



# Next Generation IEEE<sup>®</sup> 802.11ac WLAN System Design with QorIQ T102x and LS10xx Processors

AMF-SNT-T1049

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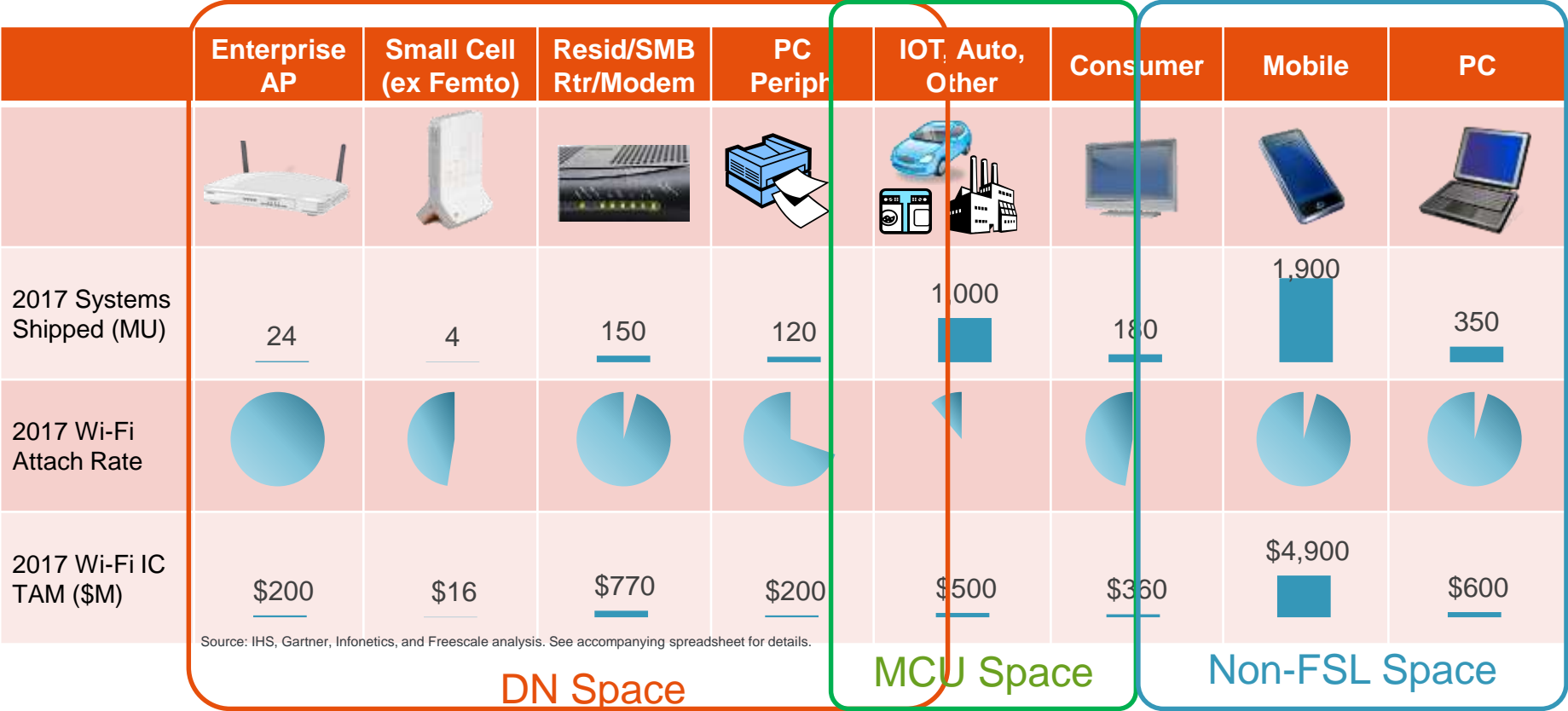


