FTF 2016
TECHNOLOGY FORUM

NXP DIGITAL NETWORKING SOLUTIONS PORTFOLIO AND ROADMAP

FTF-NET-N1863

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PUBLIC USE

AGENDA

- Session Introduction
- Session Objectives
- Key Technology Trends and Our Markets
- Digital Networking Solutions Portfolio Direction
- Solutions Portfolio (Hardware and Software) Update
  - QorIQ (ARM and Power Architecture) SoC
  - SDK, ADK, ASK
- Solutions Overview
  - Reference Designs
  - Turnkey Solutions
  - Partner Ecosystem

Session Introduction

- This sessions provides update on the QorIQ solutions portfolio including software and hardware
- Understand the target markets and benefits that the QorIQ solutions bring to your designs
- The QorIQ portfolio is the broadest 64bit (ARMv8 and Power Architecture) one in the market ensuring greatest span in performance, power, and economics in the networking, smart home, industrial, and general embedded markets
- In this session we will address broad range of topics around our solutions in order to provide you with greatest visibility to our solutions to enable your advanced system needs.
- Additionally, will introduce you to recommended sessions and demos in the FTF Technology Lab to jump start your designs.
- Finally, provide you with visibility to our overall solutions direction

Session Objectives

After completing this session you will be able to:

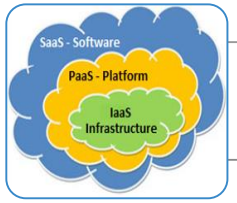
- Understand where the QorIQ solutions portfolio is winning today and how the portfolio is addressing common customer design concerns
- Select the right QorIQ family for your design
- Gain familiarity with our overall solutions offering
- Know your options for hardware and software development through NXP and the NXP ecosystem

Technology Trends Driving Our HW and SW Roadmap Direction

Social Matrix

Internet of Things

Big Data analytics



Anything as a Service

Enterprise

Cloud / Data Centers

Service Provider

Smart Home

Smart Industry

Enablement Software

- High performance OS
- Virtualization
- User Space processing
- Data path Acceleration
- Community & commercial Linux, Upstreaming

Tools / Open Source Tools

- Development and Debugging

Application Software and Open Source Ecosystem

- Security, Network stacks, visualization
- SDN & NFV frameworks – OPNFV
- Productized application software
- Professional Services and support

Reference System Solution

Technology Trends → Key Markets → System Requirements

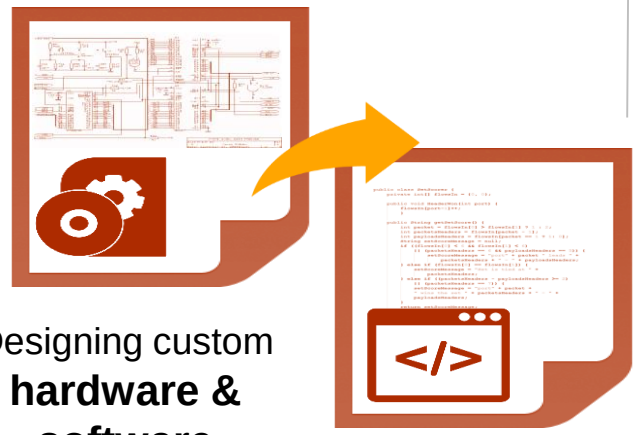
Leveraging Networking to Drive Expansion in Embedded Technologies

- **Technology leadership in Safety Certification for Multicore**
  - Founder of Multicore for Avionics (MCFA) working group
  - Trust Architecture Users Group (NXP led)
  - Secure, Trustworthy, Assured and Resilient Semiconductors and Systems (STARSS)
- **Product Longevity as a value**
  - Proven commitment to longevity and support
  - 15 year life for T series and Layerscape 28nm devices
- **Real embedded system design focus**
  - Deterministic interconnect for multicore SoCs
  - Focus on minimizing SER, FIT, AE rates for product quality
  - Large temperature ranges for embedded and industrial designs
- **Security, Security and even more Security**
  - Pervasive / Multifaceted
  - Balanced Need

Market Shifting to Virtualization (SDN & NFV)

NFV Promises Three Benefits to Operators

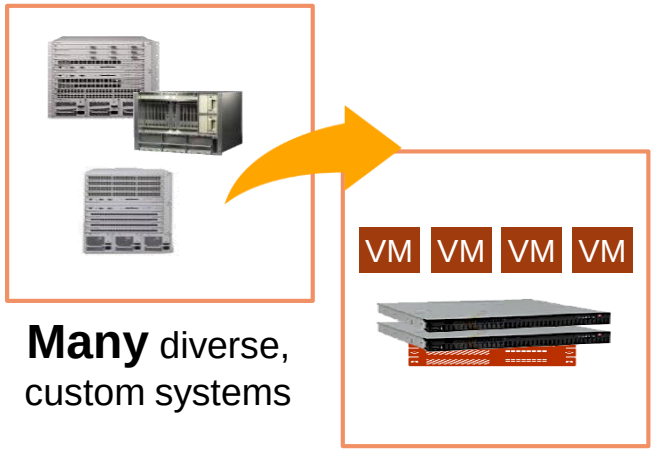
1 Service Velocity



Designing custom **hardware & software**

Writing **code** you can run and test in a VM

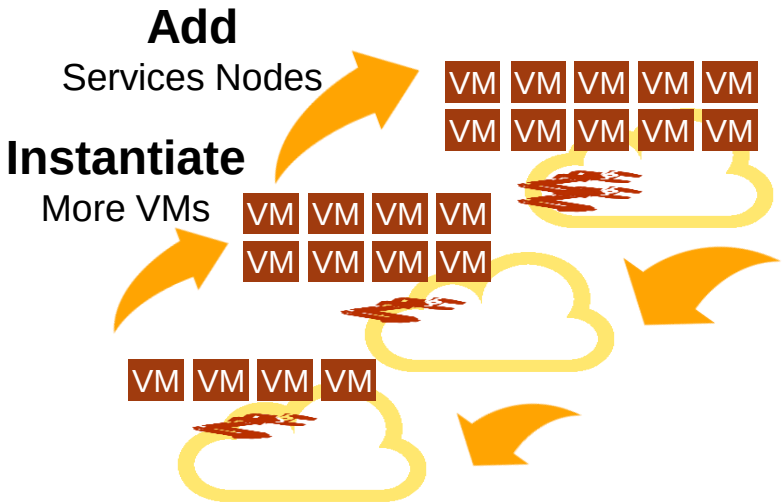
2 Capex and Opex Reduction



Many diverse, custom systems

Fewer, homogenous COTS systems

3 Scalability & Elasticity



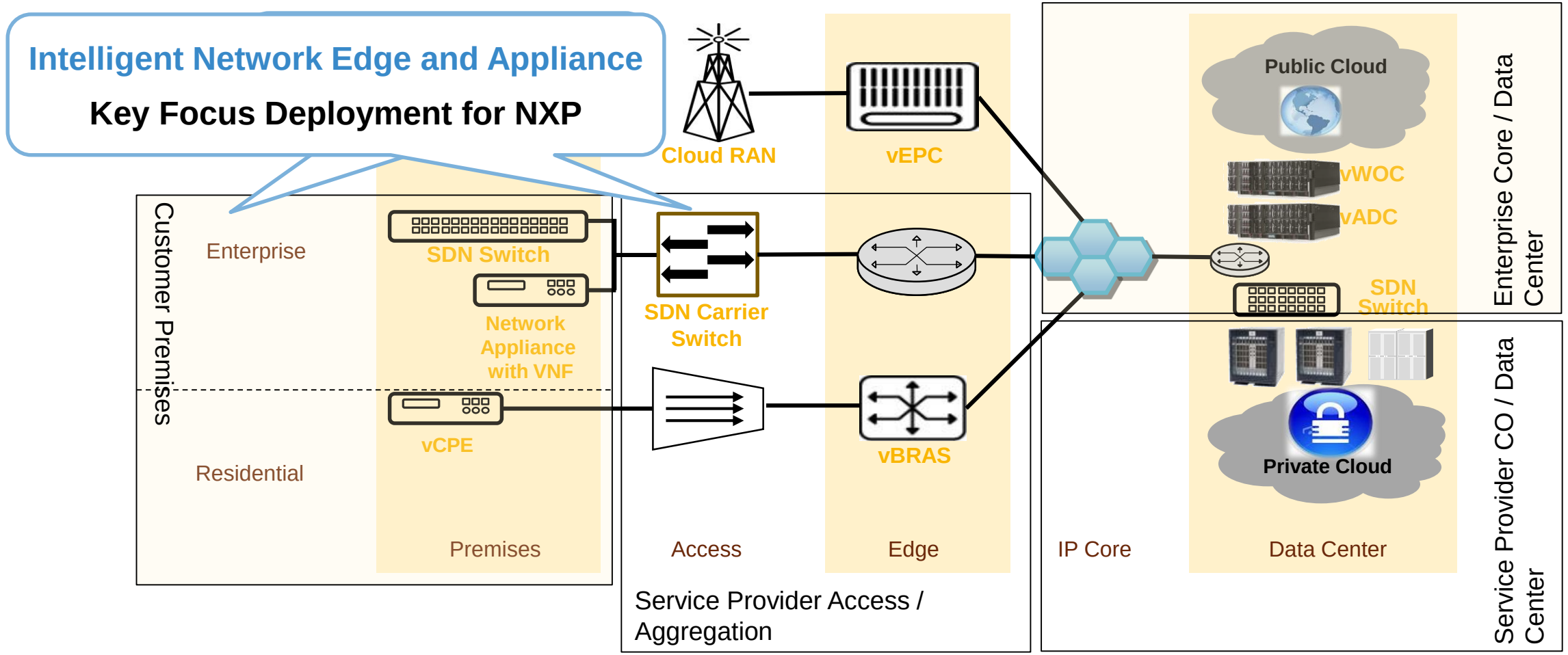
Add Services Nodes

Instantiate More VMs

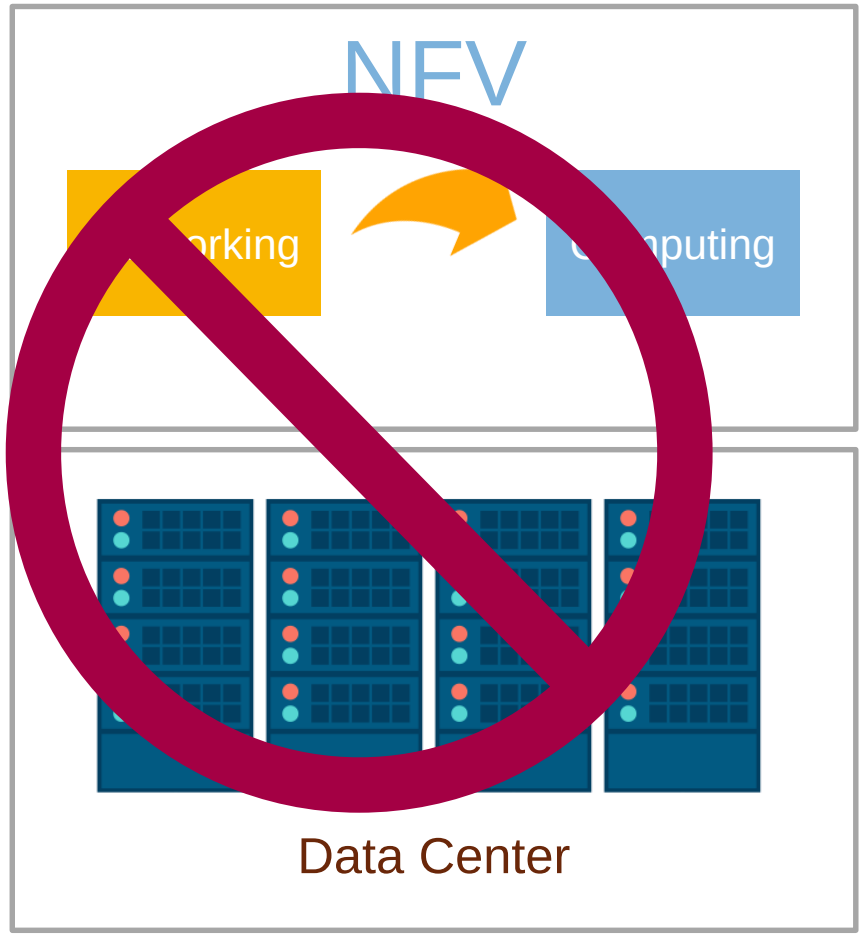
Scale Back with Demand

Drive Networking Solutions and the New Network

Virtualization Will Be Used Throughout the Network

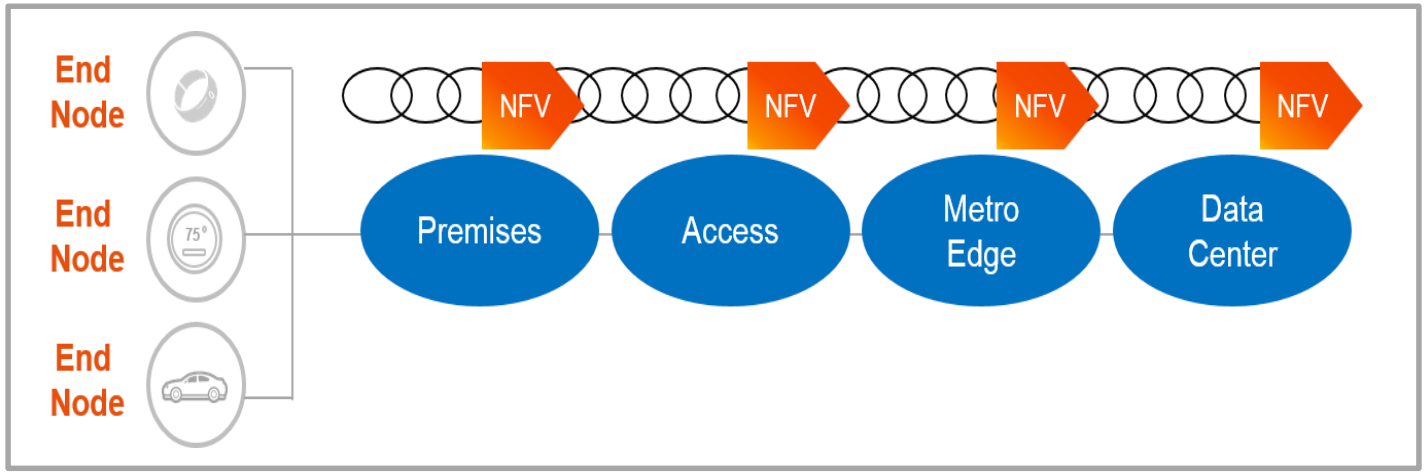


NFV Does Not Replace Networking With Computing But Blends the Two



Rigid Data Center Centralization

- **Systems in the field provide**
  - I/O, Acceleration
  - Low latency
- **The NFVI must be an intelligent flexible cloud**
  - VNF hosting distributed throughout network
  - Capability, capacity, context determine where VNFs run
- **Services can be chained across domains**



