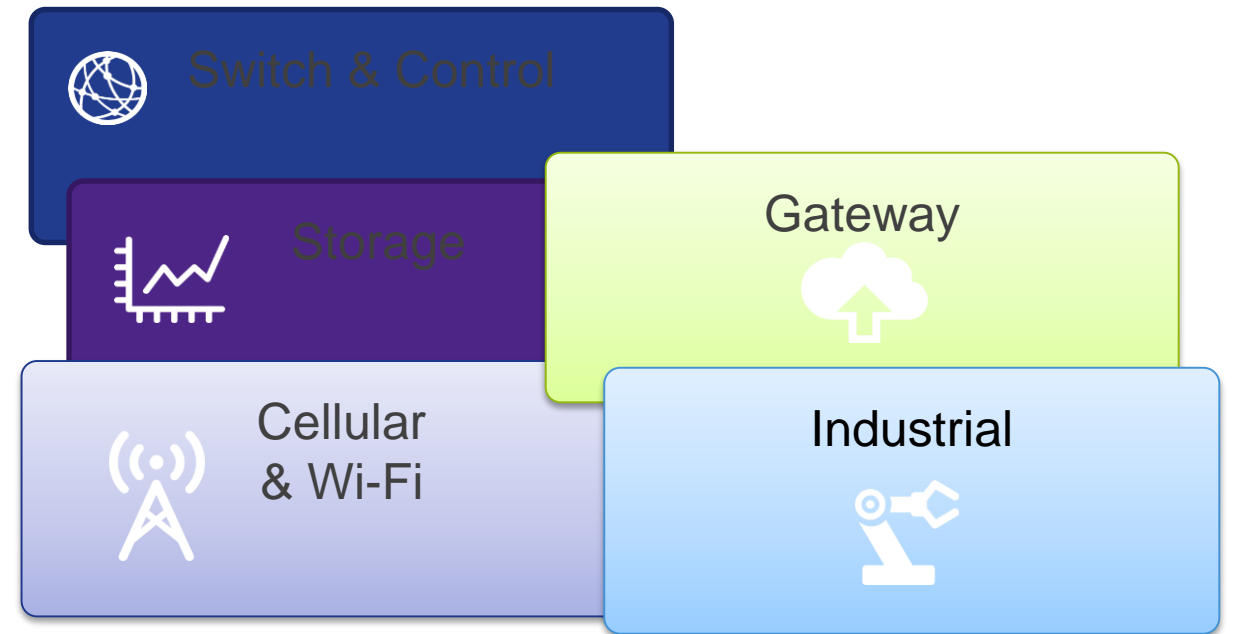


Who is Digital Networking...

Enabling Secure Infrastructure
with Cost- & Power-Efficient Solutions
and unique expertise



Targeted Solution Segments



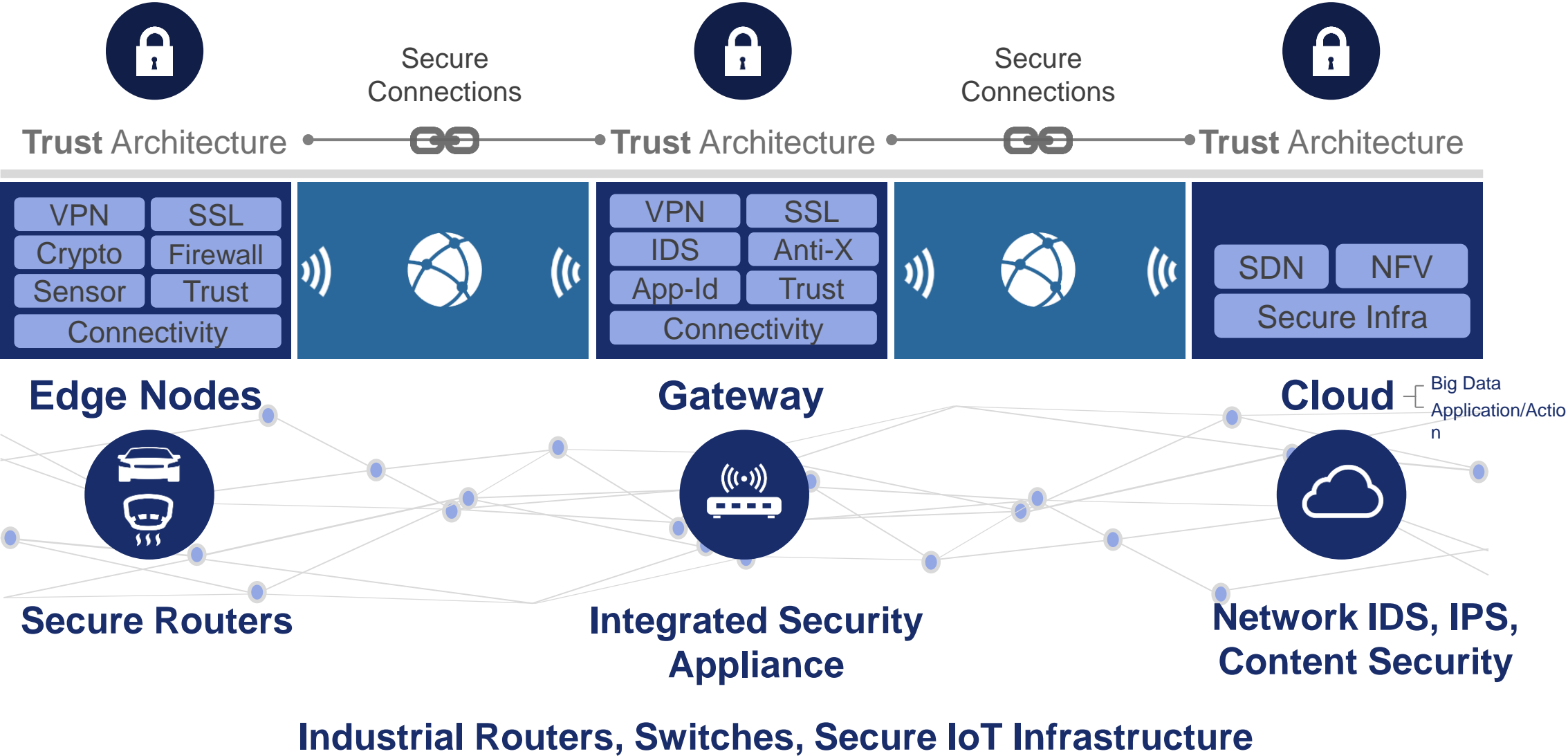
Enabling Customers with Software & Solutions

- Significant investment in Software R&D
 - Over 700 networking software engineers
 - Focus on emerging technologies – SDN, NFV, IoE, 5G
 - Top 10% Company Contributor to kernel.org for the last 7+ years!
 - Field hardened & widely deployed >10 Million copies deployed to date
- Driving ARM64 ecosystem in close collaboration with ARM Inc
- Most mature ARMv8 64-bit Software - hardened over 2 years
- Broad range of software products
- SDK, acceleration kits, middleware, commercial & production-ready SW
- Comprehensive HW+SW solutions for next generation networks
- Professional software services and support
- Active involvement and leadership in consortiums, industry forums and working groups



*Representative customer logos

Security is Everywhere



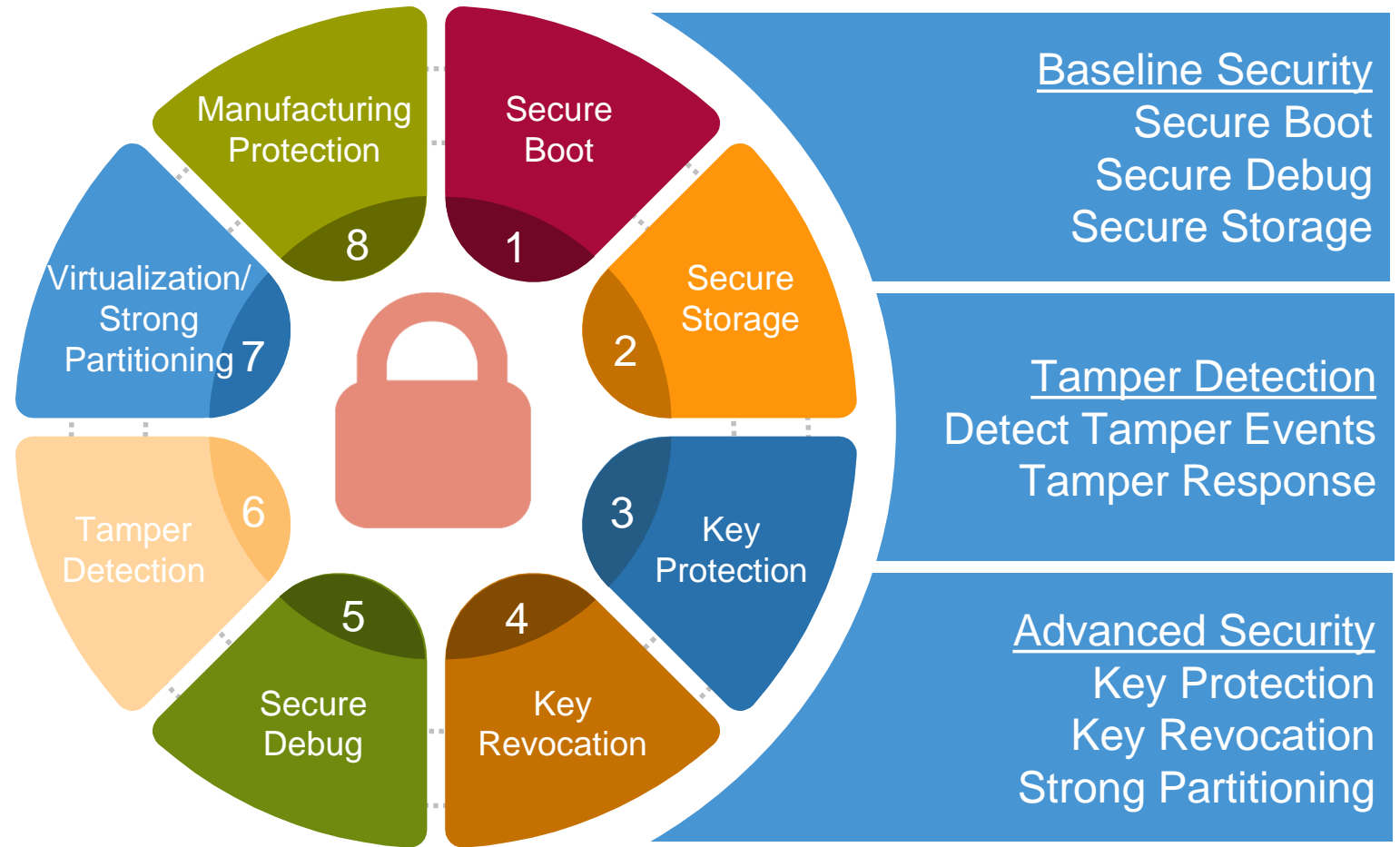
NXP Has a Core Competence in End-to-End System Security