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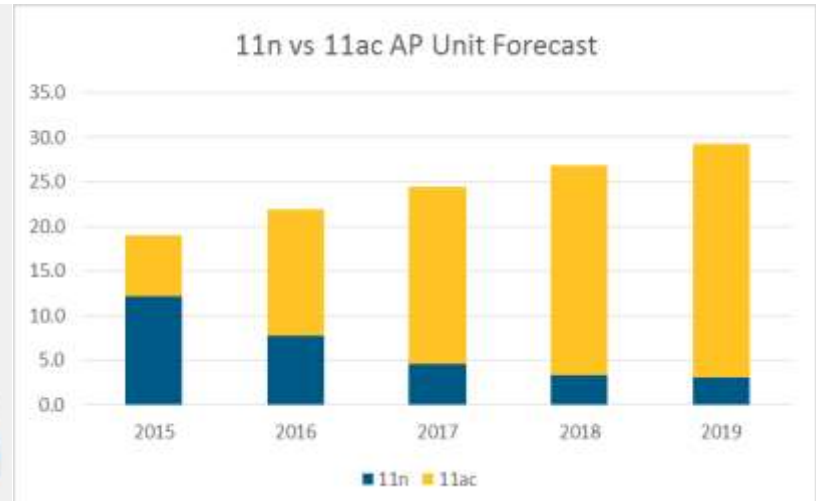
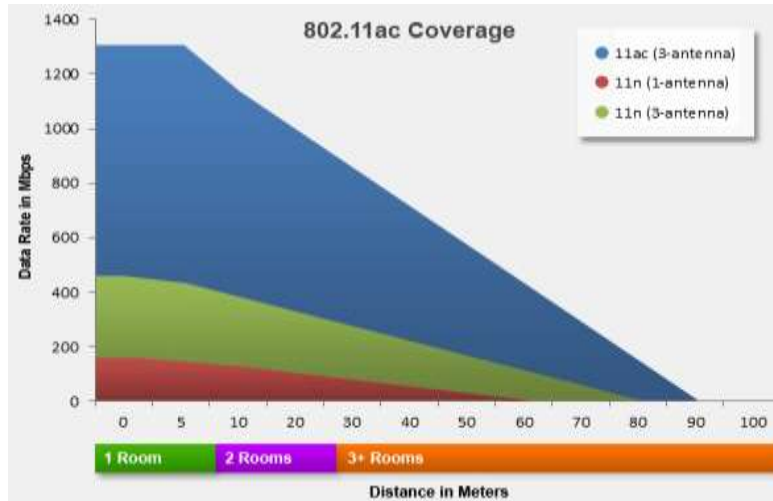


# The Broad Range of Wi-Fi Applications For Freescale QorIQ



Wi-Fi is a key technology for an ever wider set of applications  
 DN must have Wi-Fi technology to remain competitive

# Why 802.11ac and Why Freescale?



## 802.11ac = Next Gen WLAN

- Higher performance
  - Radio 867 Mbps
  - Up to 8 MU-MIMO antennas: 6.93Gbps
- Better coverage
  - Up to 95m range (10% improvement)
- Projected to be the leading WLAN technology by 2015\*

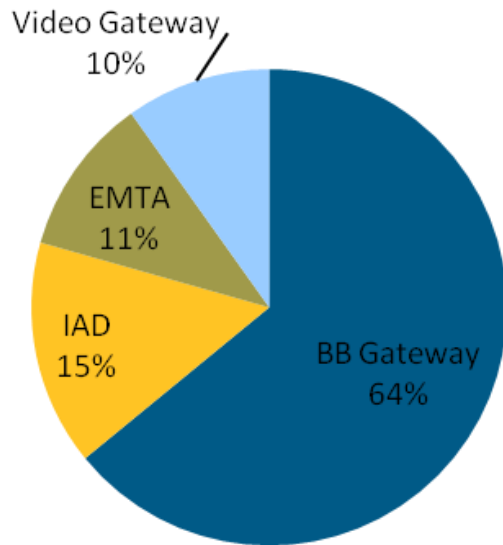
## QorIQ Family Processors

- Headroom to spare with high performance 802.11ac
  - Room for value add software
- Multiple SoCs at 3-5W for PoE
- Software and footprint compatible for a range of product offerings