Intelligent Flexible Cloud

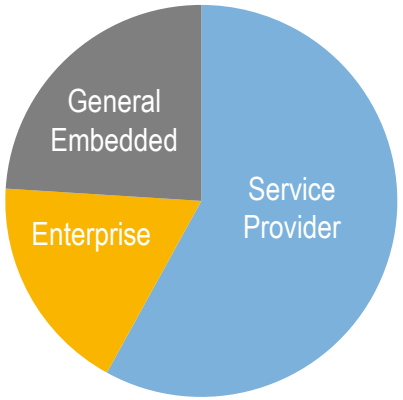
Digital Networking: Business Evolution

TODAY

Service Provider
Wireless & Wired Equipment

Enterprise / Data Center
Network Infrastructure

General Embedded
Industrial, Mil/Aero, Printing & Imaging



IoT Infrastructure:
- Smart Home
- M2M – Industry 4.0
- Smart Grid

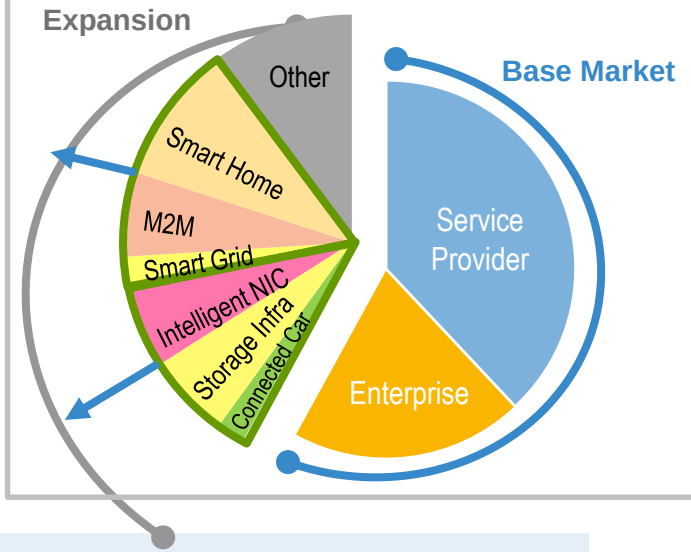
Cloud Edge:
- Intelligent NIC
- Storage Infrastructure
- Connected Car Infrastructure

FUTURE

Service Provider
Wireless & Wired Equipment

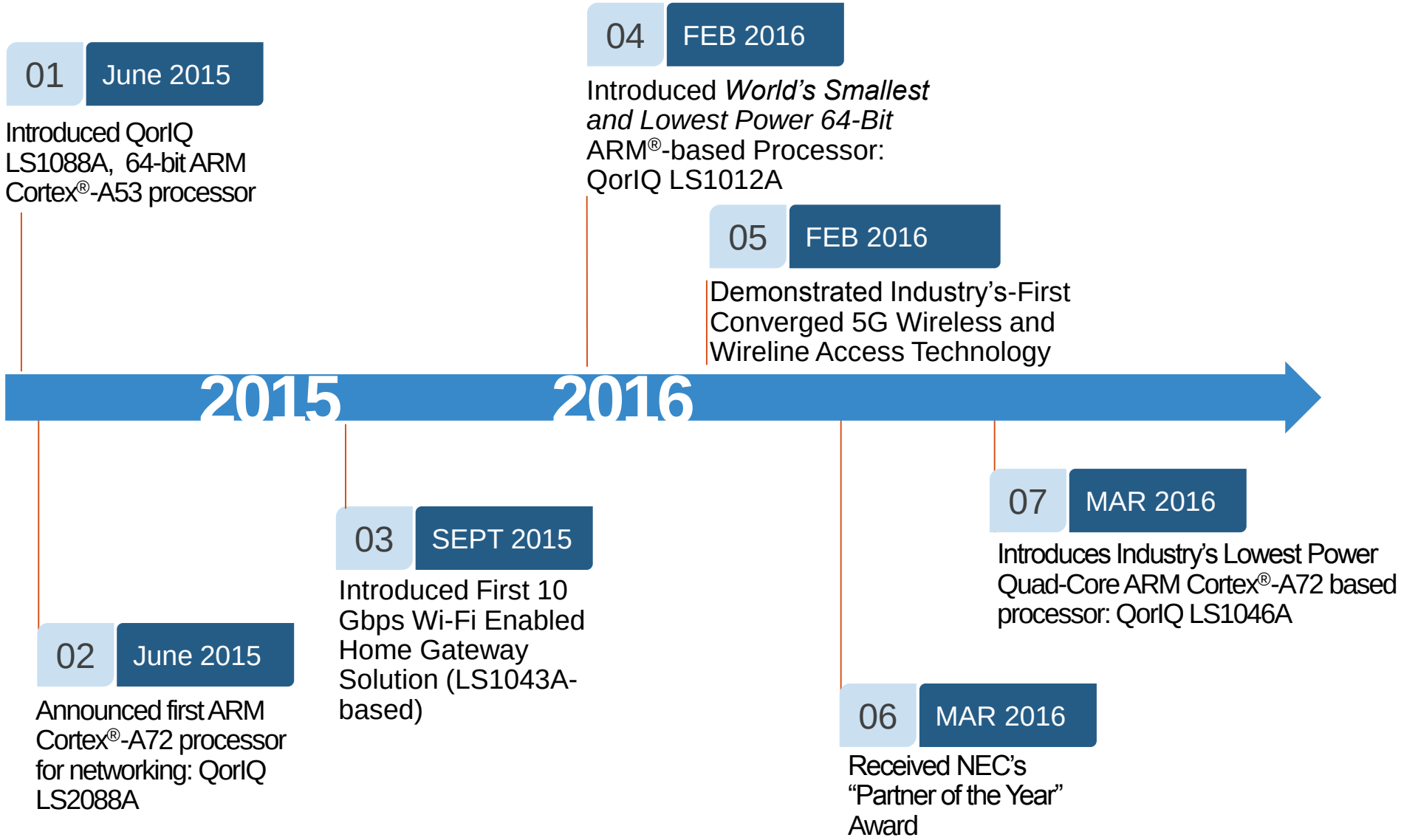
Enterprise / Data Center
Network Infrastructure

Smart World Infrastructure
IoT Infrastructure, Cloud Edge

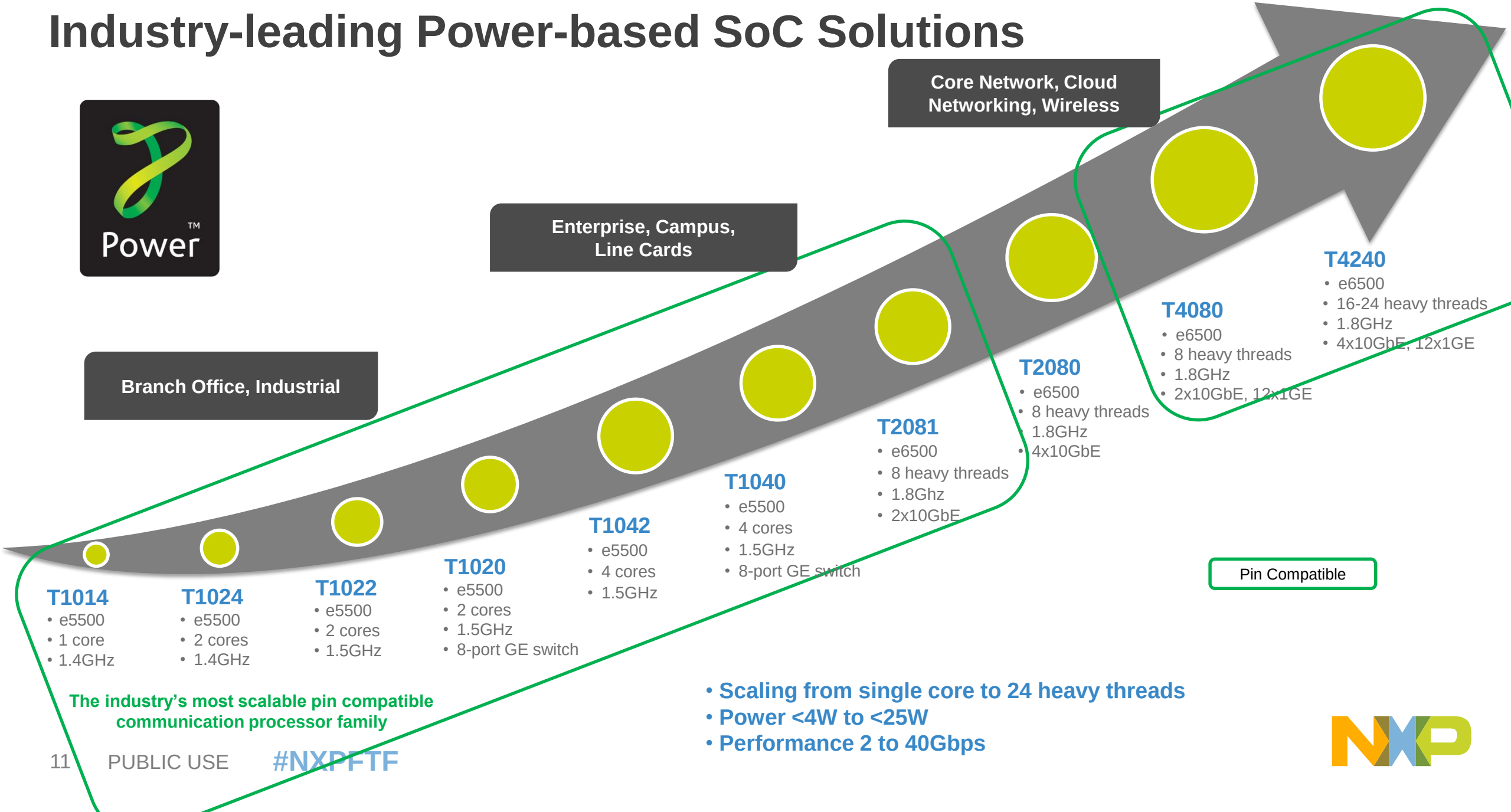


Expansion Markets Now Target Segments for Digital Networking

Since We Last Talked: A Year of Solid Accomplishments



Industry-leading Power-based SoC Solutions

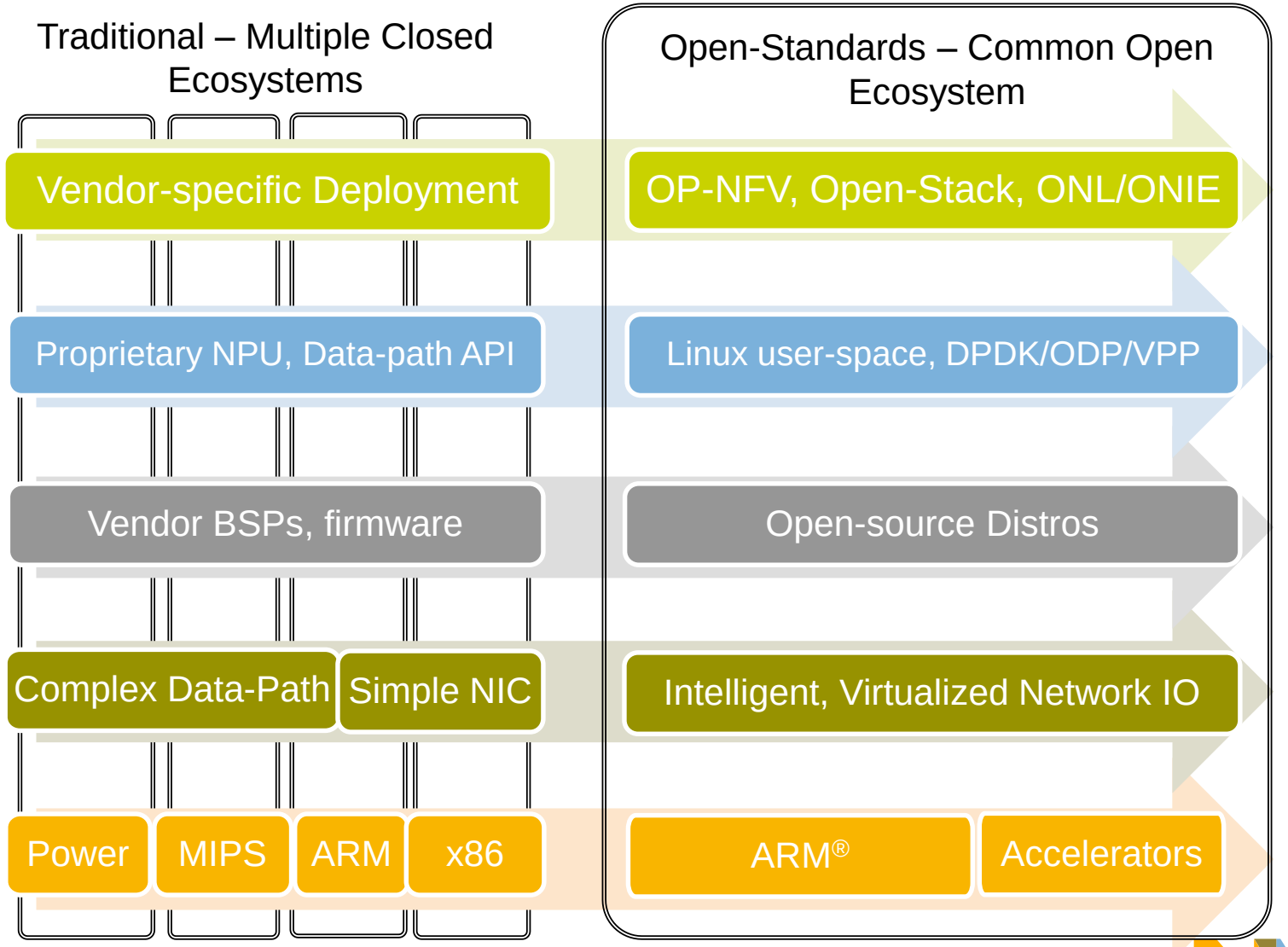


The industry's most scalable pin compatible communication processor family

- **Scaling from single core to 24 heavy threads**
- **Power <4W to <25W**
- **Performance 2 to 40Gbps**