Mobile and stationary machines want full access to cloud-based knowledge

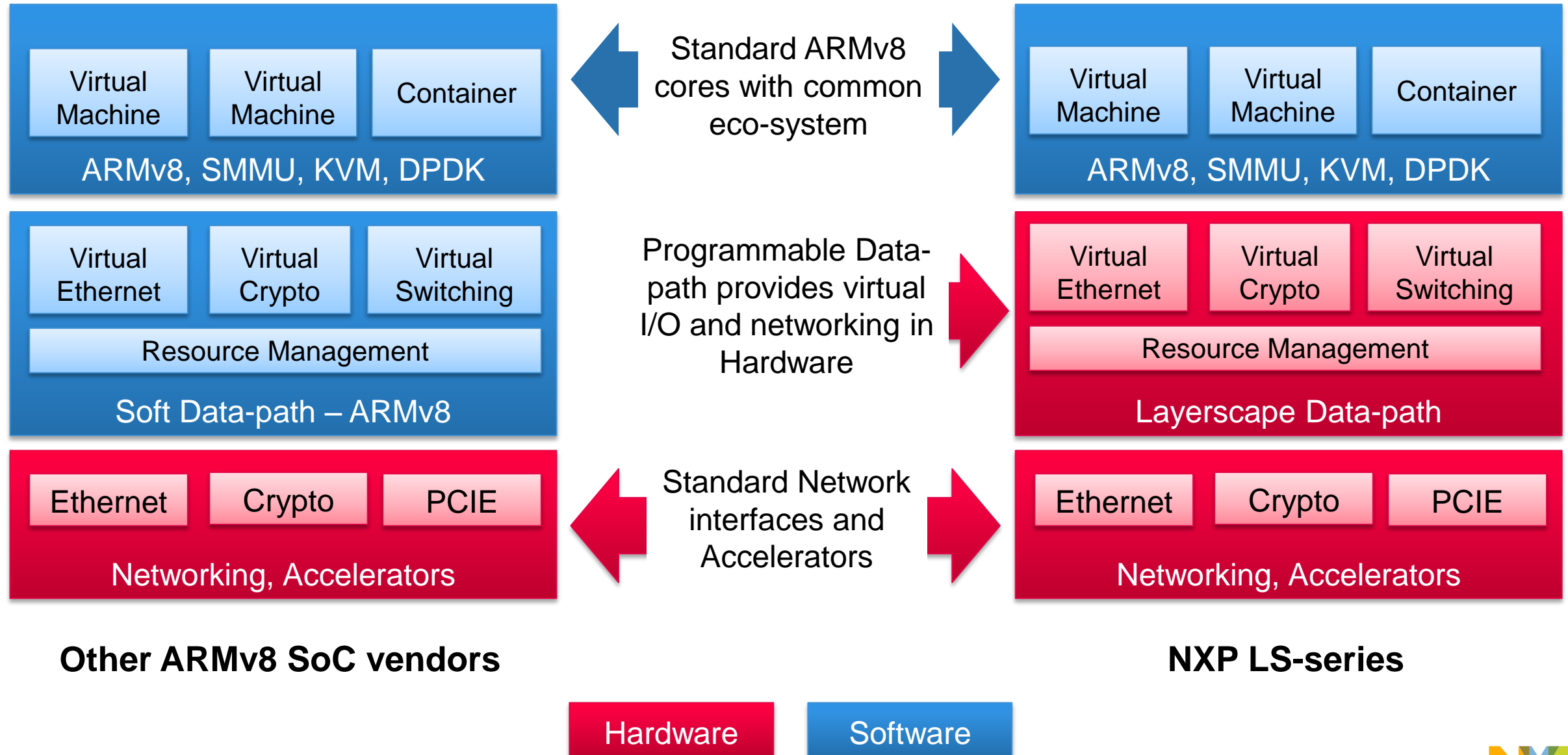
This requires **faster, more reliable** and secure connectivity

NXP is at the **forefront of secure communications** and tamper resistance

Leadership experience in security markets: over 10 Billion smart cards sold

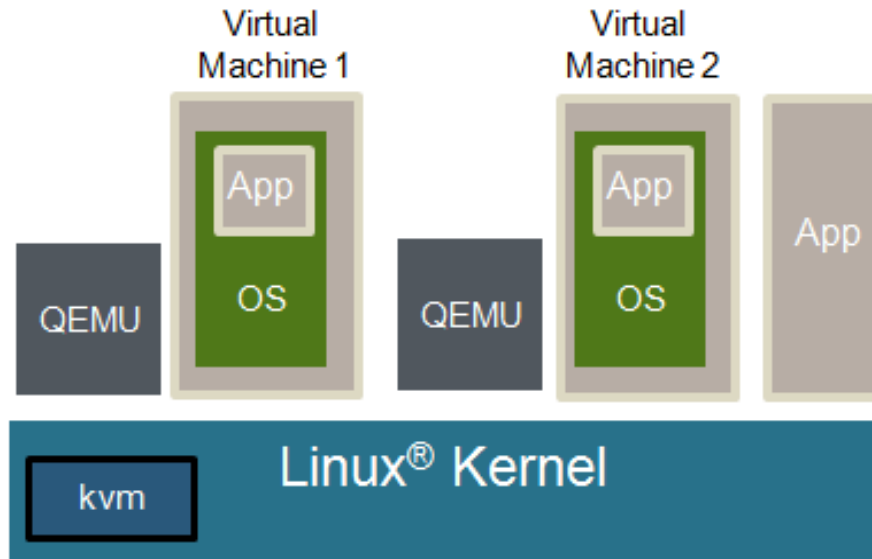


How NXP brings Differentiation to Virtualization

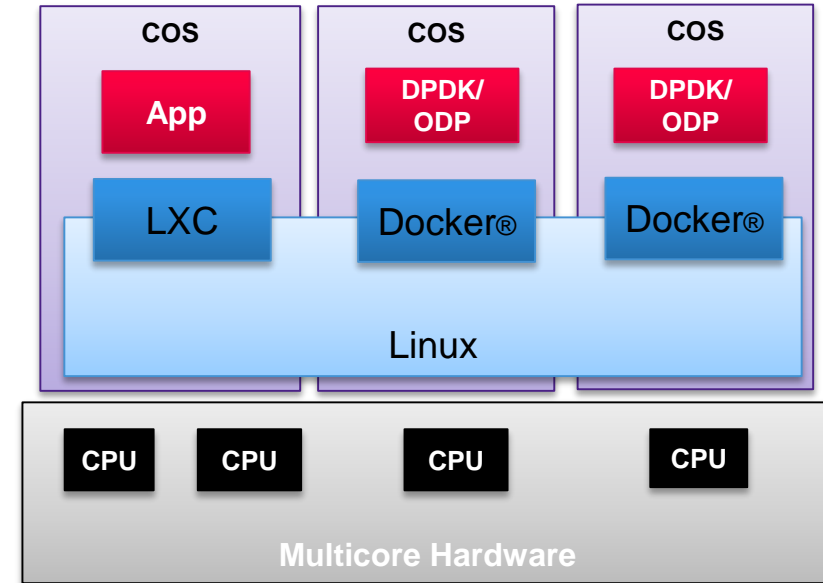


Layerscape Compute Virtualization

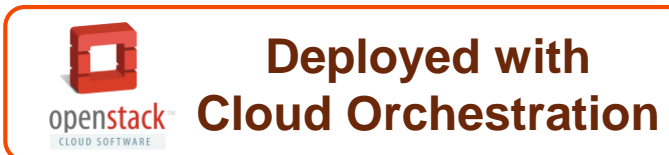
Scalable virtualization technology for the deeply embedded network edge



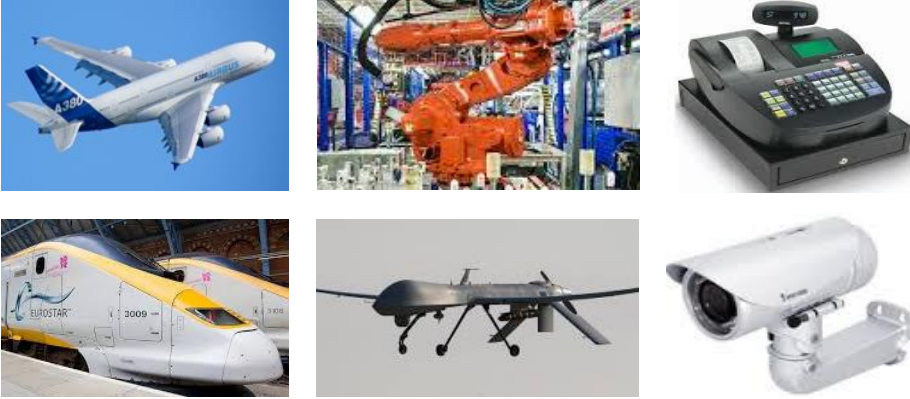
- **KVM** Linux® kernel driver to spin up VMs
- QEMU user space emulator is used in conjunction with KVM
- Solution is open source
- Virtual machines is only limited by particular SoC resources (CPU cycles, memory)



- **Linux® Containers**, OS level virtualization – Docker®, LXC
- Secure partitioning of Linux apps into domains
- Lightweight overhead compared to KVM
- Control resource utilization within domains such as CPU, I/O BW



Supply Longevity



Industrial applications require product longevity

- Long product lifecycles
- Special product certification required

NXP Industrial Application Processors

- 10 and 15-year supply longevity options
- Formal program with products listed at www.nxp.com/productlongevity

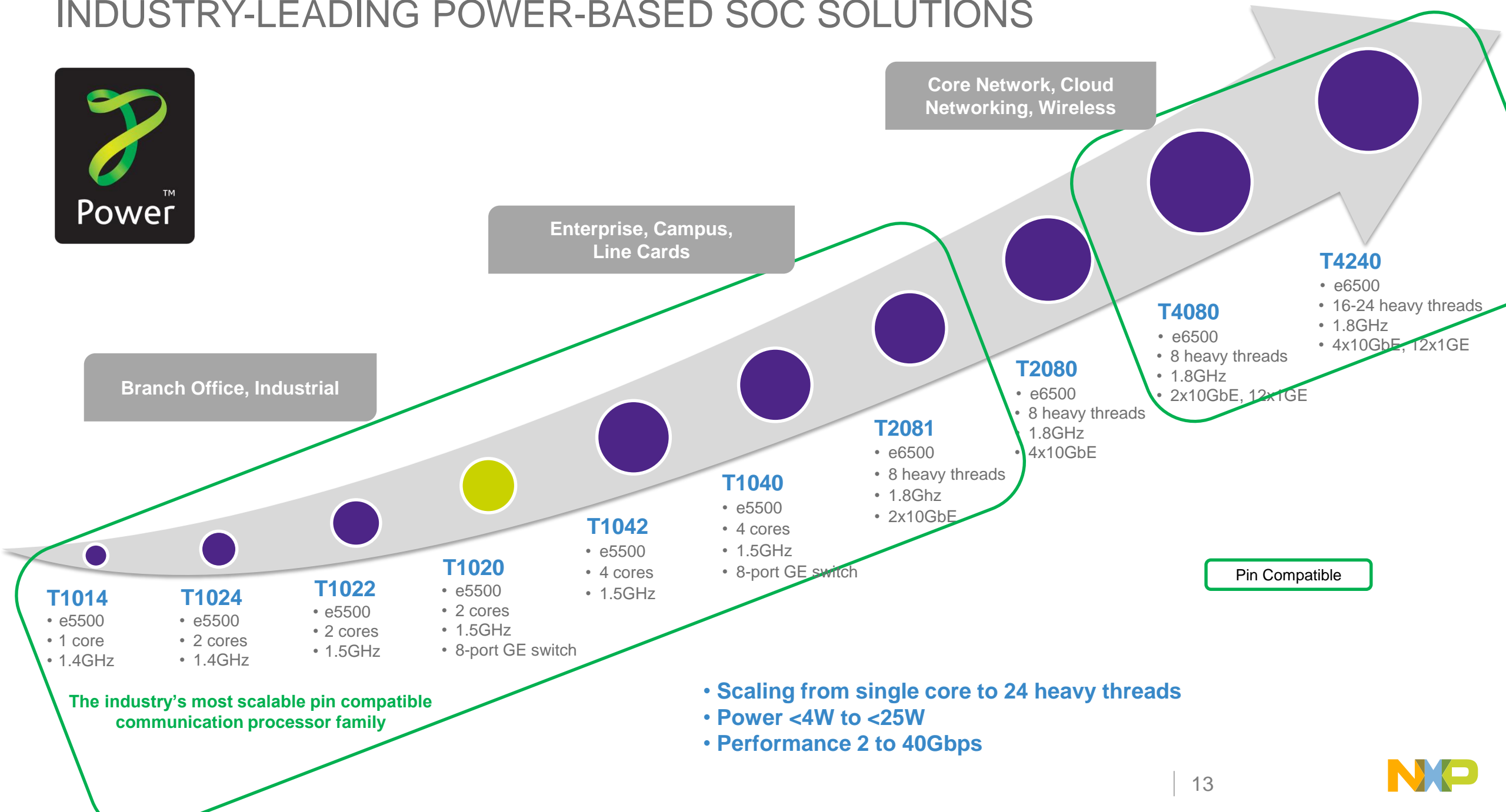


Extreme Operating Conditions

- **10-year product life** with continuous operation
- Product Life Application Notes
- Extreme **temperature conditions**
 - -40° C cold start
 - 70-85° C ambient operating conditions
 - Up to 125° C junction temperature
- Low power consumption for **fanless designs**
- Small footprint for **space-constrained designs**