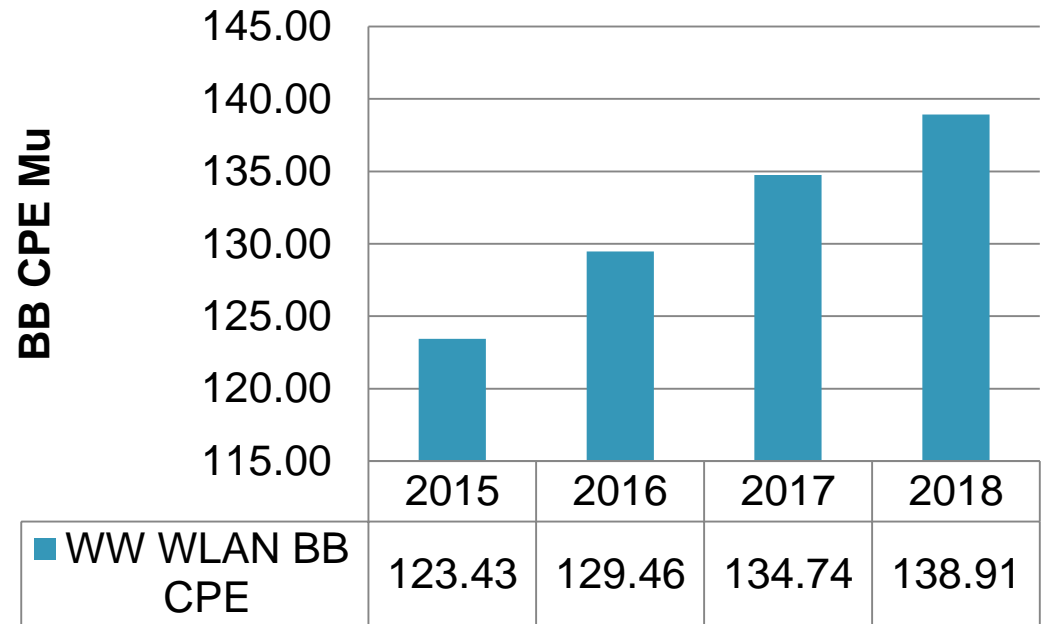
\*Source: Instat 2012

# Wireless Broad Band CPE Market

## 11ac Mu by Type '12-'18



## WW WLAN BB CPE



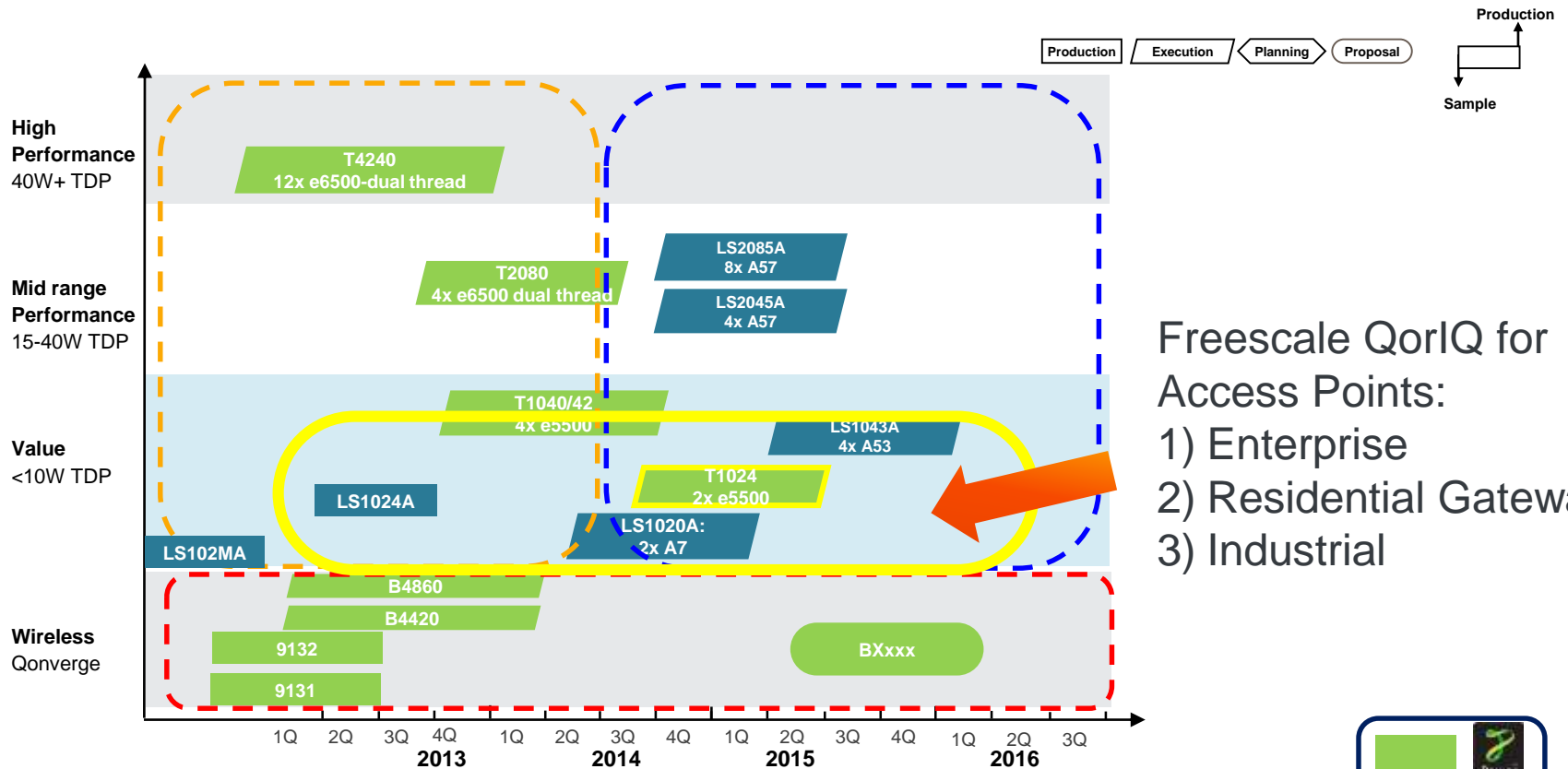
Huge numbers of WLAN enabled CPEs by 2018 with 98% WiFi enabled  
The Majority in BB Gateways