Address the Needs: NXP Driving Standardized Ecosystem

- **Open Standards impact all levels of the Ecosystem**
  - Cores
  - Network I/O, Accelerators
  - OS, Bootloaders, Middleware/APIs
  - Configuration, Management
- **NXP driving changes**
- **Portfolio of ARM64b Multicore Solutions**
- **Open Data Plane (ODP)**
  - Founder and contributor
  - Cross-arch (ARM/Power)
- **OPNFV Virtualization Layer**
  - Running on QorIQ processors
  - Supporting accelerators
- **Installation Environment**
  - UEFI, ONIE, uboot
- **Driving Open Standards Bodies**
  - Linaro, ETSI NFV, OPNFV, ONF, Linux



Leading the 64-bit ARM Wave in Networking

ARM®

Remote Terminal, PLC, Low power Nodes

Industrial Firewall, Managed Switches, Gateways, Access Points

Access Gateway, WLAN, Intelligent Edge, vCPE

SDN, NFV, Cloud Networking, Storage

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

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

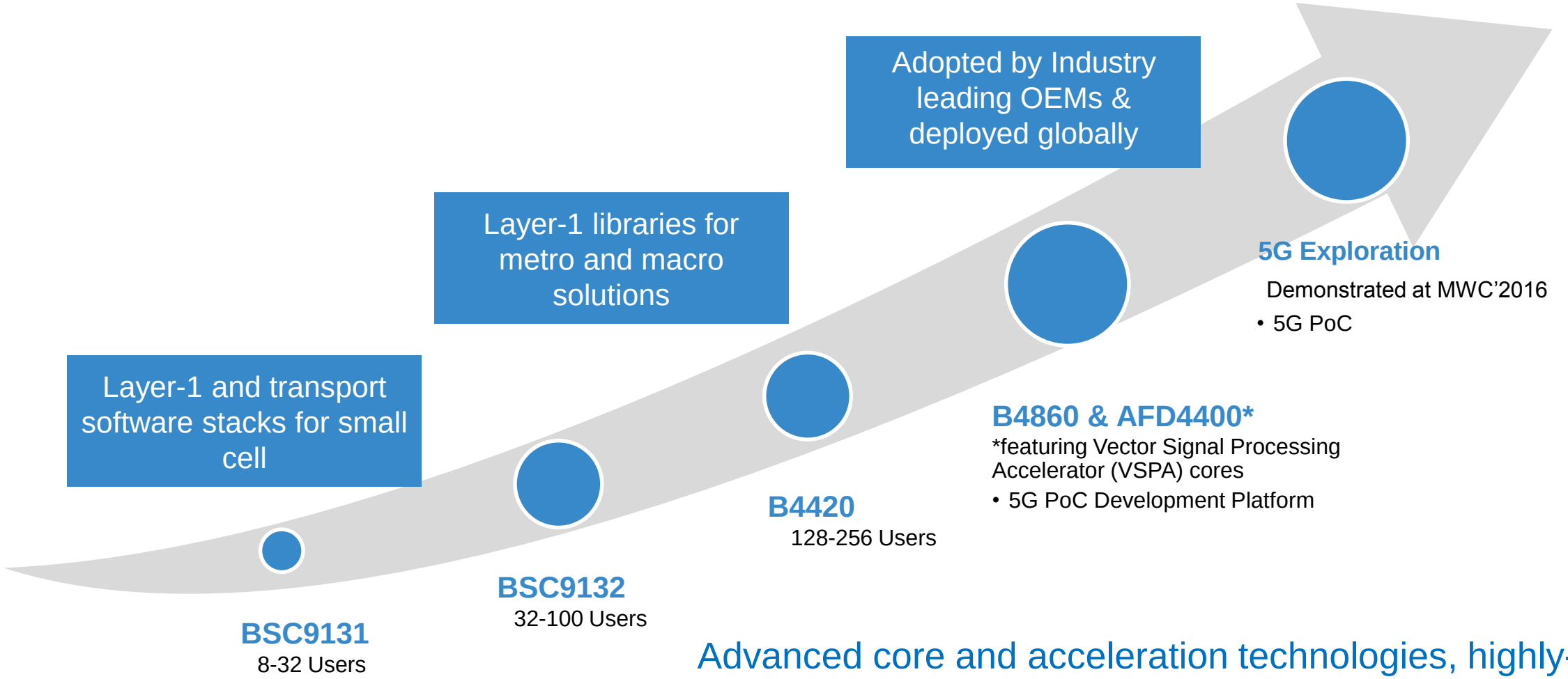
LS2088A
- Cortex-A72
- 4-8 cores
- DPAA2
- 40G Pkt
- 20G Crypto
- 20-35W
- 1st 8x A72 ARM Next gen programmable offload

LS-Next Gen
- Scaling core count
- Acceleration innovation
- R&D for power optimizations

In Concept

Pin Compatible

Complete Baseband Portfolio for LTE & Beyond



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

Networking Software and Services

Accelerate Customer Time-to-Market

- Market specific software solutions, field tested, ready to ship
- Scalable platforms, future ready roadmap

Deliver Commercial Software, Support, Services and Solutions

- Platform-based, scalable performance
- Experts from design, development, test, and production

Simplify Software Engagement with NXP

- Staying ahead of evolving standards
- Co-Development, ODM Management programs

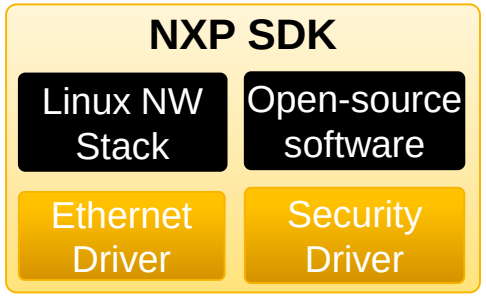
Create Success!

- Partner with customers
- Leverage *your* strengths, add *our* capabilities

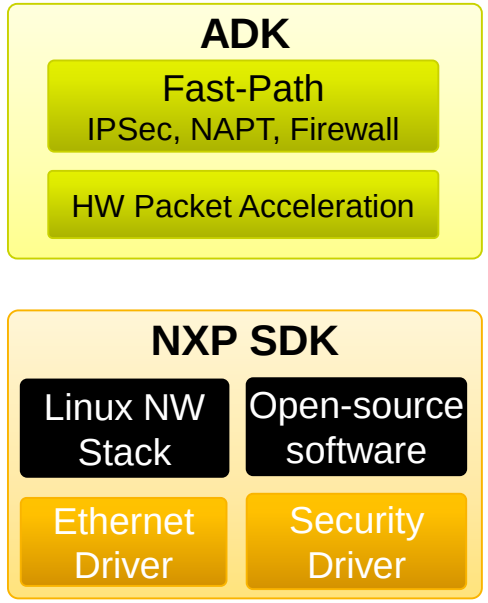
350+ CUSTOMER ENGAGEMENTS

Software Products and Services

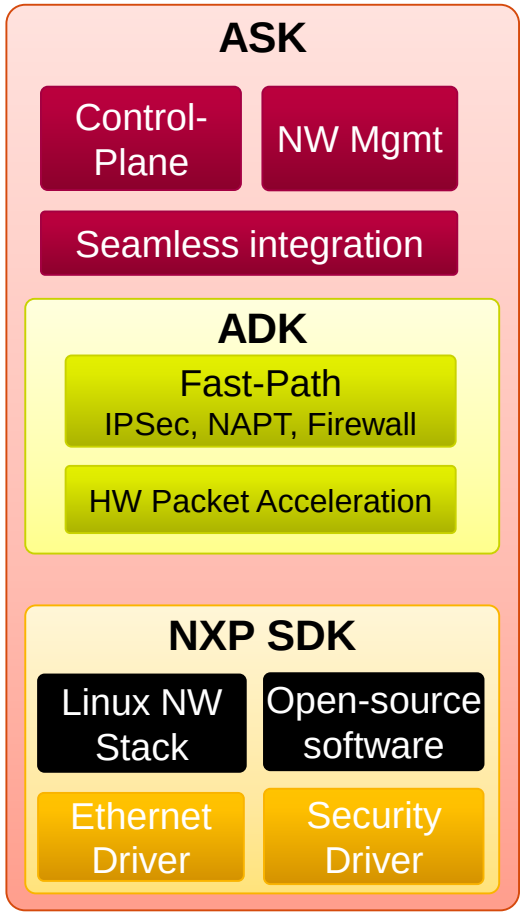
SDK:
- Optimized drivers
- Open-source Linux stacks
- Competitive performance
- Flexibility to add own applications



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



VortiQa Application Development Kit (ADK)

- IPSec, NAPT, Firewall
- Data-path offload to AIOP
- Highest Performance/Watt
- Integrated with Linux NW Stack (optional)
- Easy-to-use NF-API for configuration.

NW & Security

LS2085A, LS1088A
Licensed – complimentary*
(AIOP accelerated)

- Eliminate hypervisor overhead
- Confirms to Open-Flow standards – OF-API
- Integrated with Open V Switch

OpenFlow Switch (SDN) Basic

LS2085A, LS1088A
Licensed – complimentary*
(AIOP accelerated)

- Extensions for overlays – VxLAN, NVGRE
- Extensions for L3-L4 processing – NAPT, IPSec
- Full OF controller support
- Integrates with Linux network stack and OVS

OpenFlow Switch + Controller (SDN) Premium

LS2085A, LS1088A
Licensed
(AIOP accelerated)

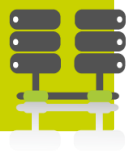
- Offloads Mgmt Path processing from GPP
- Netflow, E-OAM support
- Low-latency, high scalability.
- Supports vendor extensions

Switch Supplementary

LS2085A, LS1088A
Licensed
(AIOP accelerated)

- User-space TCP & SSL
- Zero-copy/context-switch
- Leverages async SEC capabilities.
- Scales to 24 cores. Millions of sessions
- Standard OpenSSL, EVP, socket API

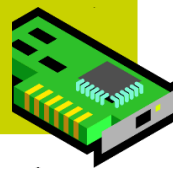
Data-Center Transport



T2080, T4240, LS2085A
Licensed

- Rich set of offload packages – L2 – L4
- HW offload for switching, overlays.
- Complete turnkey solution or build-your-own.
- Easy to use/setup on x86, ARMv8 & Power hosts

Intelligent NIC



T2080, LS2085A
Licensed
(partly AIOP accelerated)

Standard features across the board:

- Highest performance/watt
- Fully leverage HW offloads
- Optimized for application
- Ready to deploy
- Standard API – easy migration, adoption

* - initial (end-2016) discount on upfront license fees

VortiQa Application Solutions Kit (ASK)

- Data-path offload in HW
- Linux NW stack integration
- Control and Mgmt protocols
- IPv4, IPv6, NAPT, Firewall, IPSec, Switching
- VoIP & WLAN integrated

Multi-Service Gateway

LS1024A, LS1043A
Licensed

- Higher performance, acceleration
- High-Availability, Failover
- VPN, V4/v6 tunneling
- Hardware QoS offload
- UTM - DPI, Intrusion Prevention, Application visibility & control

SMB/Enterprise Gateway

LS1024A, LS1043A
Licensed

- Termination point and Access point modes
- Secure backhaul with HW CAPWAP/DTLS or IPSec
- HW MACSec offload
- Wide 802.11 ac/n/b/g/a adapter support – vendor agnostic.