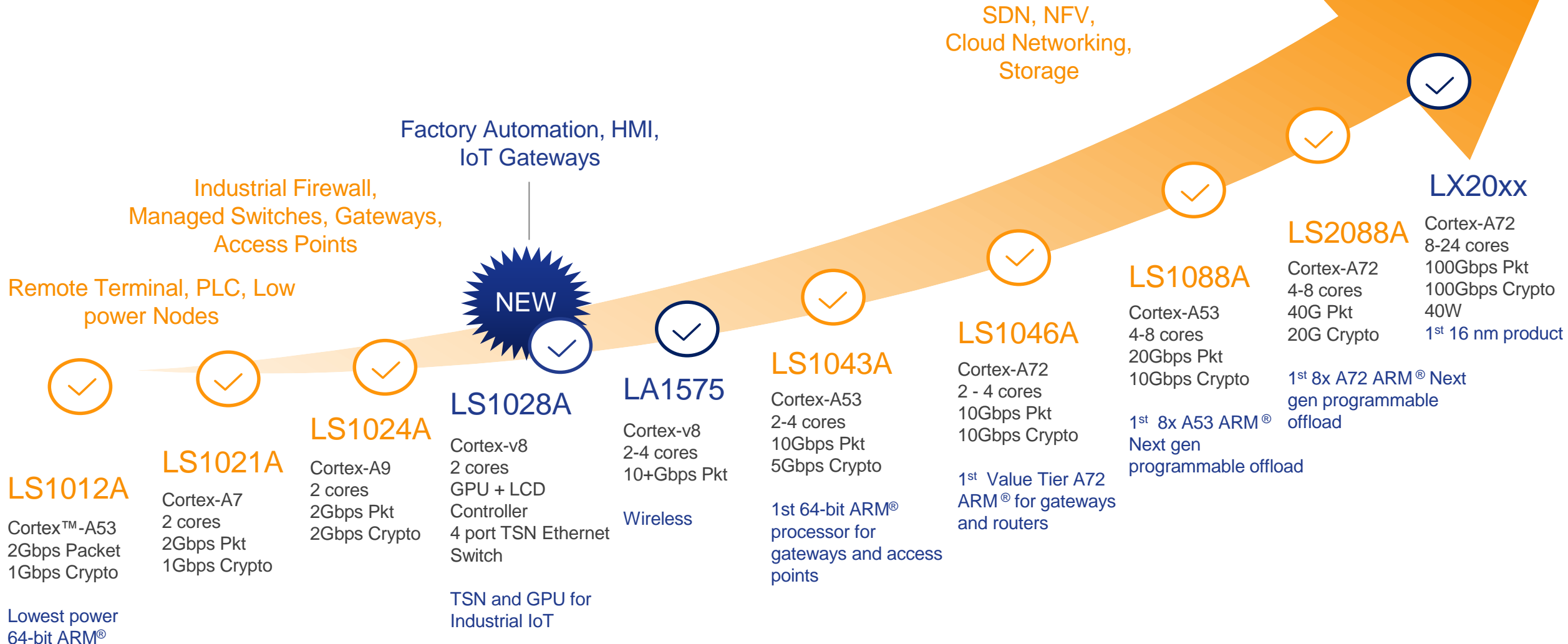
INDUSTRY-LEADING POWER-BASED SOC SOLUTIONS



Product Matrix

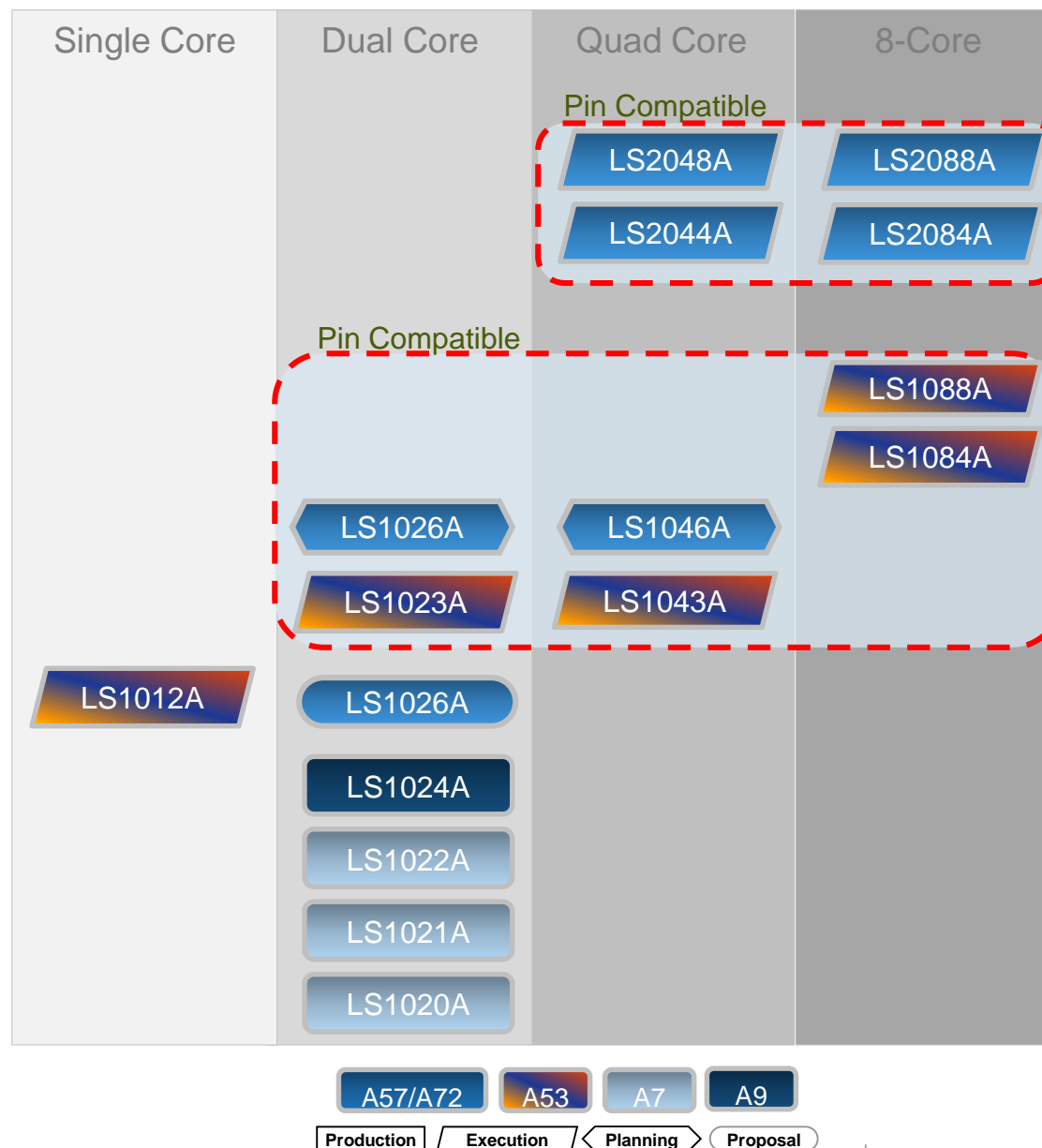
	P1020, P1011 P1021, P1012	P2020 P2010	T1020	T1022	T1040	T1042	T2081
CPU	1 to 2 e500	1 to 2 e500	2 e5500	2 e5500	4 e5500	4 e5500	4 e6500/8 threads
	Up to 800MHz	Up to 1200MHz	1200-1400MHz	1200-1400MHz	1200-1400MHz	1200-1400MHz	1500 - 1800MHz
	32K I/D	32K I/D	32K I/D	32K I/D	32K I/D	32K I/D	32K I/D
L2 Cache	256KB	512KB	256KB/Core	256KB/Core	256KB/Core	256KB/Core	512KB/Core
Platform Cache			256KB	256KB	256KB	256KB	512KB
DDR I/F Type/Width	DDR2/3	DDR2/3	DDR3L/4	DDR3L/4	DDR3L/4	DDR3L/4	DDR3/3L
	16/32-bit , 800MHz	32/64-bit, 800MHz	32/64-bit, 1600MT/s	32/64-bit, 1600MT/s	32/64-bit, 1600MT/s	32/64-bit, 1600MT/s	64-bit, 2133MT/s
10/100/1000 Ethernet (with IEEE1588v2)	3 x 10/100/1000	3 x 10/100/1000	3-Port GE Switch & 4 x 10/100/1000	5 x 10/100/1000	8-Port GE Switch & 4 x 10/100/1000	5 x 10/100/1000	2x 1/10GE + 5x 1GE
TDM	Yes	-	Yes	Yes	Yes	Yes	No
QUICC Engine	In P1021/12	-	TDM and HDLC	TDM and HDLC	TDM and HDLC	TDM and HDLC	No
SERDES	4 lanes	4 lanes	8 lanes	8 lanes	8 lanes	8 lanes	8 lanes
PCI-Exp	2 (Gen-1)	3 (Gen-1)	4 (Gen-2)	4 (Gen-2)	4 (Gen-2)	4 (Gen-2)	3 (Gen2) and 1 (Gen3)
DIU	-	-	Yes	Yes	Yes	Yes	No
SATA	-	-	2 controller 1.5 or 3Gbaud	2 controller 1.5 or 3Gbaud	2 controller 1.5 or 3Gbaud	2 controller 1.5 or 3Gbaud	NO
USB2.0	2	1	2 with PHY	2 with PHY	2 with PHY	2 with PHY	2 with PHY
Memory Card	SD/MMC	SD/MMC	SD/MMC	SD/MMC	SD/MMC	SD/MMC	
Accelerators	SEC3.3	SEC3.1	DPAA, PME SEC5.x with Trust Architecture	DPAA, PME SEC5.x with Trust Architecture	DPAA, PME SEC5.x with Trust Architecture	DPAA, PME SEC5.x with Trust Architecture	DPAA,PME, DCE, SEC5.2 with Trust Architecture
Power Management	<5.0W	<8.0W	Power Management with Deepsleep	Power Management with Deepsleep	Power Management with Deepsleep	Power Management with Deepsleep	
Package			Pin Compatible				

QorIQ Layerscape – Leading the 64-bit ARM® and Multicore Innovation



Expanding ARM-based Portfolio

- Comprehensive portfolio of 32-bit/64-bit ARM processor
- Pin compatible two to 8-core devices
 - A53 and A72 solutions for scalable performance/watt
 - Integrated Pixel processing and network/data processing
 - Video transcoding
 - Advanced I/O Processor (AIOP) for programmable packet forwarding
- Single-core 64-bit ARM
 - Less than 1W to support battery powered applications
 - PCIe, USB3.0, SATA3.0, 2.5GbE
 - Enables Low-cost 4-layer PCB
 - Small footprint 10mmx10mm