# 802.11n and 802.11ac Performance Comparison

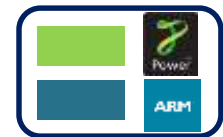
Scenario	PHY link rate	Aggregate capacity (speed)
One-antenna <b>AP</b> , one-antenna <b>STA</b> , 80 MHz	433 Mbit/s	433 Mbit/s
Two-antenna AP, two-antenna STA, 80 MHz	867 Mbit/s	867 Mbit/s
One-antenna AP, one-antenna STA, 160 MHz	867 Mbit/s	867 Mbit/s
Two-antenna AP, two-antenna STA, 160 MHz	1.69 Gbit/s	1.69 Gbit/s
Four-antenna AP, four one-antenna STAs, 160 MHz ( <b>MU-MIMO</b> )	867 Mbit/s to each STA	3.39 Gbit/s
<ul style="list-style-type: none"> <li>• Eight-antenna AP, 160 MHz (<b>MU-MIMO</b>) one four-antenna STA</li> <li>• one two-antenna STA</li> <li>• two one-antenna STAs</li> </ul>	<ul style="list-style-type: none"> <li>• 3.39 Gbit/s to four-antenna STA</li> <li>• 1.69 Gbit/s to two-antenna STA</li> <li>• 867 Mbit/s to each one-antenna STA</li> </ul>	6.77 Gbit/s
Eight-antenna AP, four 2-antenna STAs, 160 MHz ( <b>MU-MIMO</b> )	1.69 Gbit/s to each STA	6.77 Gbit/s

- 11ac adds more capacity through wider channels
  - 80 and 160 MHz
  - 256 QAM Encoding
- 802.11ac is primarily a 5GHz Technology
- 2.4GHz will still be 802.11n rates
- MU-MIMO introduced for dedicated beam-formed performance

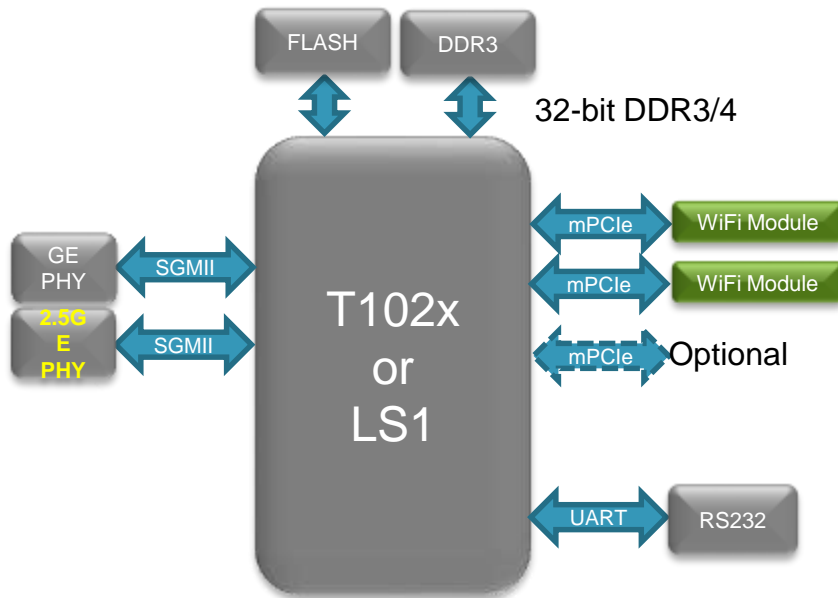
# QorIQ Multicore Communications Processor Solution Roadmap