WLAN – AP/TP

T1023, LS1043A
Licensed

- SMB, AFP, NFS, DLNA support with HW TSO/LRO
- Media streaming, display and transcoding
- Secure file-system and access
- RAID 0, 1, 5, 6, 10, JBOD support

Consumer, Prosumer NAS

LS1024A, LS1012A,
LS1043A, LS1047A
Licensed

Turnkey Segment Specific Solutions

- Application, Middleware & SDK
- Full-featured and optimized.
- Deploy directly or via ODM partners
- Systems Integration and Customization

- SIP signaling stack, H.323 Gateway
- Optimized G.711, G.726, G.723, G.729ab SW codecs – royalty free
- Wide 3rd-party SLIC/SLAC support

Voice over IP (part of MS-GW)

LS1024A, LS1043A
Licensed

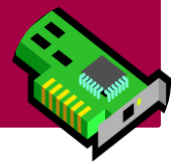
- Thread stack support for device management.
- Secure boot, Trust-zone support
- Secure GW-device communication via SSL or IPSec
- Firewall, access-control

IoT Gateway

LS1021A
Licensed

- VxLAN, NVGRE, VEPA, IPSec overlays
- HW L2-switching, optimized OVS support
- Inline vNIC offloads – NAPT, Fwl, IPSec, SSL
- x86, PPC, ARMv8 drivers in kernel, VM & user-space

Intelligent NIC



T2080, LS2085A
Licensed

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
- Smart Grid

1.3. Cloud Edge

- Intelligent NIC
- Storage infrastructure

1.1 Solutions for the Service Provider & Enterprise Segments

WLAN Access Point

- Shipping to leading global players
- Scalability for Low, Mid, High-End Solutions
- Complete protocol offload for IPSec, GRE, 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

Evolved Control Plane and Switching

- Increasing adoption of services as differentiators
- Broadest portfolio of SoC + SW solutions
- Enabling new services like network visualization for OEM customers

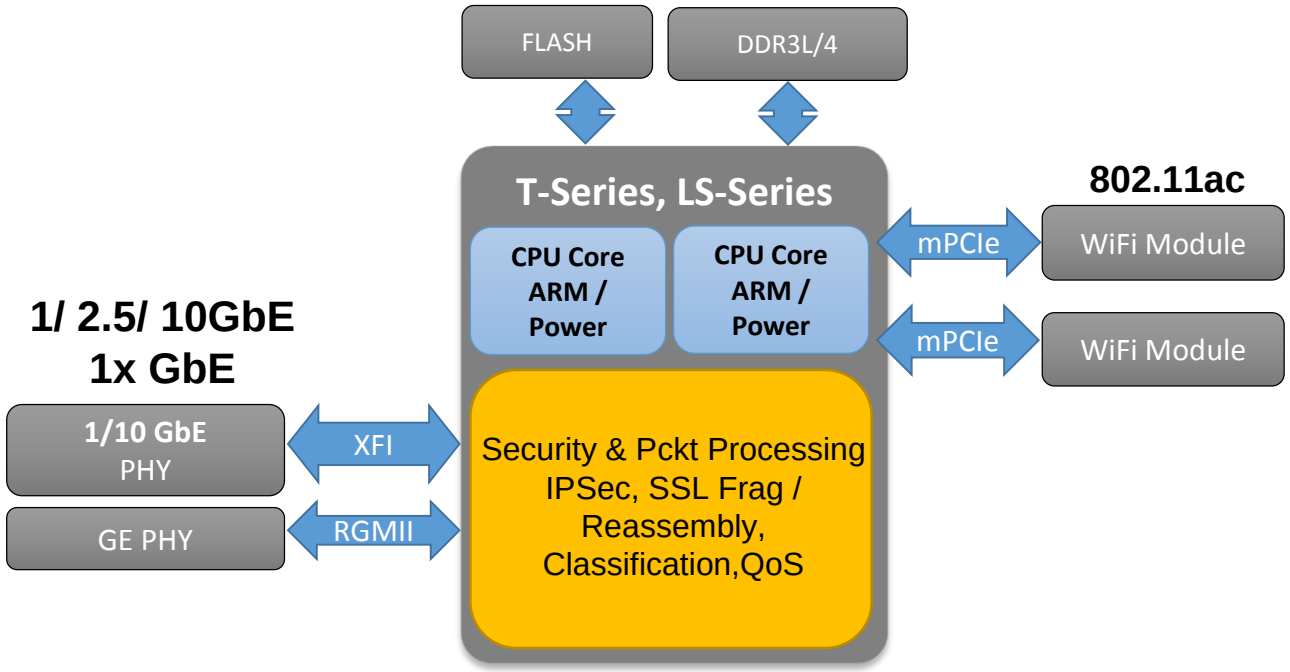
Virtualized Networks

- 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

openstack™ OPNFV OPENCONTRAIL

1.1 Leading Solution for Enterprise & Carrier WLAN Access Point

7 of 10 Global Leading OEMs Use QorIQ



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

Scalable Processor for Low, Mid, High End

- LS1012A
- LS1024A
- LS1043A

Memory Subsystem:

- 16/32/72b DDR3L/4 up to 1600MTs

High Speed Serial IO:

- Up to 3x PCIe Gen2 Controllers

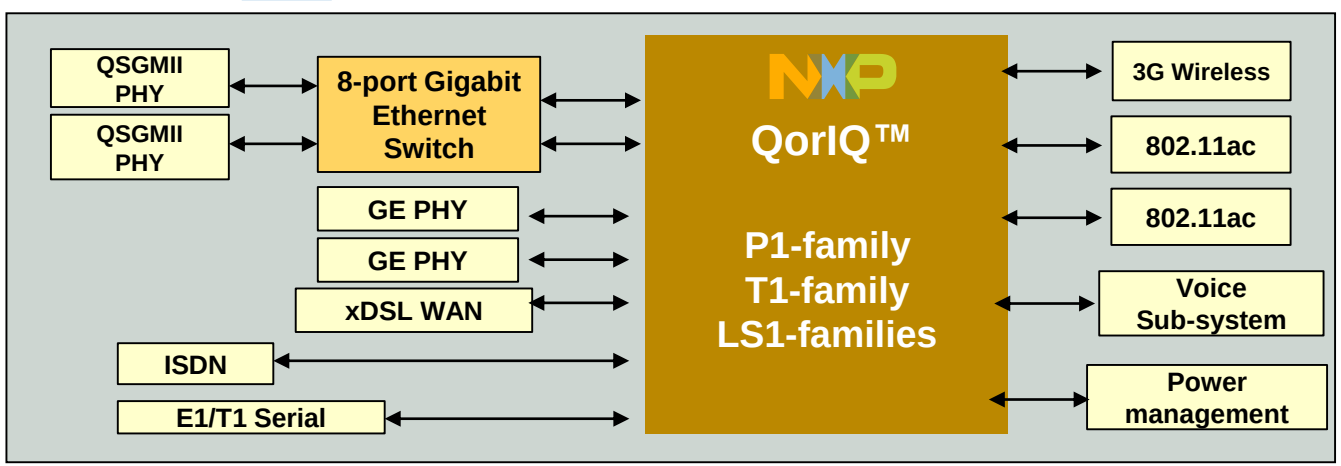
Network IO & Offload:

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

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

1.1 Leading in the Small Office / Branch Office Router Market

QorIQ is a solution for **All** Global Leading OEMs



Enterprise-grade security

WAN optimization

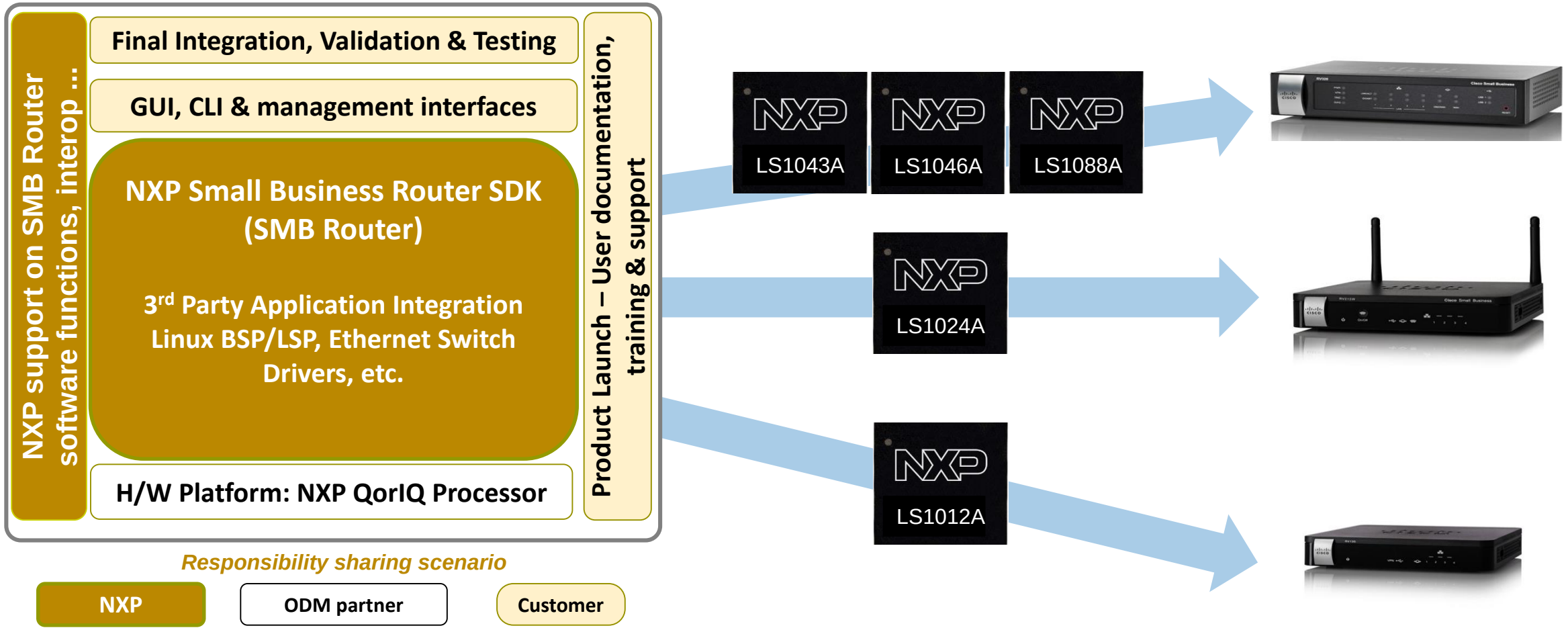
Cloud connectivity

Voice, video and data

P102x | T10xx | LS10xx

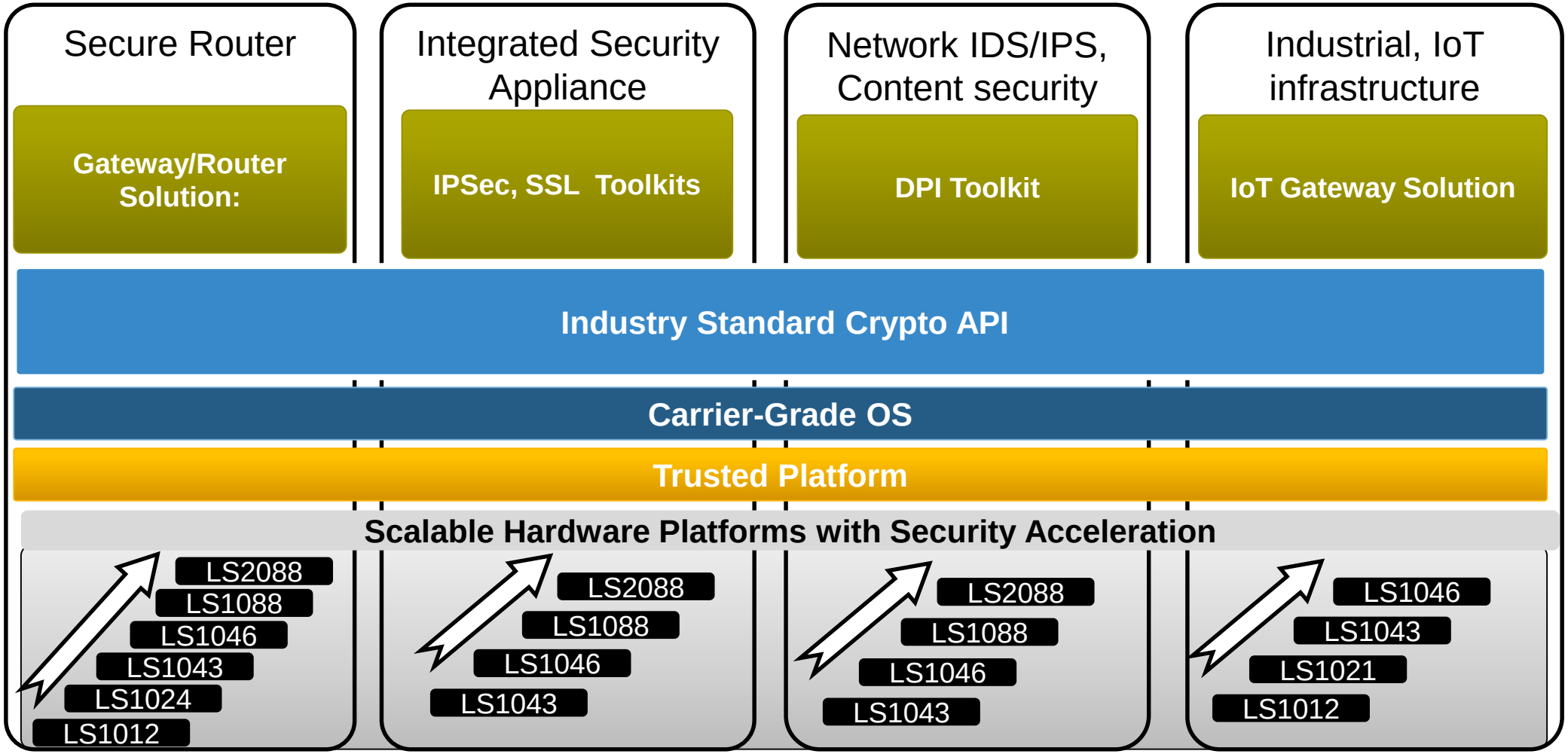
Time, Performance, Services

1.1 NXP: The Only Solution Provider for Small Business Router



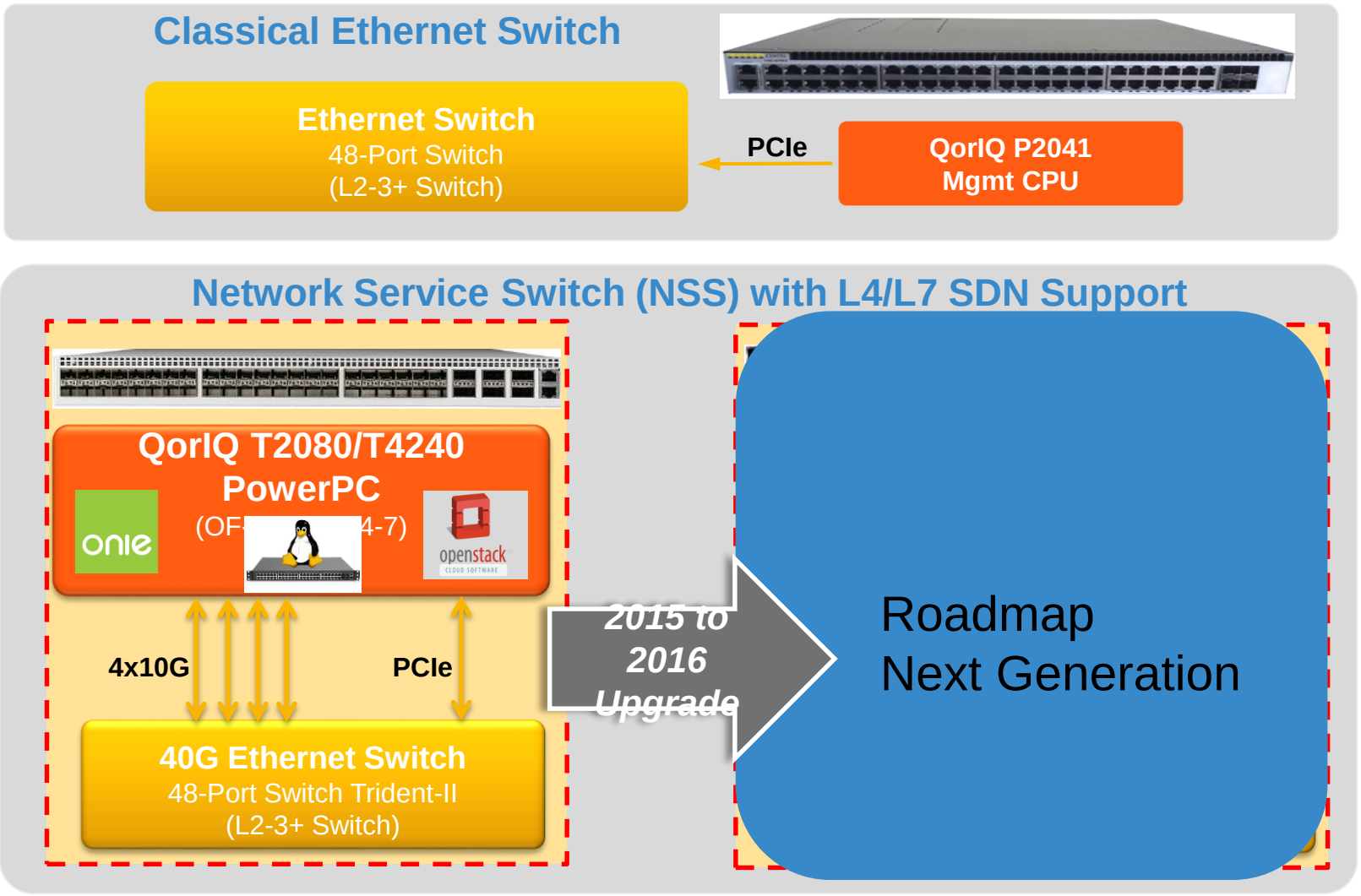
Industry Best Scalability and Performance Efficiency for Wide Range of Services
(IPSEC, VPN, FIREWALL, DEEP PACKET INSPECTION)

1.1 Right Recipe for your Security Appliance



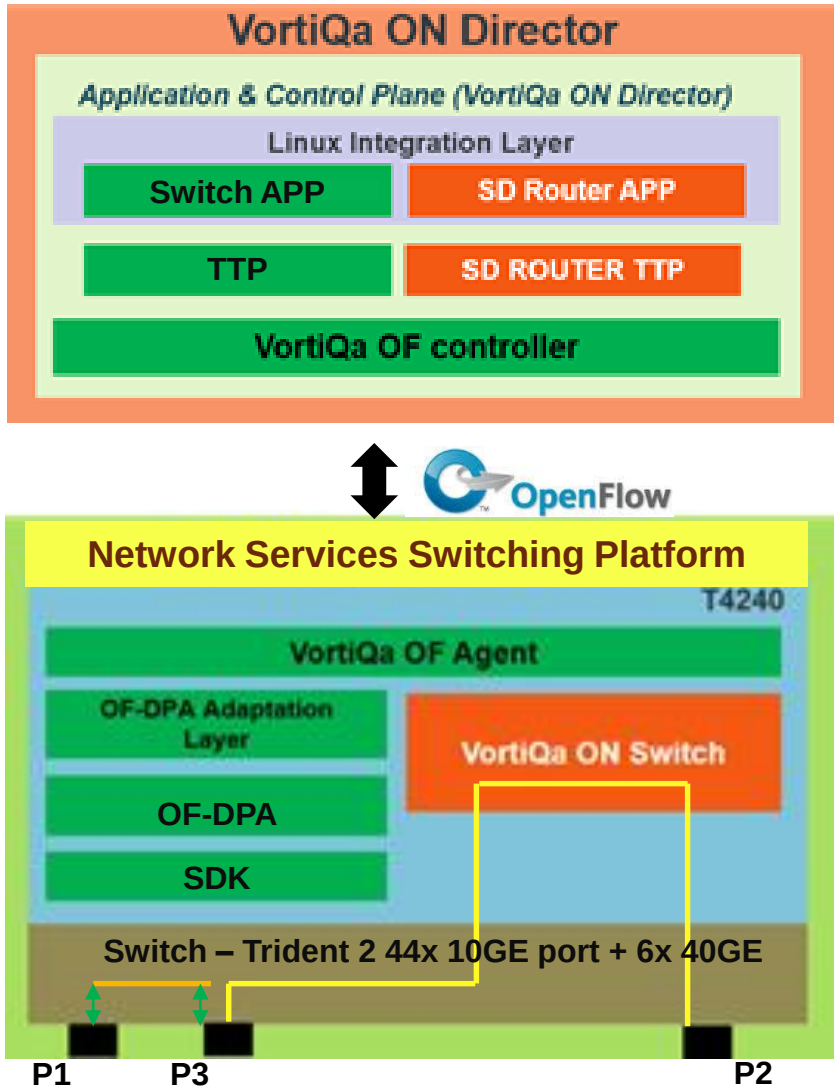
NXP value proposition: Data-path offload in HW Programmable for custom applications; Easy-to-use NF API to integrate with customer stack; Complete turnkey solution – ready to deploy

1.1 NXP Services Switch Solution Platforms



- Builds up on the success of the P2020 and P2040 based broadly adopted solutions
- Enhancements for SDN
- Services focused solution
- Flexibility, performance, time to market
- Broad ecosystem & support

1.1 SDN & Services Solution

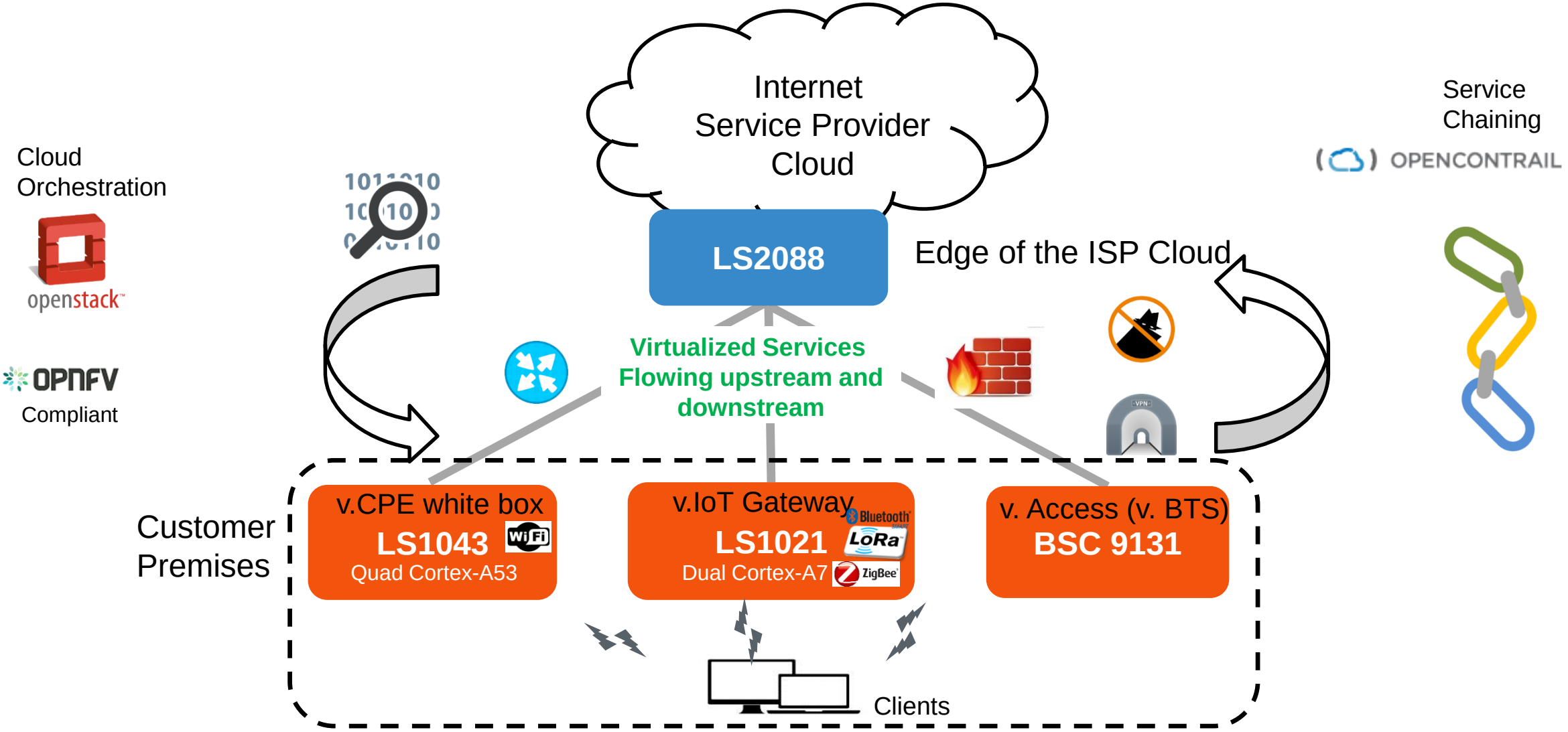


- SDN-enabled platform
- Commercially available white box solution from ODM
- Programmable dataplane
- Production OpenFlow based switch and controller software
- Augment with value added software