CoreMark and Dhrystone

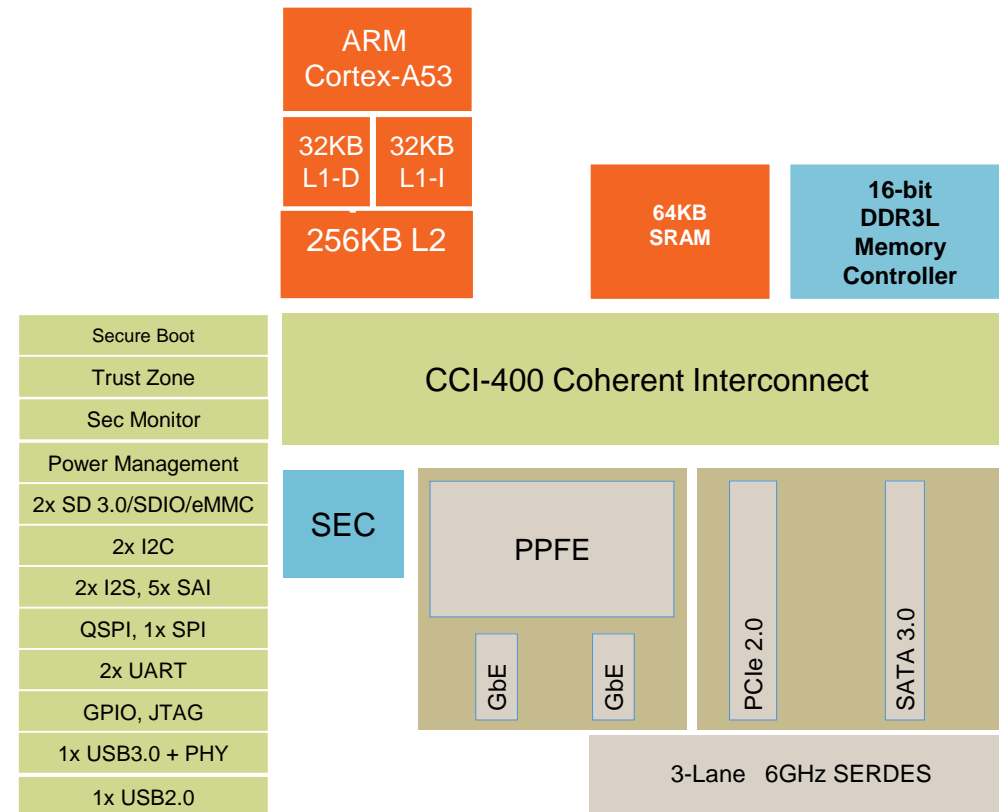
- Core Performance
 - All numbers are 64b and are actual measured numbers either on silicon or on emulator (unless otherwise indicated)

64b	e5500 T1042	A53 LS1043A	A57 LS2080A	A72 LS1046A
CoreMark / MHz -O3 with flag mining	3.84	4.18	5.74	6.37
Dhrystone / MHz	3.39	3.06	5.87	6.1
SpecINT2006 / GHz	3.2	3.7	6.1	7.07*



- 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

LS1012A Block Diagram



Samples	Production
April-2016	Q4-2016

LS1012A: Lethal Combination!

- 64b ARM CPU
- 1W Low Power
- <\$10 Price Point
- **Extreme connectivity**
 - USB 3.0
 - 1Gig / 2.5Gig Ethernet
 - SATA 3 6Gb/s
 - PCIe 2.0
- **Network-Class Security & Application Software**
 - Networking Kit
 - Wireless Kit
 - Storage Kit



Low W + Low \$ + Fast I/O + SW
= Fastest Time to \$\$

NEW APPLICATIONS MADE POSSIBLE WITH THE LS1012A



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



Ethernet Drives
Enable scale-out data storage

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



Portable Wireless Storage
On the go access to Terabytes of data



Industrial IoT
Making high-speed low-power networks pervasive

LS1012A: Success Story



VoIP gateway

Challenge:

- Low power VoIP gateway
 - Supporting multi channel VoIP Codec
 - <2W
 - <\$10 CPU
 - Scalable for future

Solution:

- LS1012A + SW Application Kit for VoIP offload and lowest power

Tiny Home WiFi

Challenge:

- Design smart Home WiFi
 - with 100's Mbps WiFi
 - Plus routing
 - Plus security
- Small consumer form factor
 - no fan
 - no heatsink

Solution:

- LS1012A + SW Application Kit delivers unmatched WiFi performance at the best competitive power.

Portable Storage

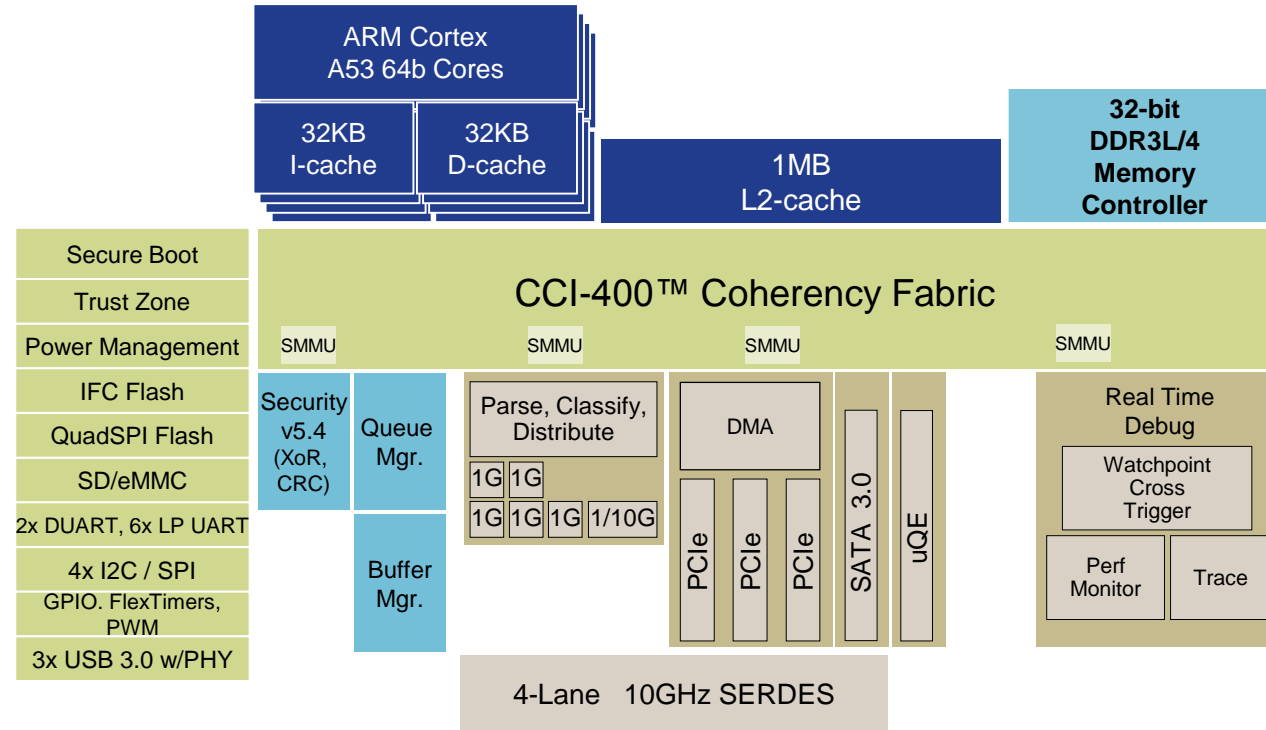
Challenge:

- Create consumer WiFi NAS
 - Tiny, portable form factor
 - Supports SSD storage
 - Batter powered system

Solution:

- LS1012A + SW Application Kit delivers unmatched 1Gbps WiFi & 100MB/s storage performance at <2W.

Leading in the Value Tier: Power Efficient QorIQ LS1043A



Device

- 28HPM Process
- FCBPGA, 0.8mm pitch

Power target

- 6-9W

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
Leadership 10Gbps NAT performance at convection cooled thermal design; Support for POE

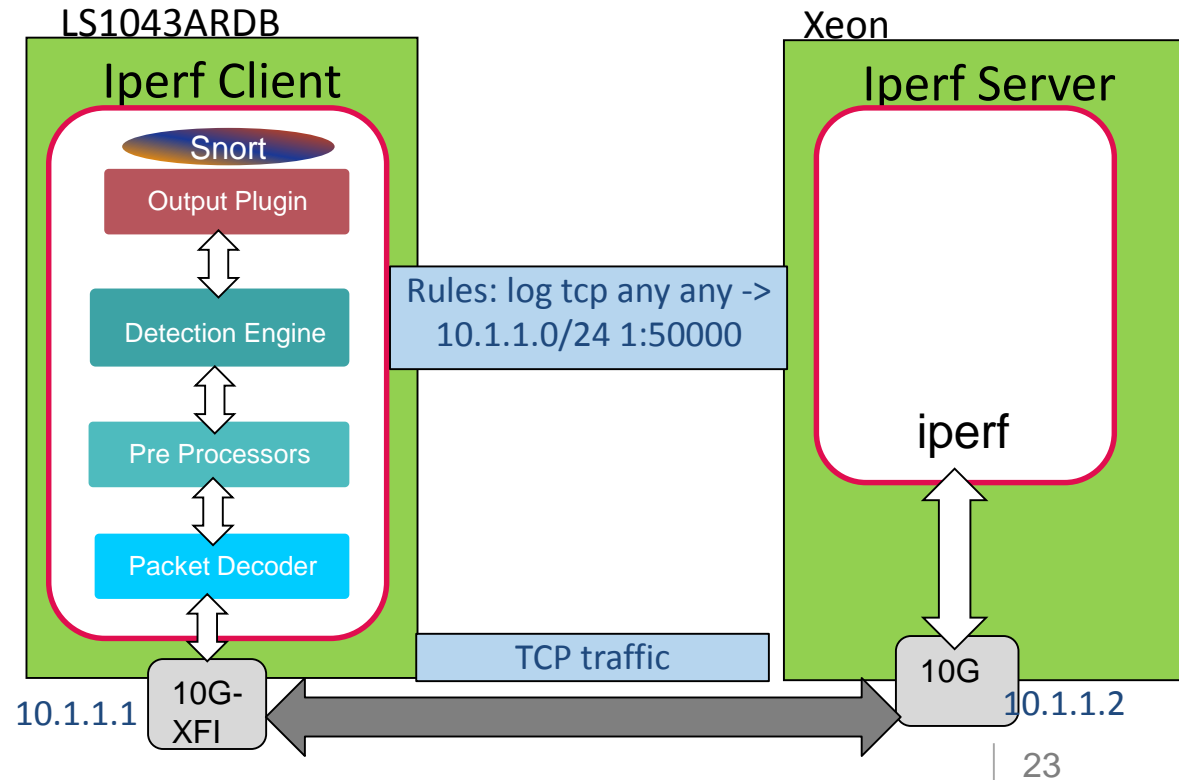
Production Now with 10-year Longevity Program!