Freescale Driving Strong AP Roadmaps for both Power and ARM Multicore

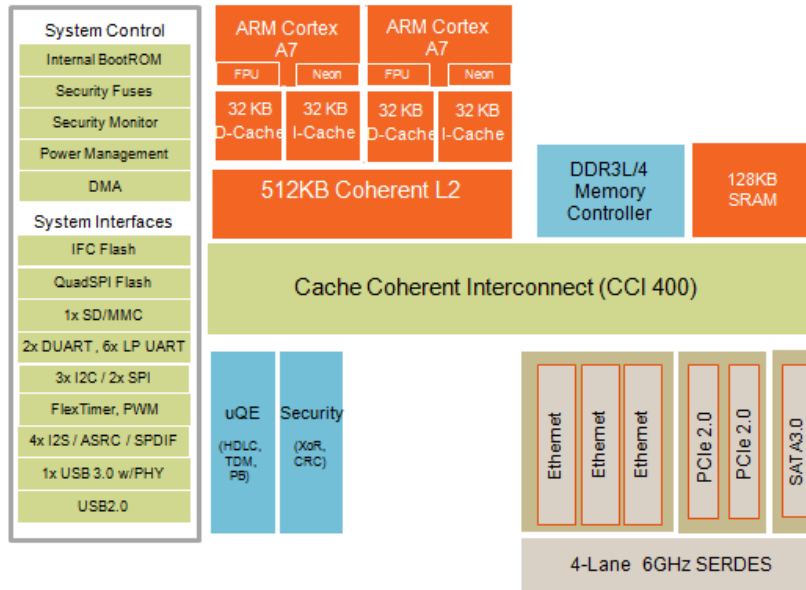


# WLAN AP Block Diagram



- Scalable single and dual-core portfolio of QorIQ devices (600MHz to 1.2GHz)
- Low Power to enable Power over Ethernet
- 1 or 2.5 or 10G Ethernet ports
- Hardware based Security Engine with Advanced Security and Trust Architecture
  - Support for IPSec, DTLS
- Complete reference designs with support for 802.11ac and 802.11n
- Multiple ODMs with production ready hardware design on QorIQ processors

# QorIQ LS1020A



- **Dual ARM Cortex-A7 cores up to 1.0 GHz**
  - ECC protected L1/L2 caches
  - DDR3L/4 up to 1.6GHz
- **Over 5,000 Coremark at under 3.6W (TDP power)**
- **Industry best Coremark / mW ratio**
- **Secure Boot and Trust supported**
- **High integration reduces BOM costs for targeted applications:**
  - 802.11ac AP Routers
  - Line cards
  - Multi-service gateways
  - M2M, Smart “X”

## Key Architectural Features:

- ARM AMBA4 MPCore™ Virtualization
- DDR3L/4 32-bit with ECC support
- 3-port GigE with IEEE 1588
- 2x PCI Express Gen2
- Multi-protocol 4-Lane SerDes
  - PCIe-2, SATA3, SGMII
- QUICC Engine – HDLC/TDM
- EnergyStar support with fast wakeup
- **2Gbps IP / 1Gbps IPsec forwarding**

## Key System Integration Features:

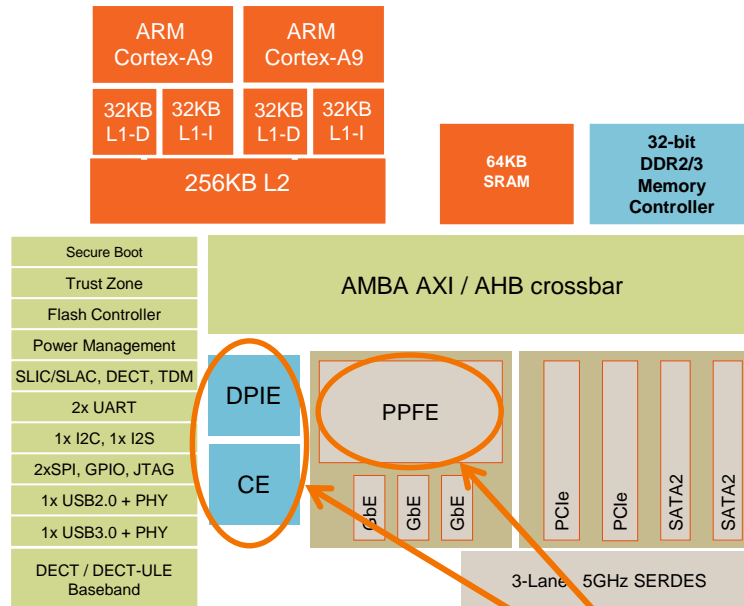
- Low-cost NAND/NOR flash systems
- Low-cost DRAM systems
- USB3.0 Super Speed (5GT/s)
- SATA III (6GT/s)
- Audio networking
- QorIQ Trust Architecture and ARM TrustZone support
- Alignment with Kinetis/Vybrid portfolio