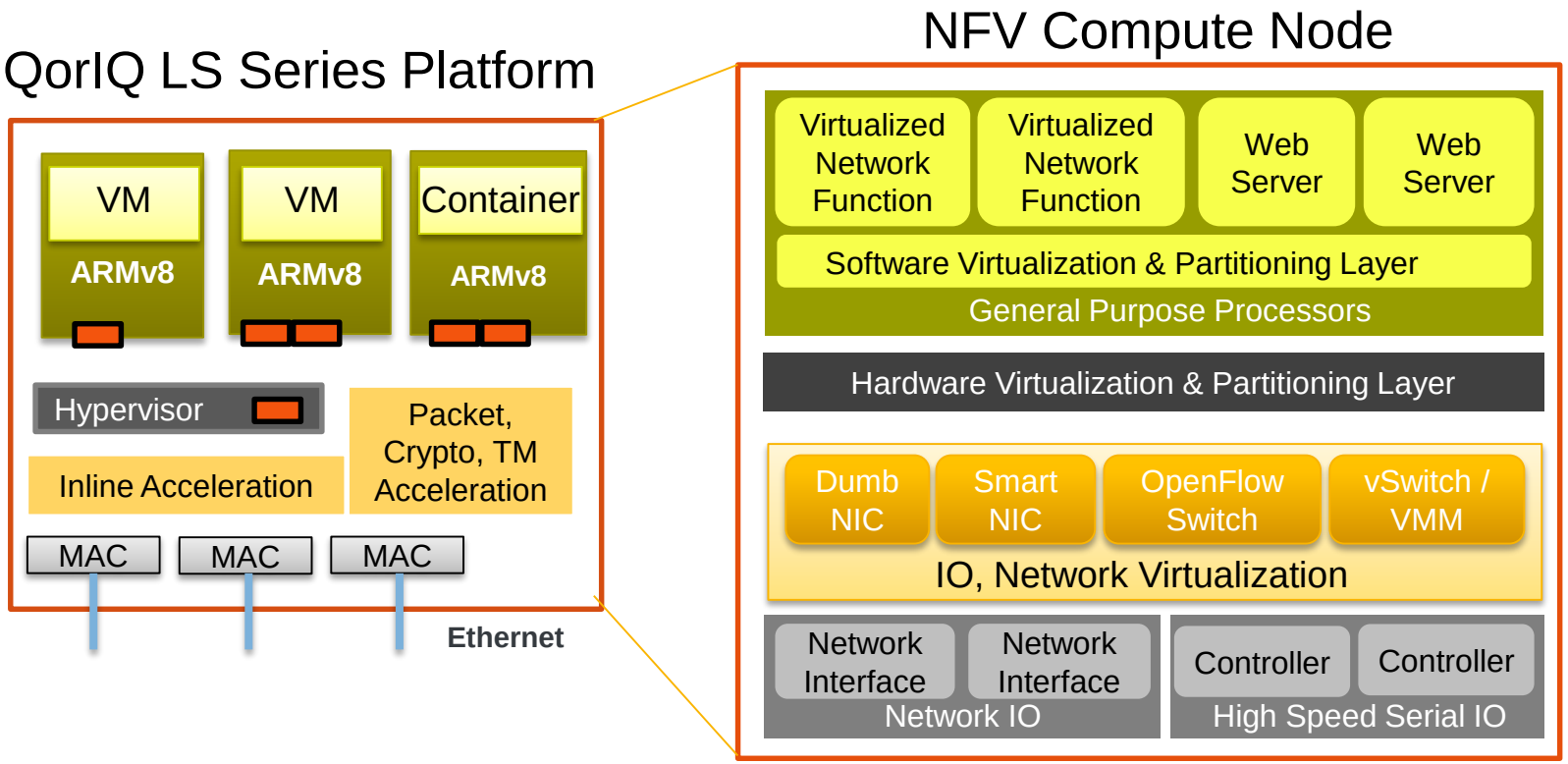
QorIQ

T4240 & T2080

1.1 NXP Driving Virtualized Networks



1.1 Open Platform for NFV – Mapping to Hardware



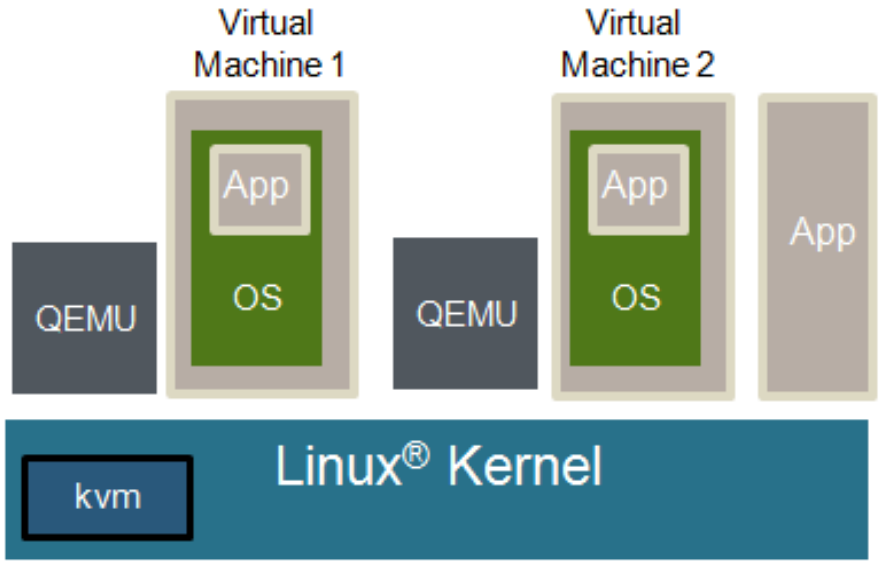
- **Expanded acceleration capability to offload Hypervisor and VMs**
  VxLAN, OVS, Firewall, Traffic Control, IPSec, Netflow, SDN
- **Driving standardization**
  Linux, ODP, Virtio, DPDK
- **Driving relevant open standards bodies**
  ETSI NFV, OPNFV, ONF, LNF
- **Standard SW installation environment**
  - UEFI, ONIE, ACPI, uboot

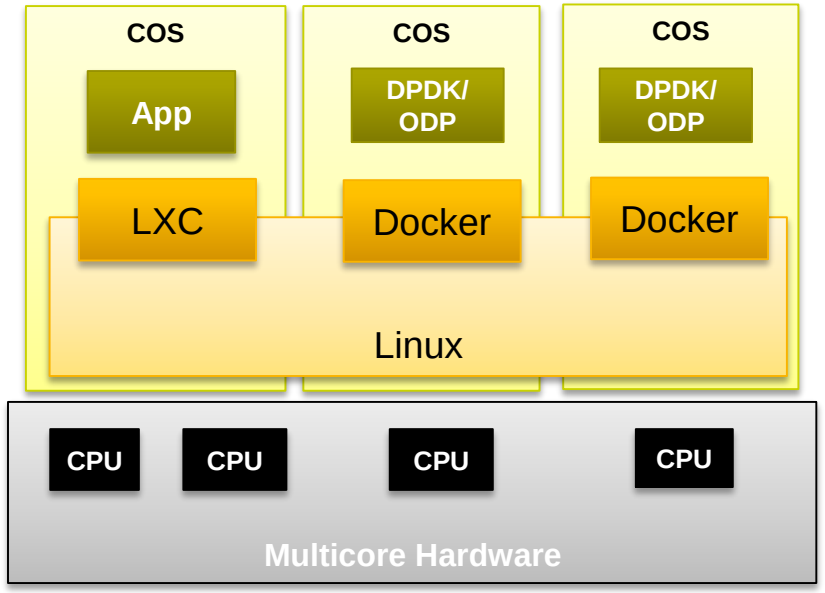
Open, Scalable, Performance / Cost Optimized Solution

Software fully compatible with open standards

1.1 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

Deployed with Cloud Orchestration

1.1 NXP Solutions for Virtualization

Standard Hardware Platforms	• QorIQ LS Series: ARMv8 cores + virtual networking
Standard Linux Distro	• CentOS, UEFI, Debian, Ubuntu
Standard Virtualization components	• KVM, QEMU, Dockers, Ceph
Standard Orchestration and Management	• OP-NFV: OpenDayLight, OpenStack
Standard API and libraries	• DPDK, ODP, OVS, Virtio
Reference Virtual Network Functions	• vFirewall, vNAT, vRouter, vVPN
Out-of-the-Box Experience	• Benchmarks, User-guide, Documentation

DEPLOYED VIA AN OPEN ECO-SYSTEM

1.2 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

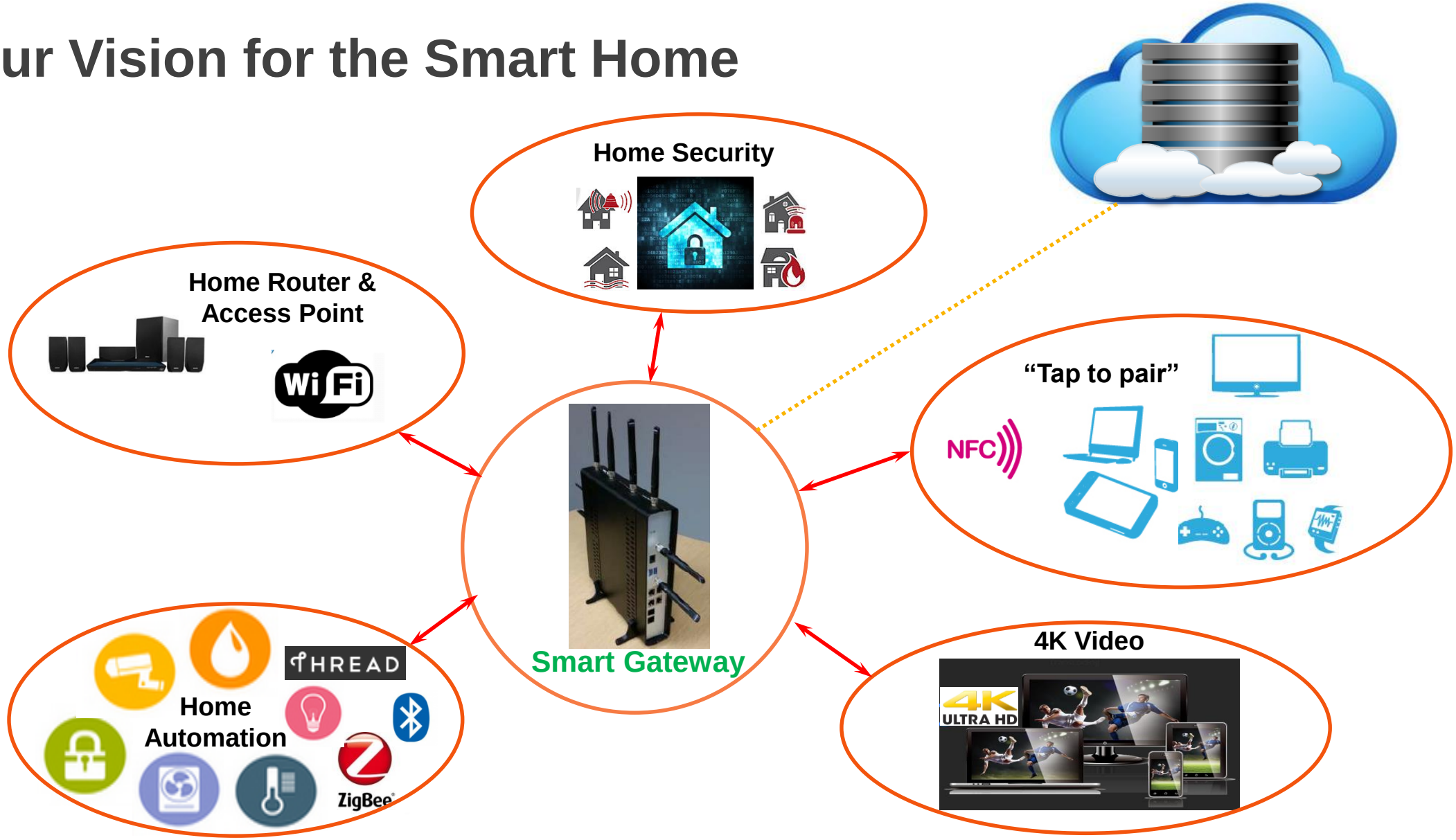
IoT Gateway & TSN Exploration

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

Wireless Audio

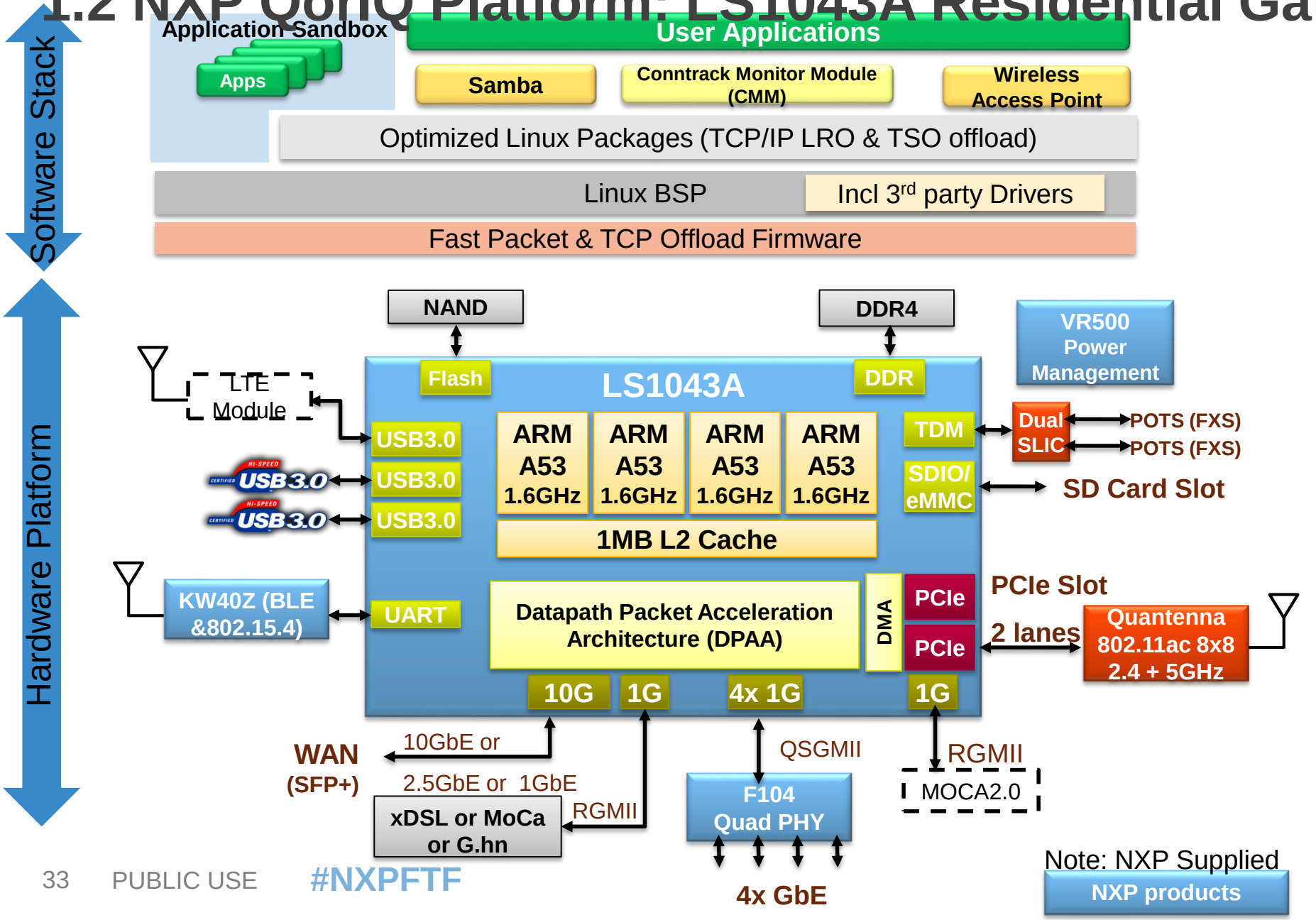
- Architected for line-rate networking with low CPU overhead
- High-performance 64b ARM CPU with NEON & FPU
- 5x serial audio ports
- Low power ultra-compact package for portable applications