LS-series DPAA Core Scalability Using SNORT Use Case Study

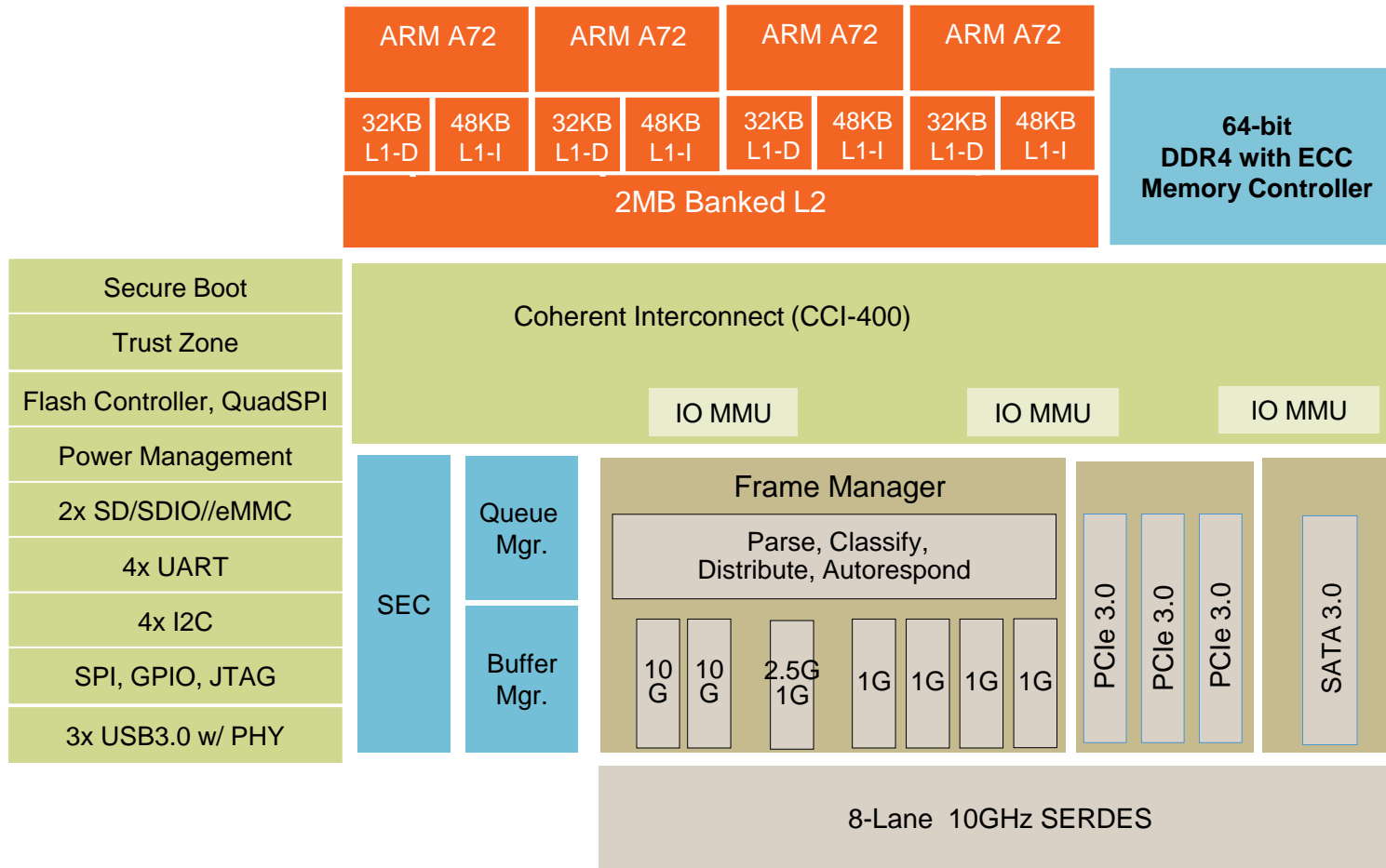
LS1043 and LS1046 Achieve Linear Scaling from 1 to Many Cores

LS1 as Client X86 as Server	LS1043A single core	LS1043A Quad Core
LS1043A at 1.2Ghz	1.36Gbps	4.16Gbps
LS1043A at 1.6Ghz	1.84Gbps	5.13Gbps

- Hardware setting:
 - LS1043ARDB:
 - CPU: 1600MHz; BUS: 400MHz; DDR: 1600MT/s; DDR size: 2GB, 32bit
 - L1 cache: 32KB I-Cache and 32KB D-Cache
 - L2 cache: 1MB shared
 - 1 Intel x540 10Gb NIC
 - Intel Xeon E5-1620 v3 @3.5GHz 8Cores
- Software setting:
 - LS1043ARDB-v0.4 (Linux-3.19.3)
 - Iperf-2.0.5
 - Snort-2.9.4.6 GRE (Build 73)



LS1046A: Performance & Power Optimized Cortex A72 Processor



Core & Memory Subsystem

- 4x ARM Cortex A72 up to 1.8GHz
- 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, Lidded FCBGA

Samples	Production
July 2016	Dec 2016

Leading Quad A72 processor with two 10GbE ports

100% IP design reuse from LS2088 & LS1043 in production!



LS1046A: Features

- 4x 64-bit ARM v8 A72 CPUs, up to 1.6 GHz operation, 32 KB L1 data cache and 48 KB L1 instruction cache, shared 2 MB L2 cache, Neon SIMD engine, ARM v8 cryptography extensions
- Cache coherent interconnect (CCI-400), up to 600 MHz operation
- 1x 64-bit DDR4 SDRAM memory controller with ECC, up to 2.1 GT/s, supports 32/64-bit operation, x8 & x16 devices
- QorIQ data path acceleration architecture (DPAA) incorporating acceleration for the following functions:
 - FMan: Packet parsing, classification, and distribution
 - QMan: Queue management for scheduling, packet sequencing, and congestion management
 - BMan: Hardware buffer management for buffer allocation and de-allocation
 - SEC5.4: Cryptography acceleration
- 2x MACs supports 10G/2.5G/1G/100M/10M, 1x MAC for 2.5G/1G/100M/10M MAC, 5x MACs for 1G/100M/10M MACs, support for RGMII, SGMII (and 1000Base-KX), SGMII 2.5x, XFI (and 10GBase-KR), Energy efficient Ethernet support (802.3az), IEEE 1588 support
- 3x PCIe 3.0 controllers, 1x supporting x4 operation, 1x SATA 3.0 controller
- Additional peripheral interfaces
 - IFC supporting NAND and NOR flash with 28-bit addressing and 16-bit data
 - 3x USB 3.0 controllers with integrated PHY, 1x QSPI, 1x SPI controllers, 1x SDXC/eMMC, 4x I2C controllers
 - 2x 16550 compliant DUARTs and 6x low-power UARTS (LPUART), GPIO supports
 - 8x Flextimers and generic timers

QorIQ & Layerscape Distribution Markets and Applications

Transportation/ Defense



- Mobile Gateways
- Train Control
- Heads up display
- Radar Imaging
- UAV
- Surveillance

Industrial Automation



- Power & Energy
- Robotics
- M2M Gateway
- Machine Vision
- Programmable Logic Controllers
- Access Gateway

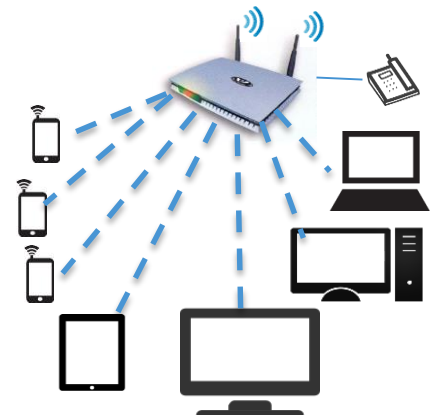
Networking



- IoT Gateways
- Wireless LAN
- Router
- Top of Rack Switch
- Customer Premise Equipment
- Security Appliance
- SAN Controller

- RNC
- Metro networking
- Core/edge router
- Femto/Pico Cell
- ADC
- WAN Optimization Controller
- Server appliance
- Network Attached Storage

Where to sell:



Market Segment	Application	Target Products
Energy/Smart Grid	Substation Ethernet Switch	LS1012A, LS1021A, LS1023A/43A
	Gateway / Router / Energy Harvesting	LS1012A, LS1021A
	Remote Terminal Unit (RTU)	LS1021A
	Relay Switching Equipment	T101x/2x, T102x/4x, T208x, LS1012A, LS1023/43A
	PLCs	T101x/2x, T102x/4x, LS1021A, LS1023A/43A
	Intelligent Electronic Device (IED)	T101x/2x, T102x/4x, LS1021A, LS1023A/43A
	Merging Unit (MU)	T101x/2x, LS1021A, LS1023A/43A
	Physical Security (Entry, Surveillance)	T101x/2x, LS1021A, LS1023A/43A
	Phasor Measurement Unit (PMU)	LS1021A
	Power Meters	LS1021A
	Wireless (WiFi)	T101x/2x, T102x/4x, LS1021A, LS1023A/43A
	Human Machine Interface (HMI)	T101x/2x, T102x/4x, T2, T4, LS1021A, LS1023/43A
Home	FTTH Gateway	LS1021A, LS1024A, LS1023A/43A
	Residential Gateway / Business vCPE	LS1012A, LS1023A/43A
Industrial	Industrial Ethernet Switch	LS1012A, LS1021A
	Industrial Firewall	T101x/2x, T102x/4x, T2, T4, LS1021A, LS1023/43A
	Gateway / Router	LS1012A, LS1021A, LS1023A/43A
	Automation/Machine Controllers	T101x/2x, T102x/4x, T2, T4, LS1021A, LS1023/43A
	Distributed Control System (DCS)	T101x/2x, LS1021A, LS1023A/43A
	Remote Terminal Unit (RTU)	T208x, T4xxx, LS2xxx
	PLC	LS1012A, LS1021A
	Wireless (WiFi)	LS1021A
Other	Human Machine Interface (HMI)	LS1012A, LS1021A, LS1023A/43A
	Point of Sale (POS)	LS1021A
	Automatic Teller Machine (ATM)	LS1021A
Surveillance	Elevator Control	LS1021A
	NVR Video Surveillance	LS1024A, LS1021A, LS1043A
Transportation	Mobile Gateway	LS1021A

SOLUTIONS ROADMAPS

1.1. Service Provider and Enterprise

- *WLAN Solutions*
- *Services Routers & Appliances Solutions*
- *Evolved Control Plane and Switching*
- *Virtualized Networks*

1.2. IoT Infrastructure

- *Smart Home Solutions*
- *Industry 4.0*

1.3. Cloud Edge

- *Intelligent NIC*
- *Storage infrastructure*

Defend the Base and Drive Expansion for Revenue Growth

Solutions for the Service Provider and Enterprise Segments

WLAN Access Point

- Shipping to leading global players
- Scalability for Low, Mid, High-End Solutions
- Complete protocol offload for IPSec, DTLS, CAPWAP
- Complete SW solution with OpenWRT support



Services Routers, Network Appliance

- Scalable portfolio of SoCs with common SW
- Complete software stack with offload support
- Offload provides compelling performance in a smaller power envelope: **10G and 20G fanless design options**
- Protocol aware offload with **25% performance advantage** over crypto only architecture: e.g. x86, Cavium
- Strong ODM support



Evolved Control Plane and Switching

- Increasing adoption of services as differentiators
- DNG offers strong portfolio of SoC + SW solutions
- Enabling new services like network visualization for OEM customers
- Leverage our installed base with leading global OEMs



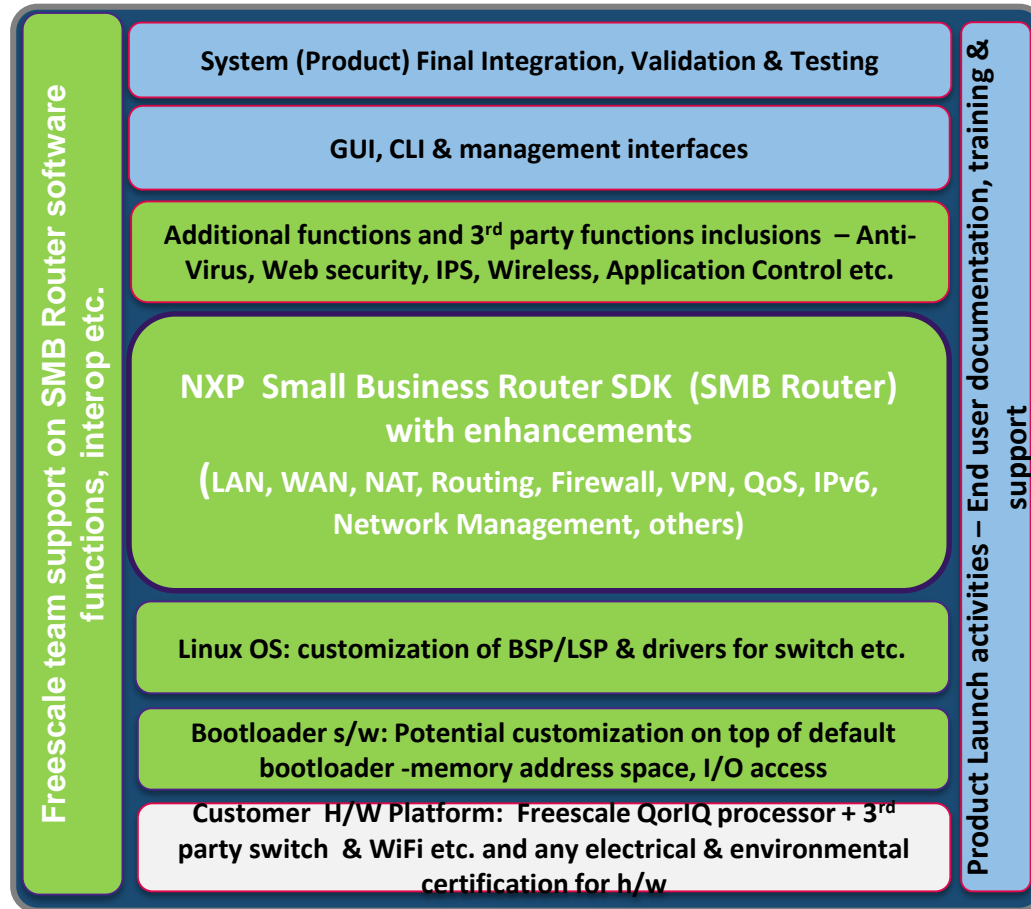
Virtualized Networks

- Leadership in virtualization technology (HW and SW) and acceleration assist for virtualization
- Strong performance analysis to demonstrate virtualization performance
- Driving industry standardized approach for ease of adoption