## Package & Board:

Package:	525-pin, 19x19mm, 0.8mm ball
Power:	~2.6W @1.0GHz Typical
Temp:	-40C (TA) to 105C (Tj)
Boards:	Tower low-cost board Freescale Linux BSPs



# Expand into New Markets and Grow with our Existing Customers - LS1024A Block Diagram



## Datapath Acceleration

- **CE** - crypto acceleration
- **PPFE** - Programmable Packet Forwarding Engine
- **DPPIE** – 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 DDR2/3 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

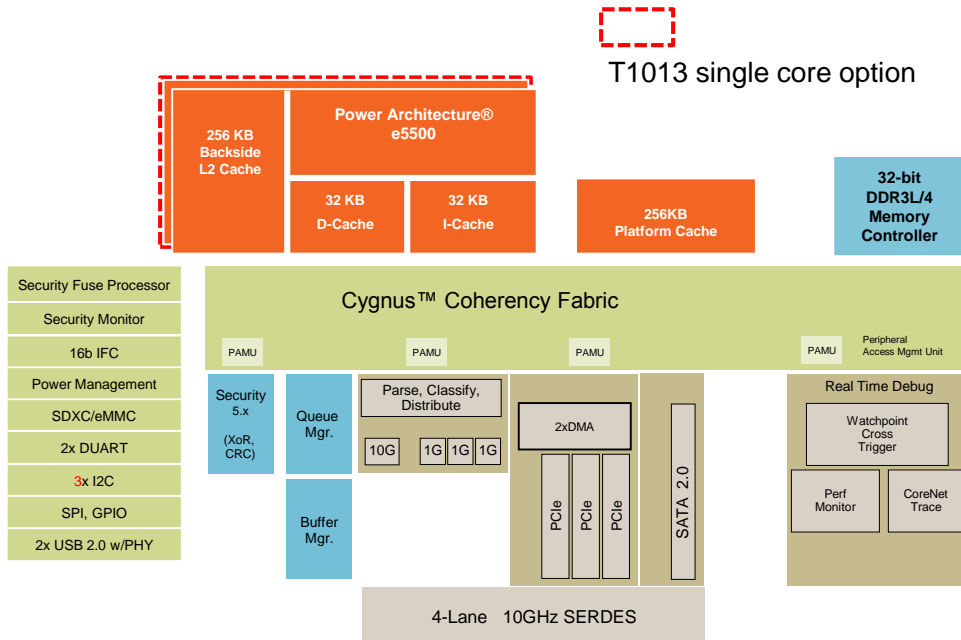
- Integrated DECT and DECT-ULE baseband processor

## High-speed Interfaces

- 2x PCIe 2.0 (5GHz)
- 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

Grow the Freescale Market Reach with the LS1024A

# T1013/23



## Datapath Acceleration

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

## Device

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

## Power targets

- 3-4W Typical
- 4-5W TDP

## Processor

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

## Memory Subsystem

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

## Cygnus Switch Fabric

### High Speed Serial IO

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

### Network IO

- FMan packet Parse/Classify/Distribute
- Lossless Flow Control, IEEE 1588
- 4x 10/100/1000 Ethernet Controllers
- 4x GbE or 3x GbE+ **1x 1/10GbE or QSGMII**
  - 10G KR supported for backplane
- MACsec on all ports
- **Green Energy Operation**
- Fanless operation dual-core 1.4GHz