1.2 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

1.2 NXP QorIQ Platform: LS1043A Residential Gateway Solution



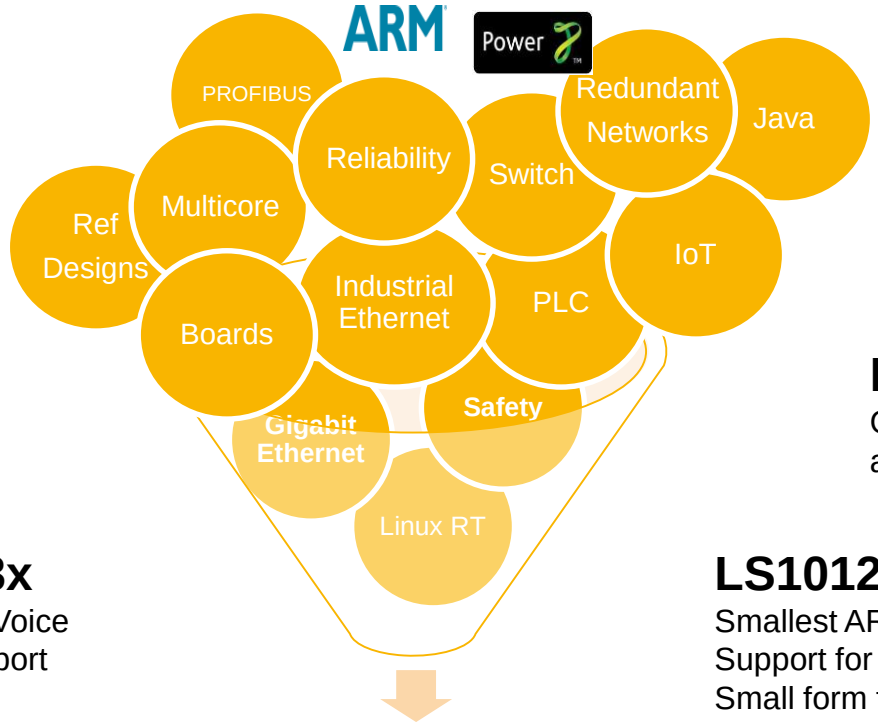
- Industry's first 10G Gateway solution
- Supports Quantenna Wave3 **8x8 WiFi** via 2-lane PCIe gen.2
- Pin compatible scalable portfolio of solutions
- Complete Software solution for Gateway, NAS, additional applications

1.2 Going Broader in Industrial

T1040 Family
Quad-core power optimized
Gigabit Ethernet Switch

T1024 Family
Leadership performance for WLAN
Unmatched performance efficiency
Acceleration strategy

BSC913x
DSP for Voice
LTE Support



LS1043 & LS1046 Families
A53 scaling to High performance A72 Quad Core
Pin compatibility across two families
Multi-10GbE support – driving adoption in industrial

LS1020A Family
Good performance, great power efficiency
and unmatched integration

LS1012A Family
Smallest ARM64bit SoC Solution
Support for advanced 2.5GbE & packet, security engines
Small form factor & Battery powered applications

QorIQ

Power

Factory

Transport

Buildings

Infrastructure

Industrial Solutions Enabled by NXP Digital Networking

Industrial Managed Ethernet Switches

Leverage networking leadership position

ARM, Power, Accelerators

Gateway/ Router

Leverage networking leadership position

Industry leading low power – performance portfolio across ARM, Power, Accelerators

Industrial Firewall

Scalable IPSEC

Support for broadest range of cyphers

HW acceleration

ARM and Power

LS1, LS2, T1~T4

Remote Terminal Unit (RTU) / Automation Controller

Scalable 1-to -4 cores

ARM & Power

LS1, T1 families

Programmable Logic Controllers (PLCs)

Single-Dual Core ARM & Power

Low power

LS1-Families

T1-Families

Robotics

Scalable 1-to-many cores

Power & ARM

High Compute-to Power dissipation ratio

- LS1-families
- LS2-families
- T1, T2, T4

SDK, ADK, ASK DRIVING SCALABLE PERFORMANCE AND TIME TO MARKET

1.2 NXP IoT Gateway Summary

SMART
INDUSTRIAL

SMART
INFRASTRUCTURE

SMART
HOME

SMART
BUILDING / OFFICES

Enterprise, Carrier, Cloud
Partner Network

Sensor
Partner Network

QorIQ IoT Enablement

Trust/Security
Providing multiple levels of protection

Networking
GigE, Wifi, 3G/4G

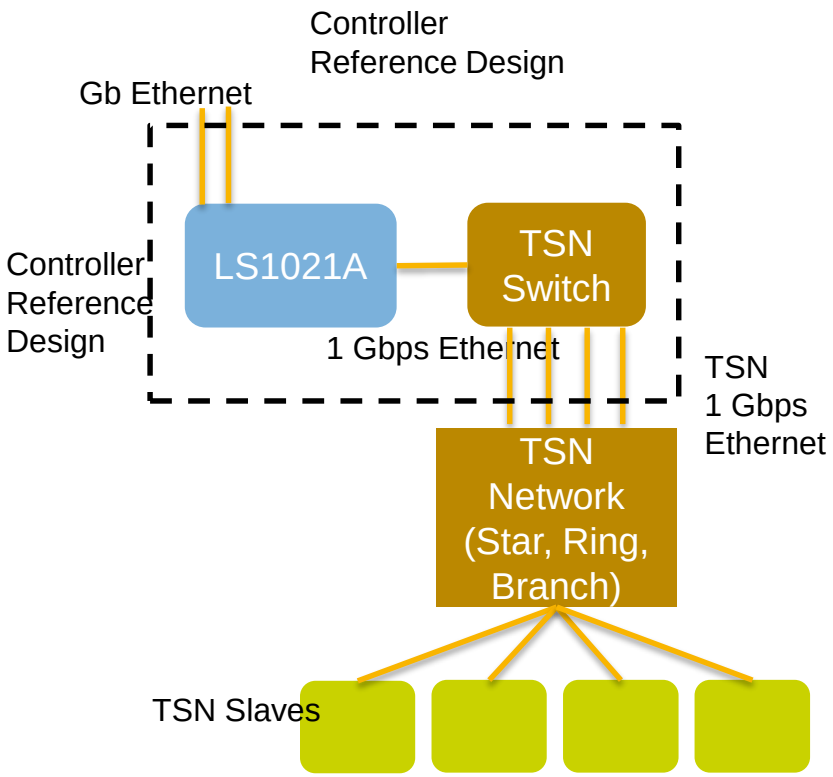
Processing
ARM Cortex v8 cores, SoCs <2 Watts

Ease of Use
Linux, Java VM, OSGI, OpenWRT, Node-RED

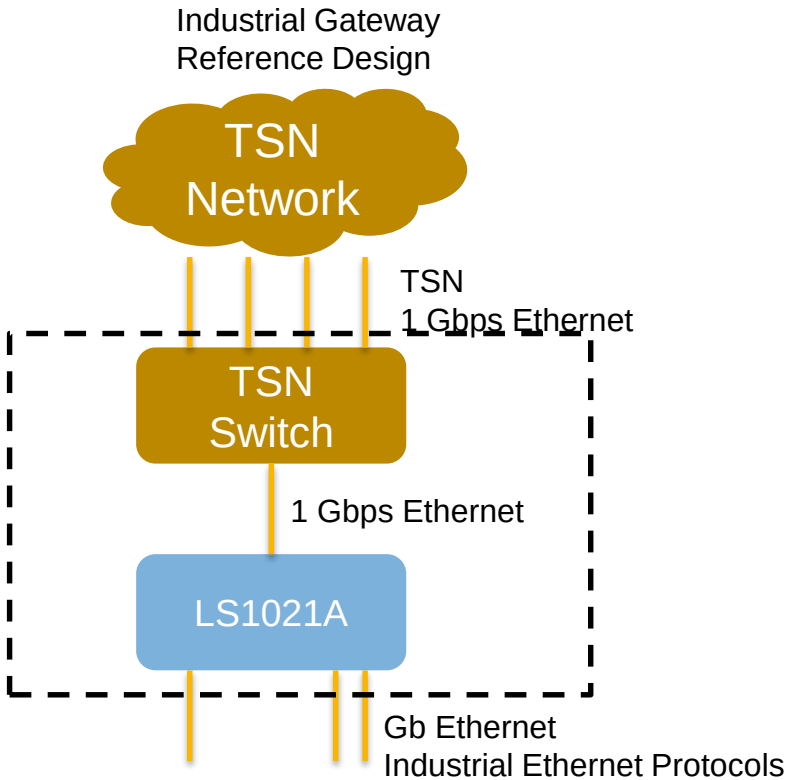
Sensor Connectivity
Zigbee, 6lowPAN, BTLE, Thread

THE ONLY SUPPLIER TO PROVIDE COMPLETE IOT SOLUTIONS

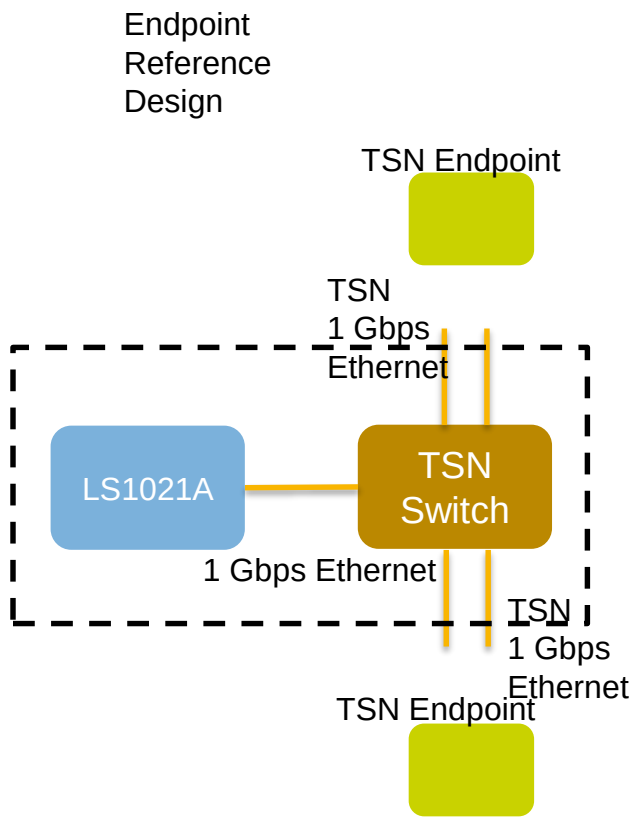
1.2 TSN Reference Design for Application Development



Applications
TSN PLCs,
Automotive Gateway



Applications
Legacy Industrial
PLC,
Industrial Gateway

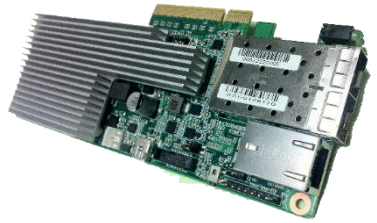


Applications
Robotics controller, motor control, synchronized audio playback

1.3 Solutions for the Cloud Edge

Storage Infrastructure

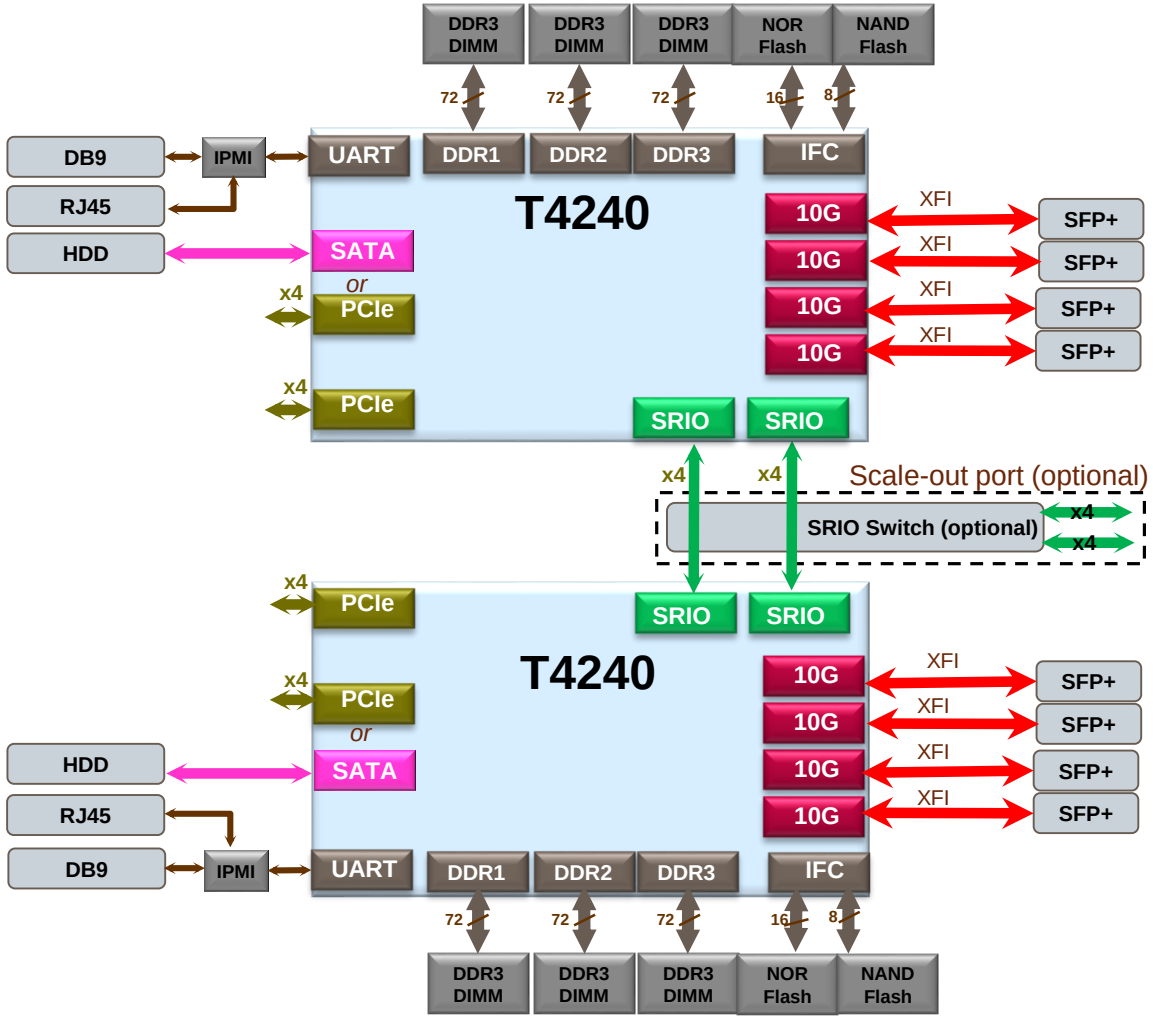
- Developing solutions for a broad range of applications
  - Software defined storage
  - Storage controllers
  - Cold storage
  - Ethernet drive cold storage