OPENCONTRAIL

NXP – DNG: The Only Solution Provider for Small Business Router



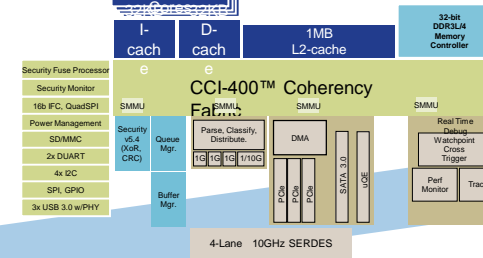
Responsibility sharing scenario

NXP

ODM partner

Customer

LS1043A

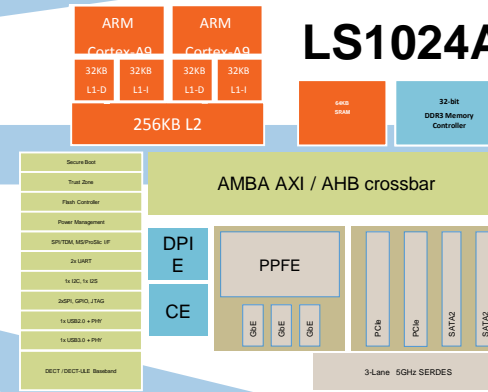


LS1046A

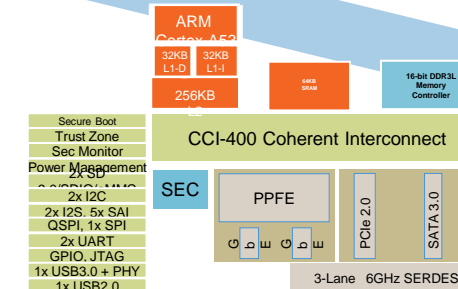
LS1088A



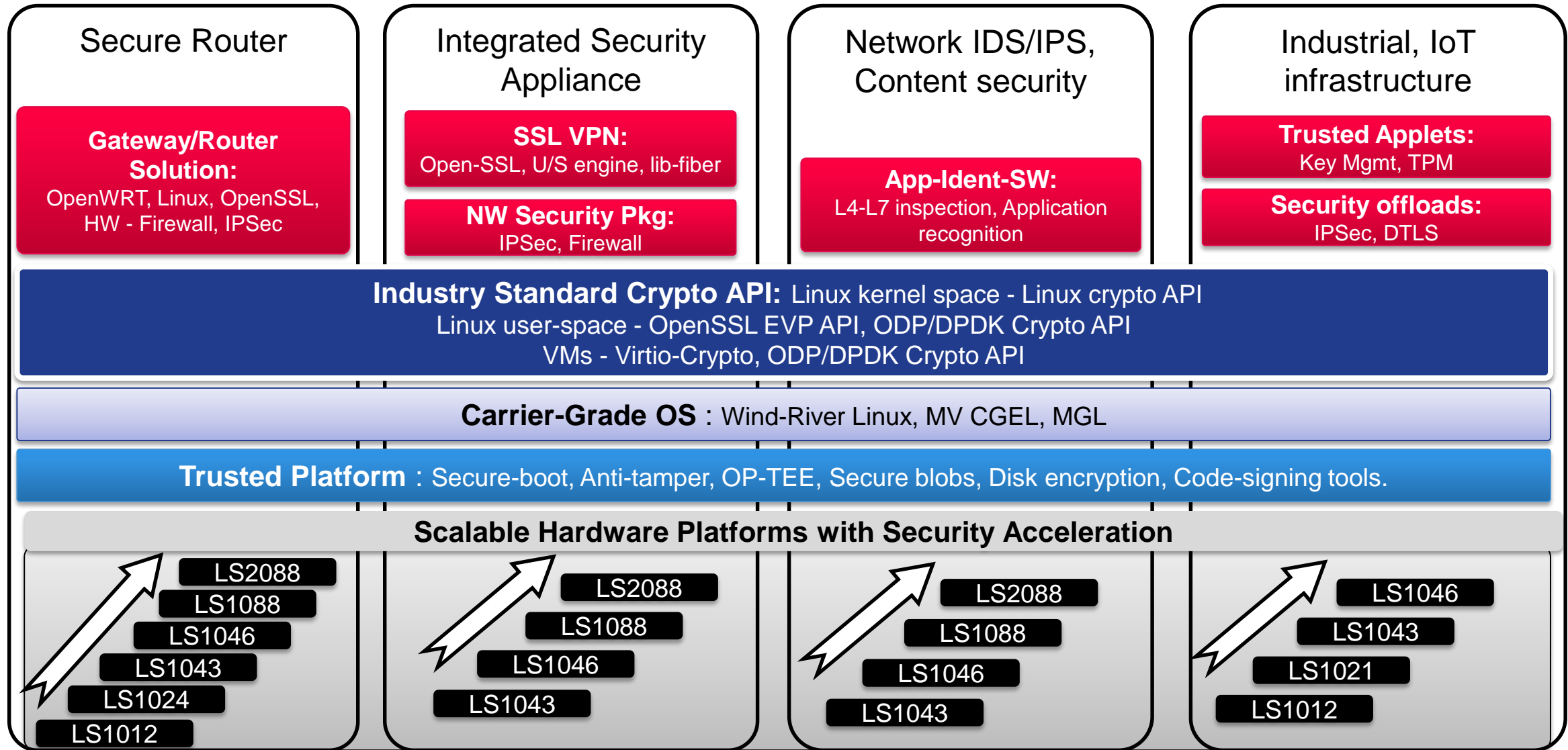
LS1024A



LS1012A

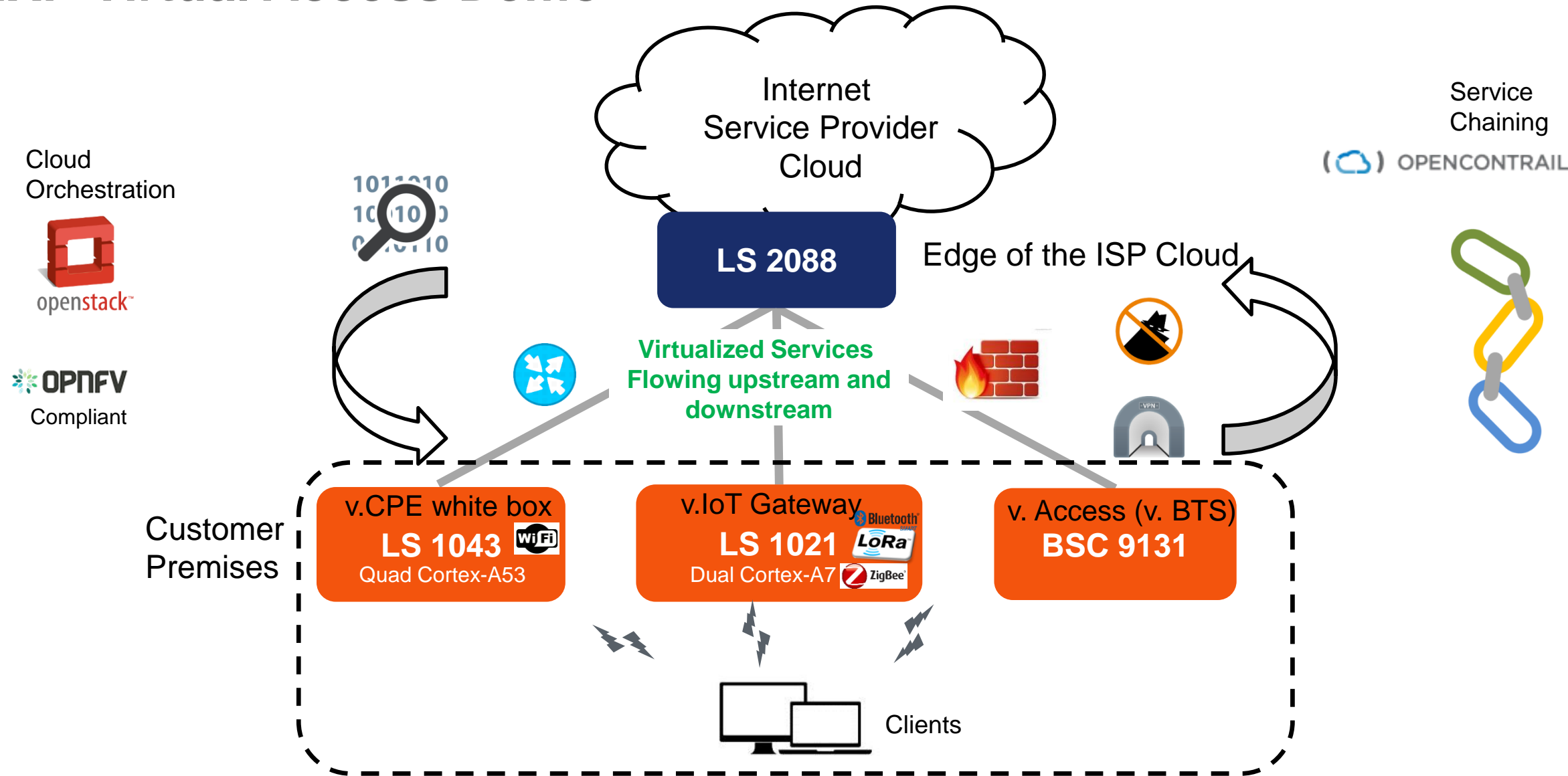


Right Recipe for your Security Appliance



NXP value proposition: Data-path offload in HW Programmable for custom applications; Easy-to-use NF API to integrate with customer stack; Complete turnkey solution – ready to deploy

NXP Virtual Access Demo



NXP Driving Solutions for the Smart Home / CPE Market

Broadband Gateway

- Shipping to leading global gateway players
- First to market with 10GbE support
- Broadest ecosystem of WLAN support
- 10Gbps performance with min CPU loading
- Complete SW solution with OpenWRT support



Network Attached Storage (NAS)

- Scalable portfolio of SoCs with common SW
- Complete software stack with offload support
- RAID performance well above competition
- Strong ODM support



IoT Gateway

- Flexible platform with broad industry support
- Innovative solution for sensor aggregation
- High performance networking with wide range of protocol support