# QorIQ T1024/23 Status

- **T1024/14 & T1023/13**

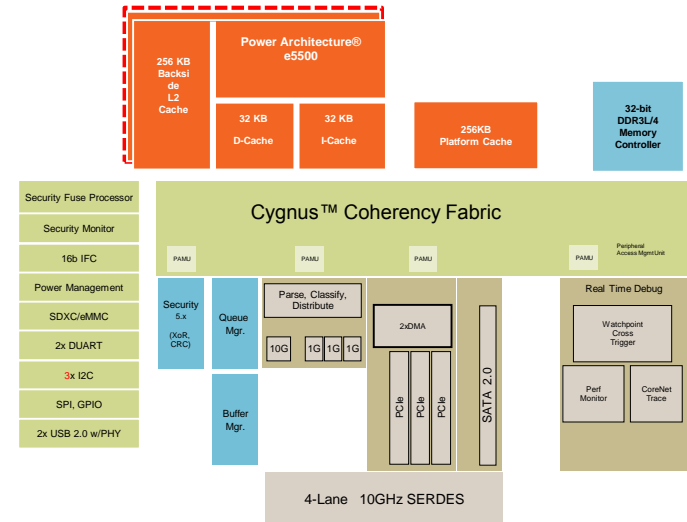
- Single & Dual Core to 1.4GHz
- 3-4W options
  - T1024 & T1023 Wide Sampling Now
  - T1024 & T1023 Production June 2015

- **Development Boards**

- T1024 Feb 2015: rev-PC 1u form factor with 10G & 2.5G
- T1023 March WLAN/SMB router form factor with 2.5G
- T1023 WLAN end April – WIP with BCM & AQ PHY

- **Hardware and Software Compatible with current T1**

- T1024/14 is pin & SW compatible with T1022
- Common system design documentation on Freescale extranet
- T1023/13 is system & SW compatible (smaller 19x19 package)



# Why QorIQ LS1 & T1 are Winning

## • WLAN 11ac Headroom

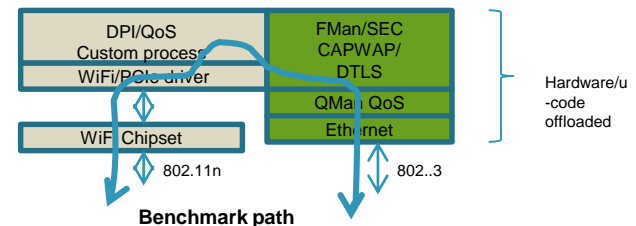
- Best Free CPU cycle in class
- Frees cores for value added applications
- ~80% available CPU cycles with 5GHz 4x4
  - Theoretical Rate (1200Mbps) single radio 4x4 5G
  - Theoretical Rate (1800Mbps) dual radio (4x4 5G & 4x4 2.4G)
- Support for leading Wi-Fi module drivers
- Freescale optimizations for leading drivers

## • Full DPAA Hardware processing for:

- Ideally for EAP or Edge VPN
- Packet classification, parsing and distribution
- L2, L3 Tunneling Header processing
- Full Protocol encrypt / decrypt
- Hardware Frag/Reassembly
- Secondary (post decrypt & reassembly) PCD scan available for QoS or App ID
- CEETM also available for rate shaping & scheduling

\*T1023 or LS1024 best for tunnel offload model

## Secure Tunnel Offload\*



# Segment Solutions Reference Platform Solutions



Enterprise AP-WLAN (802.11ac)  
(Single & Dual-core P10xx)



Security Appliance



IOT Smart Wireless Networked Smart  
Gateway P1, 8308, Layerscape LS1



DLNA VOD Video-on-Demand  
NVR – Network Video Recorder  
(Video Surveillance)-P1, P2041



Multi-service Gateway  
(Media & Voice Gateway  
NAS, NVR Video Serv...)



NAS – Network Attached Storage (P1: 1Gb)  
SAN – Storage Area Network  
(P2 – P5: T4: 10Gb)