Intelligent NIC

- Scalable set of solutions to offload host processors in the Cloud / Cloud Edge and enhance efficiency of system deployment
- Leveraging low-power T2080 and high performance T4240 multicore and software solutions
- Ready iNIC SDK
- RSA and SSL Solution leveraging C29x processor family and Software framework

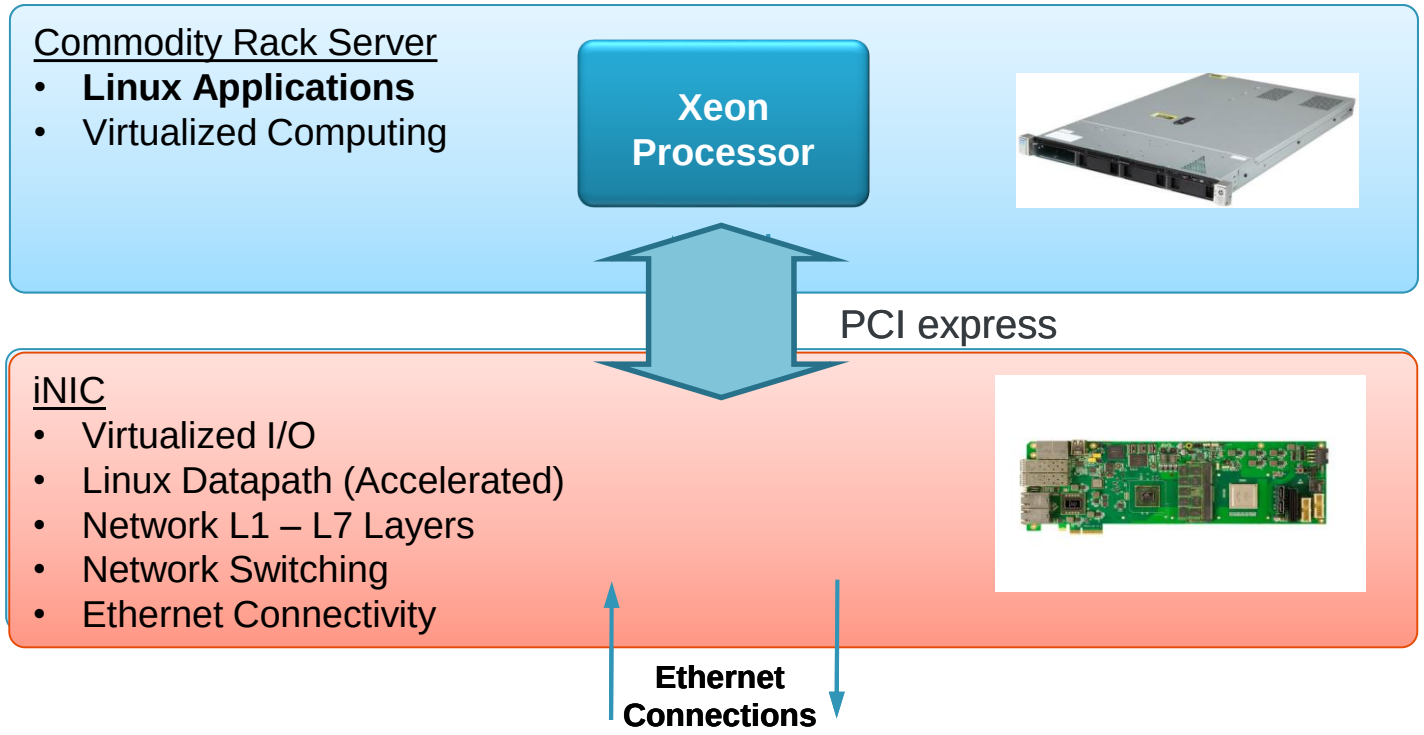
1.3 Leverage the Efficient Performance of Multiple T4240 SoC



Two platform configurations

- ***Storage platform***
  - CEPH, OpenZFS, Cinder, iSCSI, RAID5
- ***Scale out platform***
  - Hadoop

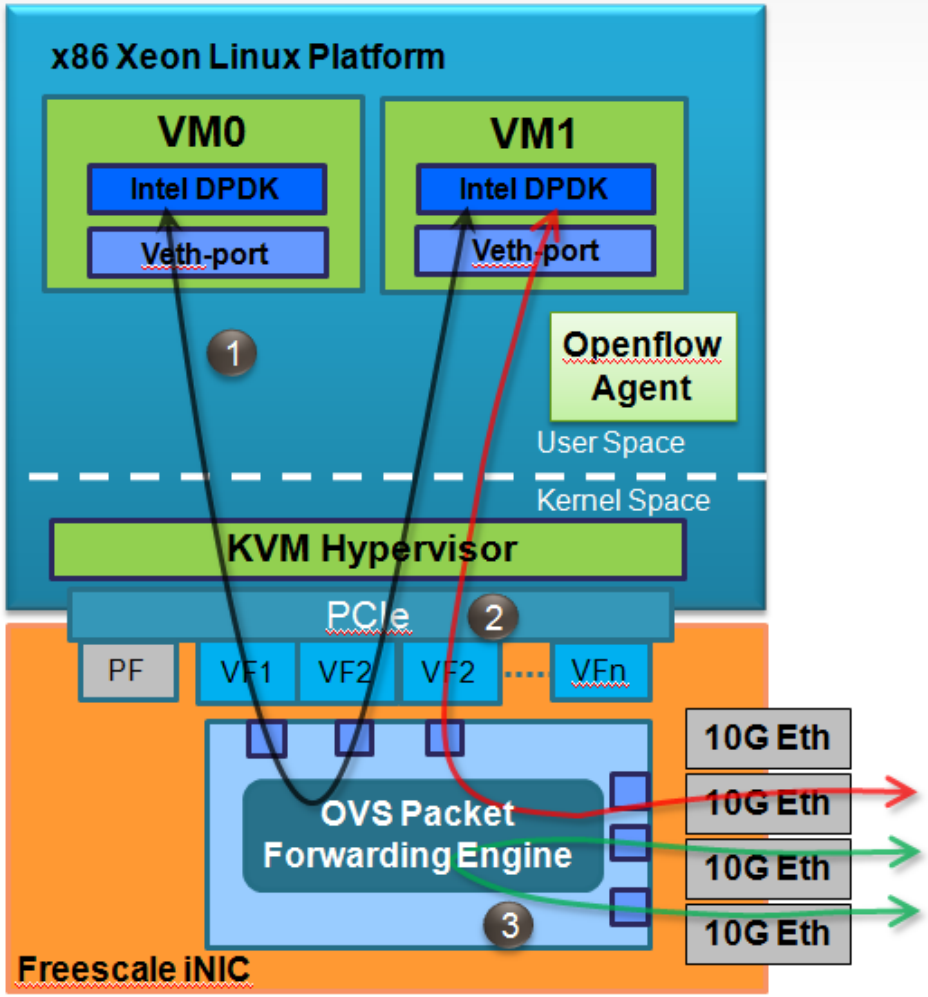
1.3 NXP Digital Networking iNIC Solution



- **Standard NIC**: Substantial networking processing load is handled by Xeon CPU
- **iNIC**: Offloads network centric operations to increase server processing for applications (The money maker)

- **Advantages of iNIC:**
  - Offloading of x86 CPU to increase aggregate with application performance cost effectively.
  - Increase top end server performance
  - Scalable iNIC platform performance T2080 to T4240. Reusable software.
  - Hardware acceleration for Data Path, Pattern Matching, Security and Decompression /Compression, PKC/Record offload

1.3 T2080 iNIC Solution



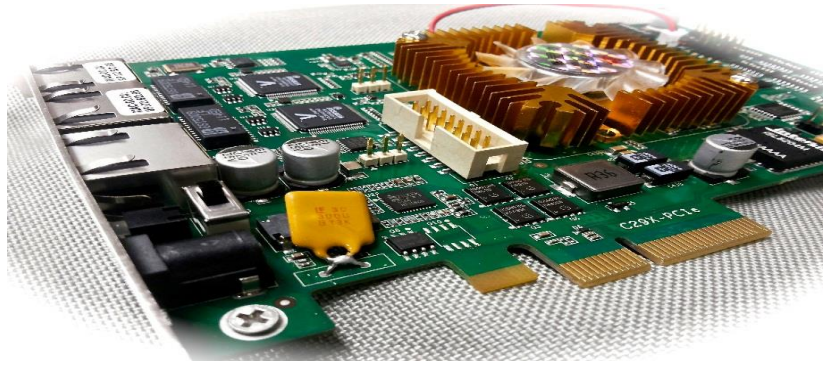
- 4x 10GE NIC card with T2080
- Offloads OVS (Open vSwitch 2.0) for more efficient server operation
- DPDK compatible driver
- Supports VM-VM, VM-Enet, Enet-Ent switching
- Open Daylight, Open Floodlight

1.3 C29x Crypto Coprocessor

Public/Private Key Management Acceleration

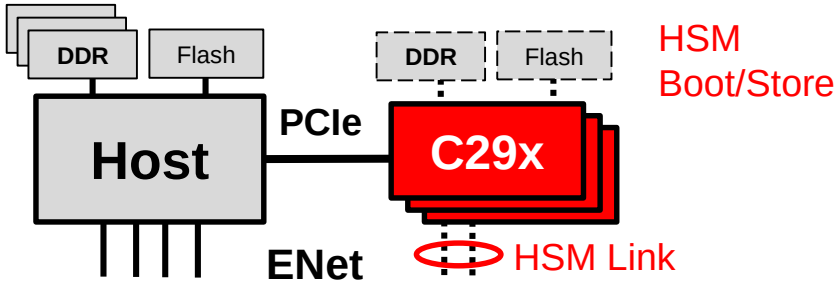
- Public Key Cryptography
  - RSA, DSA, Diffie Hellman, Elliptic curve (ECC)
- Large key size: Up to 4096-bit
- High-speed transfer rate
  - PCIe Gen2.0 x1/x2/x4
- Software
  - Linux® Kernel Cryptographic API
  - OpenSSL Crypto API
- Operating Mode
  - Offload: PCIe Accelerator
  - HSM: HW Security Module Subsystem
  - x86 or QorIQ Host

SCALABLE RSA / SSL SOLUTION



Dev board shown, ODM production board available

	C291	C292	C293
Security Engines	1	2	3
Typical Power (65C)	~4W	~6W	~10W
2048 bit RSA OPS/sec	8K	18K	32K
1024 bit RSA OPS/sec	31K	64K	116K



LS1012A Target Markets and Applications

Broadest Market Reach ARM64-bit SoC Solution

Storage

- Consumer NAS
- Battery Powered Mobile NAS
- Ethernet drives for datacenter storage

Internet of Things

- Value tier IoT gateway
- Trusted-enabled IoT Gateway
- FTTH Gateway
- Entry Broadband Ethernet Gateway

Industrial Automation

- Building Control systems
- Industrial firewall
- Automation/Machine controllers
- Distributed control systems

Energy/Smart Grid

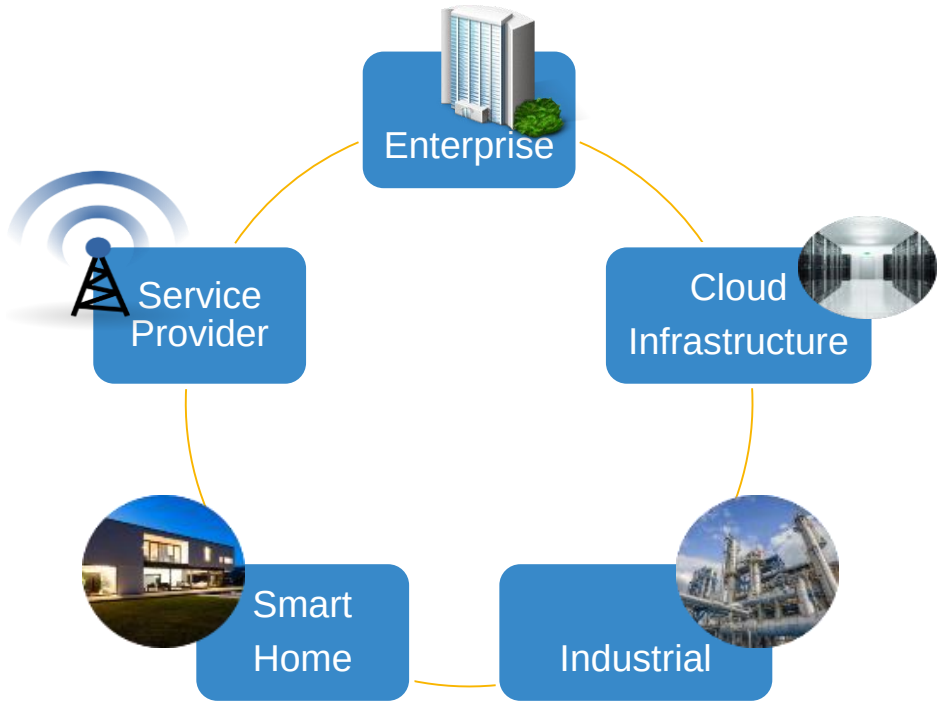
- PLCs
- Power meters
- Wireless WiFi
- Human Machine Interface

Summary: NXP Offers the Broadest Processor Solutions Portfolio

- Solutions portfolio enabling the broadest number of market segments spanning Smart Home, Cloud Edge, Service Provider, Enterprise Networking and Industrial

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

- Balanced architecture, broad ecosystem, global support
  - Multicore processing optimized for scalability
  - High performance interfaces
  - Offload for key applications
  - Deterministic performance for real time embedded systems
  - Proven distributed security architecture
  - Longevity and trusted supplier



SECURE CONNECTIONS
FOR A SMARTER WORLD

ATTRIBUTION STATEMENT

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