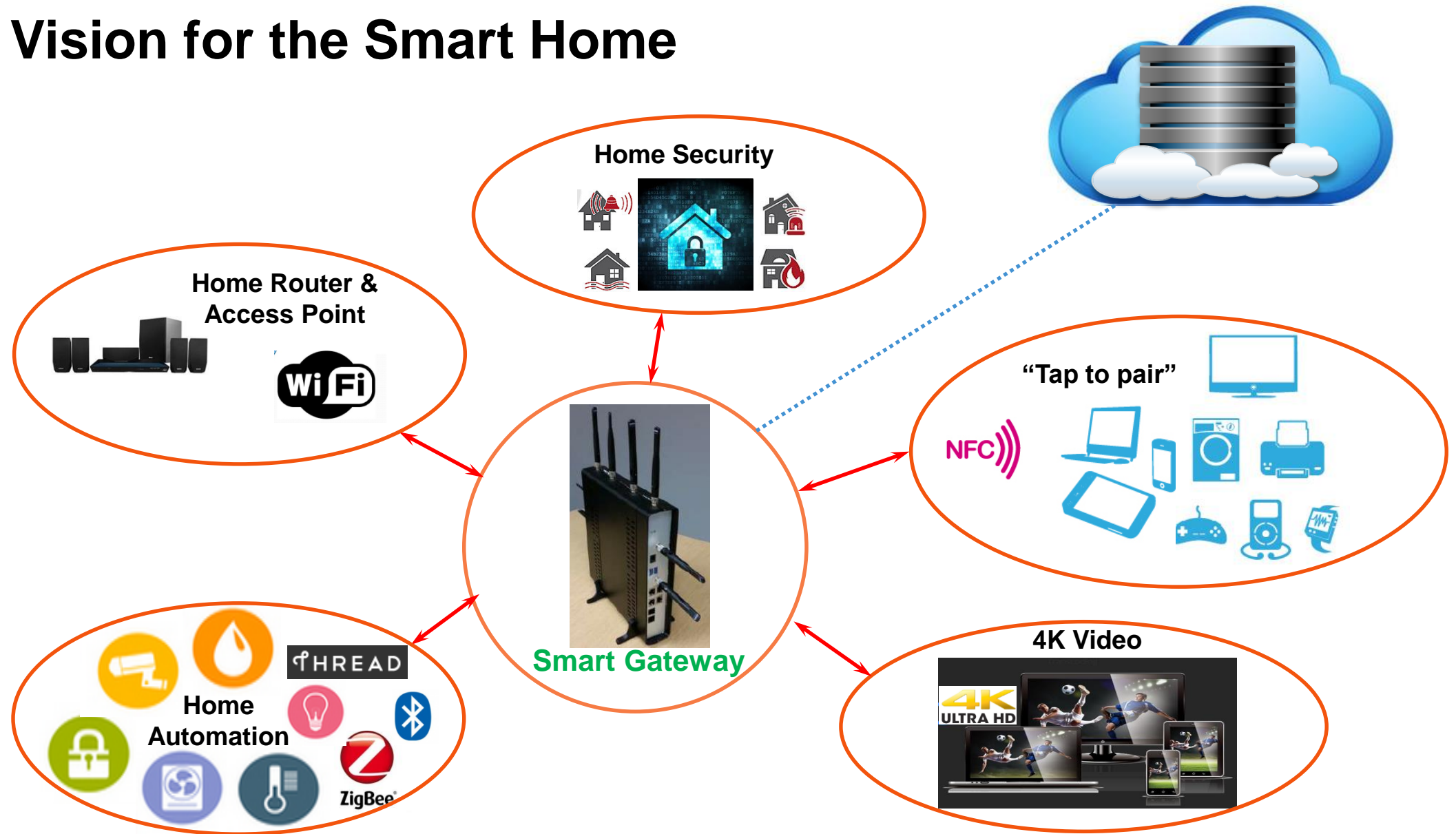


Wireless Audio

- Differentiated Features for Networked Audio
- Architected for line-rate networking with low CPU overhead
- High-performance 64b ARM CPU with NEON & FPU
- 5x serial audio ports
- Low power ultra-compact package for portable applications



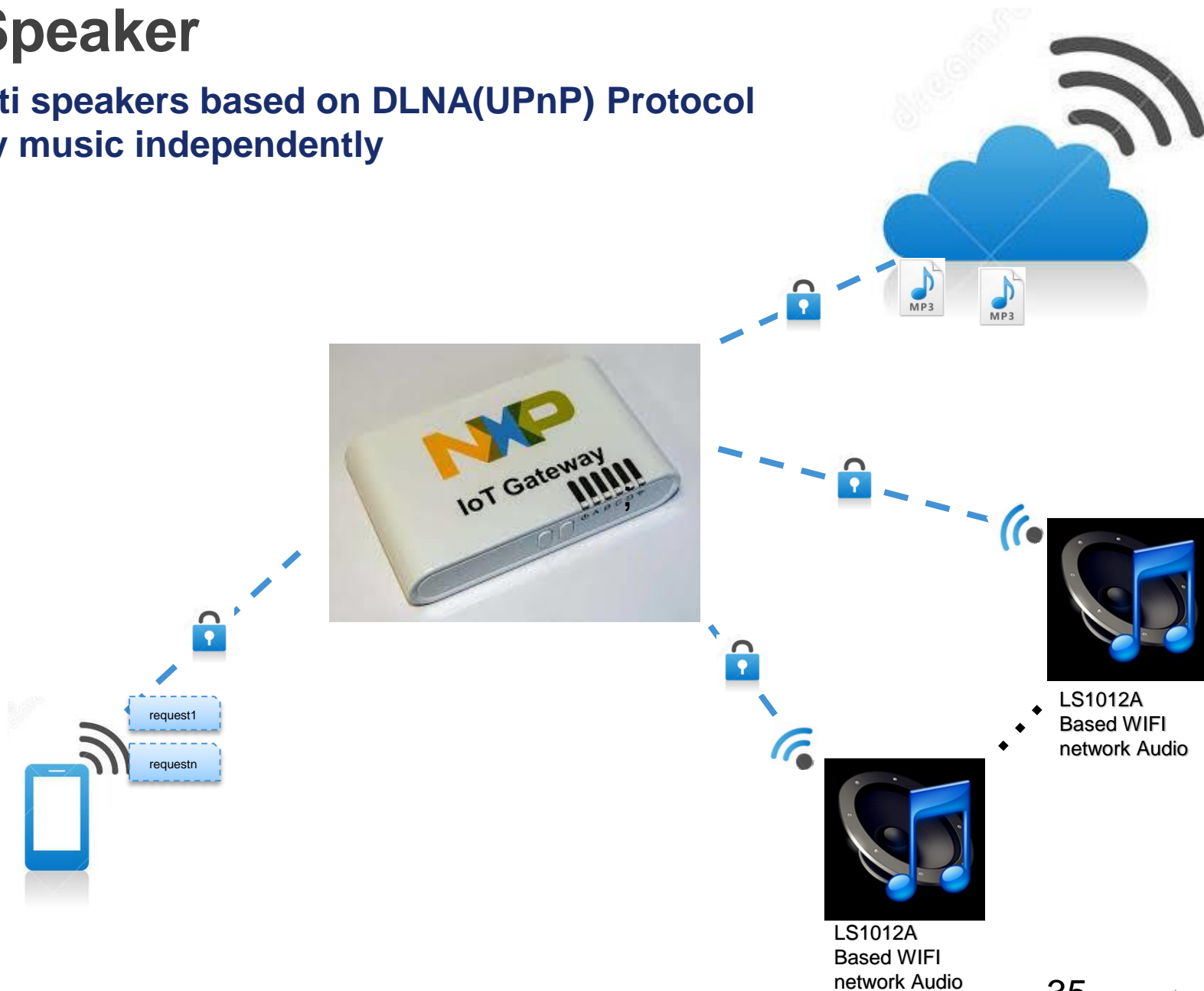
Our Vision for the Smart Home



Set of solutions focused on Ease of Use, Mobility, Assurance and Automation
Leverage NXP portfolio, relationships, customer reach, DNG Software and SoC differentiation

Wireless Speaker

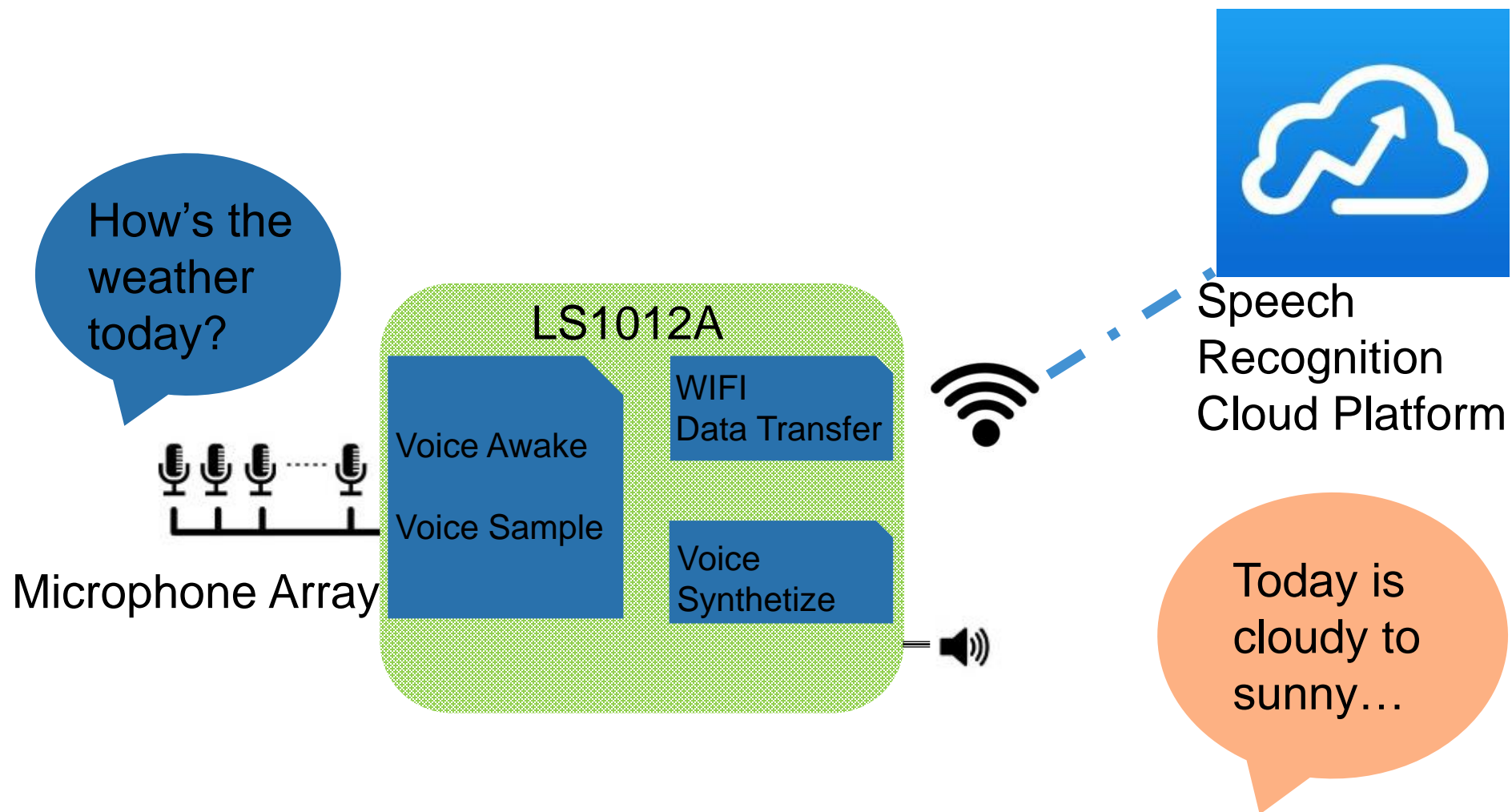
Multi speakers based on DLNA(UPnP) Protocol
play music independently