Industrial Gateway &  
Data Concentrator  
(Smart Grid) – P1



913x-WLAN Small Cell



T4/T2 1U Appliance  
(UTM, etc), L2/L3  
Switch, L4-L7 Secured  
ADC



Data-Center SDN  
SAN Storage iNIC,  
vNIC T4/T2 PCIe Card

# Faster Time to Market with Key ODM Designs

Best Processors

Turnkey Software

Key Platform

Right Partners

Freescale  
QorIQ Processors

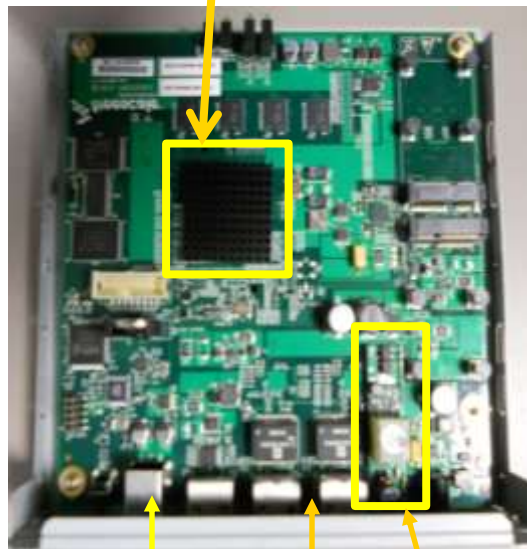
VortiQa Software  
Security Applications

Optimized  
Reference Design

ODM Integration  
Partners

## Freescale Reference Design

QorIQ P1 Family Processors



2 x USB 2.0

2 x GbE

PoE  
Module

## Sample of ODM Partners

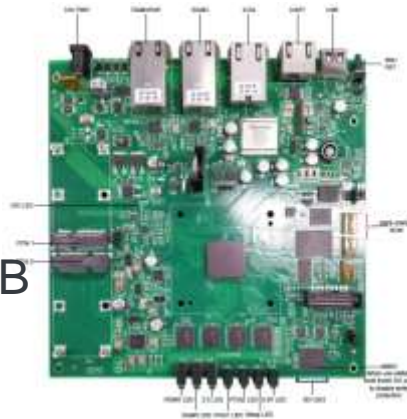
- Accton
- Senao
- Alpha Networks
- WCA



# T1 Reference Designs



T1024 RDB



T1023 RDB

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

# T1-Series Aquantia 2.5G Phy Status

- **Fastest OEM TTM 2.5G Phy solution with Aquantia validated solution**
- **Three T1 platforms support SGMII 2.5G**
  1. T1024 for 2.5 SGMII & 10Gbps XFI
  2. T1023 for 2.5 SGMII
  3. T1023 AP Reference Design for 1, 2.5, 5, 10Gbps
- **Aquantia AQ2104 → AQR105 QDS SGMII validation card program**
  - Riser Card Schematic Review Complete & Layout in progress
    - AQR105 SGMII 2.5G option

AQUANTIA<sup>®</sup>

- Freescale is leading WLAN support with NBASE-T alliance board membership and demonstration of 2.5G OC SGMII
- Also as a member of the Broadcom MGBASE-T Alliance



# T1-Series Status – Software Solutions

- **Software**

- Turnkey ASK SW packages delivered on the LS1024A Platform today
- Vortiq – DPI on P1020, developing T1022, much more available (SDN, QoS, AIS etc)
- Qosmos - Mature DPI on P1020, developing T1022, PME code on MPC8572
- Procera – DPI on P1020
- Broadweb – DPI on P1020/P2041, developing T1022, PME on P2041

- **Freescale Networking Software & Solutions Group**

- 800 person strong team
- Created to deliver value added services:
  - Applications: Vortiq Application ID & Signatures, SNORT, SDN, NFV, VPN/Firewall
  - 3<sup>rd</sup> party application integration & tuning
  - Frozen branch support
  - Custom software services

**8 out of 10 leading  
Enterprise Wireless APs  
OEMs use Freescale SoCs**



# Freescale LS1 & T1-Series Summary

- **Quickest 11ac Wave-II Time to Market**
  - LS1 & T1 Samples, Software Development Kit and ODM Platforms available now
  - Power Architecture code re-use saves several Quarters of R&D porting effort for leading P1020 WLAN Platforms
  - ARM A9 & A7 deliver low power ARM ecosystem support today
- **Best Performance**
  - Proven WLAN EAP performance – 11ac at 1.8Gbps TCP w/ 60% Headroom
  - Proven L2/3 tunneling offload & reassembly to 2.5Gbps
  - 2.5G Phy Options
  - Turnkey SW application options (App ID, VPN/FW, SDN, SNORT)
- **Platform Enables Broadest WAP Portfolio**
  - T-Series span from 1-8 cores, pin & SW compatible devices
  - LS1 Series delivers 2-4core performance with 32b and 64b options
  - Multiple ODM solutions & RF cards supported - offering Low, Medium & High End Options

Freescale delivers lowest SW risk & fastest time to market for performance EAPs!



[www.Freescale.com](http://www.Freescale.com)