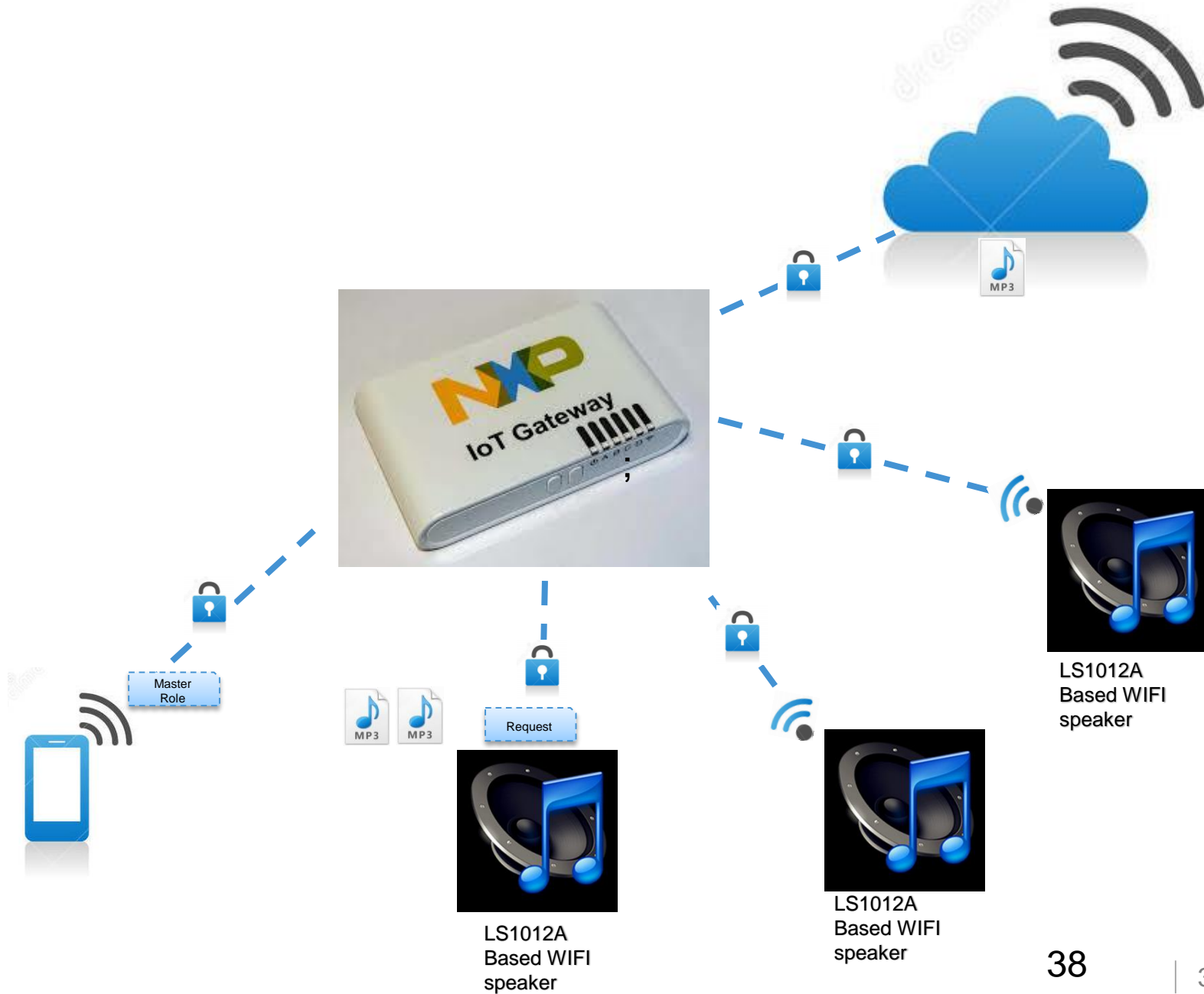
Smart Voice Assistant + Wireless Speaker Ref Design



Voice Assistant



Multi Speakers Synchronous Playback



UPnP Player- QQ Music Player Screenshot

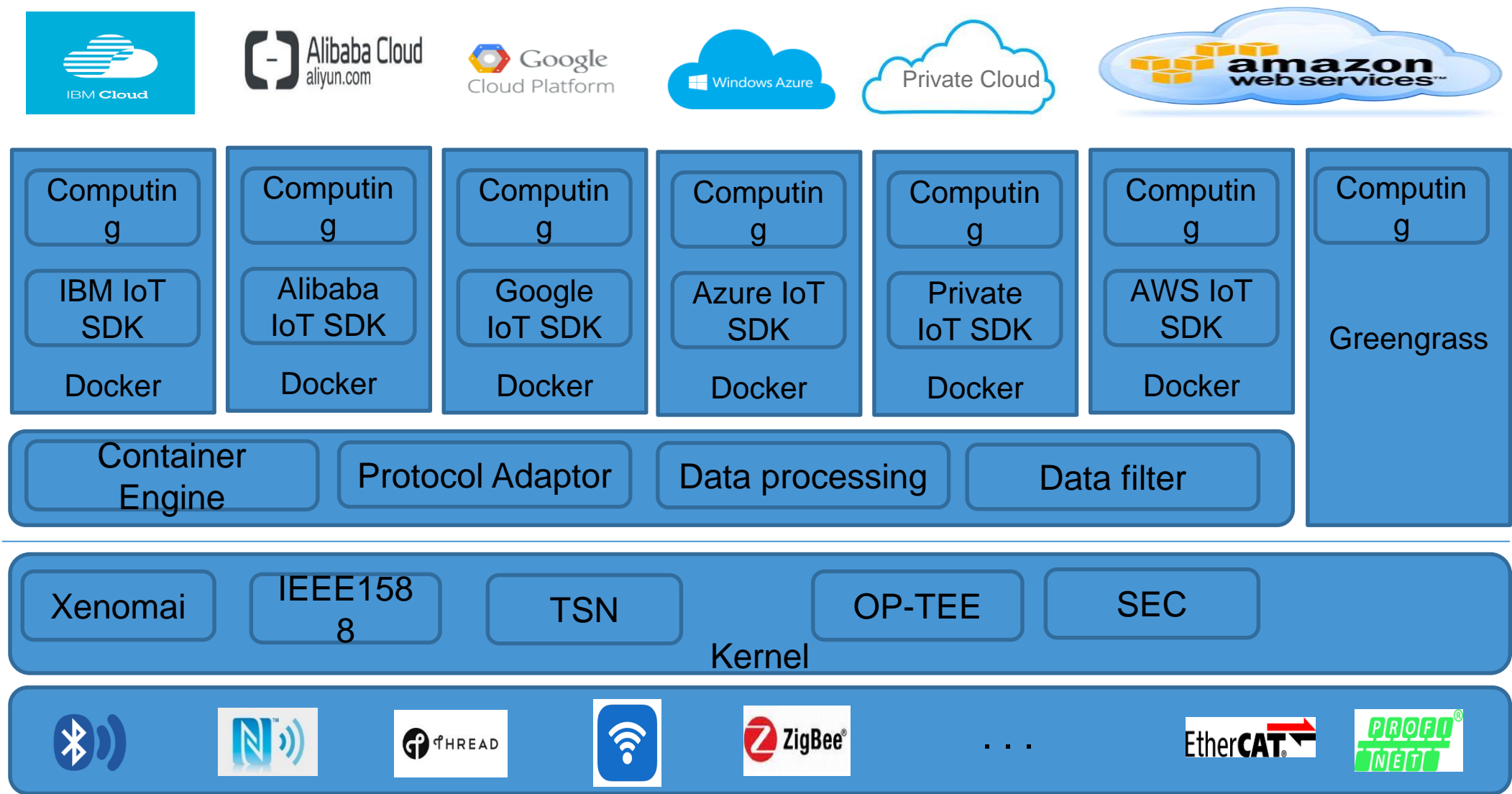


Master
Speaker

Slave
Speaker



Cloud-based IoT Fog Computing Platform

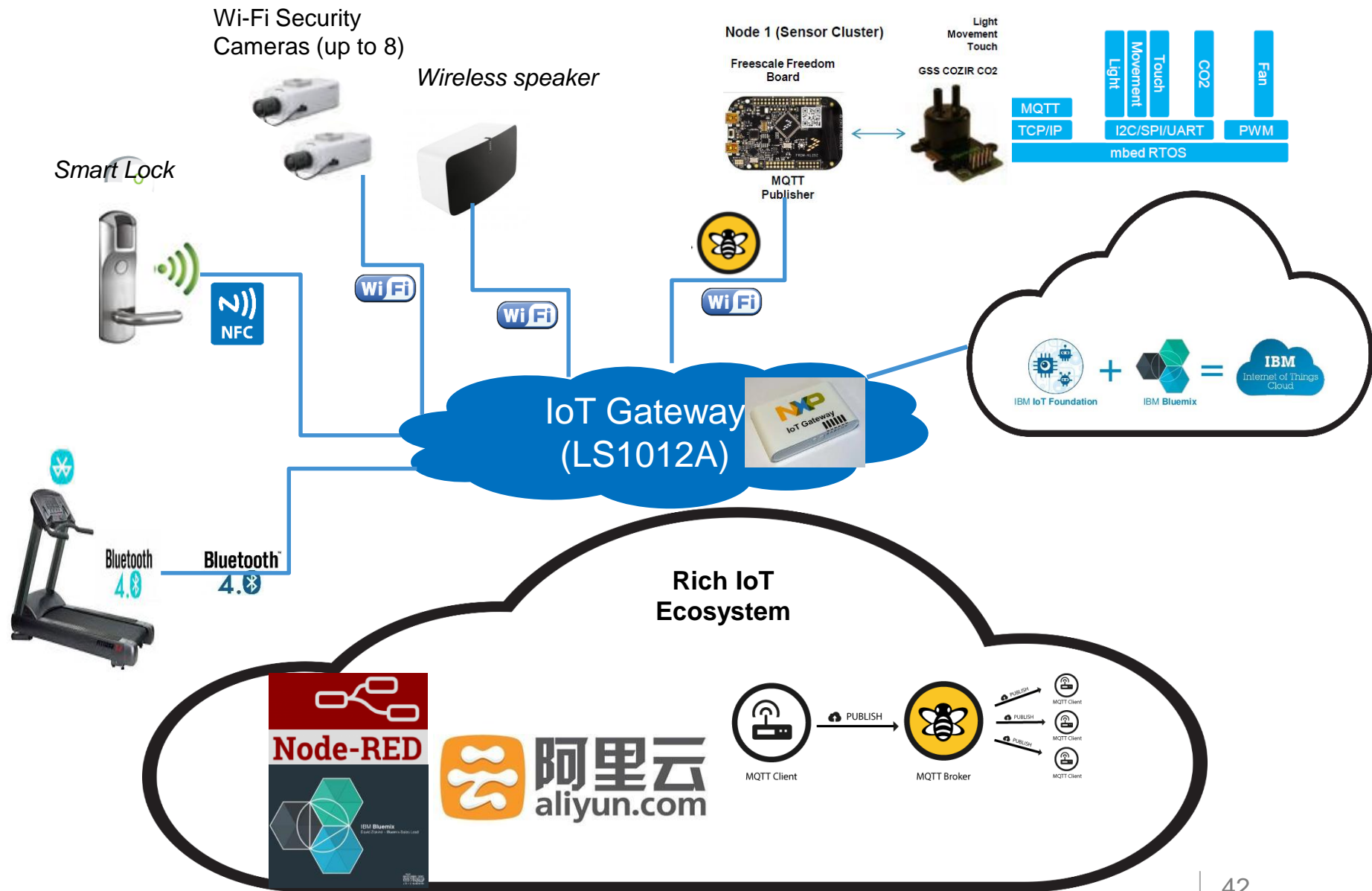


Cloud IoT Gateway Solution

- WIFI Gateway based on NXP LS1012A
- IoT Gateway with rich connections:
 - WiFi
 - Bluetooth
 - Zigbee/Thread
 - Zigbee
 - NFC
- Support IoT clouds :
 - IBM Bluemix(MQTT), Node-Red
 - Alibaba Aliyun(Alink)
- Support OpenWRT, Docker/LXC, Secure Boot
- Target Market : Smart Home , Industry 4.0



IOT Gateway by LS1012A





SECURE CONNECTIONS
FOR A SMARTER WORLD