Designing in the QorIQ T Series Product Family: Software Considerations
Freescale has over 1,000 software engineers, over 700 focused on Digital Networking

- Increasing investment on software through hiring and acquisition
- Focus: Heterogeneous Multi-core, Run-time, Tools, Key Applications
- Robust Ecosystem with Freescale Connect Partner Program
- Strategic Partnerships, including Mentor Graphics, ENEA, Green Hills, QNX and Wind River
Digital Networking: Software Strategy

Best-in-Class Multicore Software Development and Debug Solutions

Investment in silicon optimized software IP across our Multicore portfolio

- Over 1000 in-house software resources
- Stand-alone base tools and run-time technologies built around standard platforms
- Available throughout the ecosystem

In-house resources & IP plus Partners provide open choices for vertical solutions and tools

- Optimized solutions, reference designs and greater application performance
- Alternative to restrictive/captive approaches
- Peace of mind that software IP will not be locked in
- Freescale Professional Services where needed

Key Software Acquisitions & Investments

1999: Metrowerks
2002: AMC, Lineo
2003: Freescale Professional Services
2005: Seaway Networks
2008: Intoto
2009: MQX Runtime Platform
2010: Processor Expert, Chipwerks
2013: Launch Digital Networking Services

+ Open Ecosystem of Partners
Software Development Stakeholder Model

- Linaro
- yocto PROJECT
- Third Party Linux
- Customer Platforms
- Community Kernel.org
- Software Services
- Linux Software Dev Kits

[Image of a diagram showing the relationships between the stakeholders in software development, including Linaro, yocto PROJECT, Third Party Linux, Community Kernel.org, Customer Platforms, Software Services, and Linux Software Dev Kits.]
Freescale Platforms—QorIQ processors built on Layerscape architecture

Foundation Software Platforms

Application-Specific Packages
- Highly optimized for key application and hardware
- licensable and customizable
- More features and performance
- API abstracts GPP implementation

DCN
- Apache

SMB/Ent
- Ent-UTM?

SDN
- OF-Ctrl

Transport
- IKE

ASP API

DCN
SSL
TCP

SMB/Ent
FastPath

SDN
OF Switch

Transport
IPsec
PDCP

Base SW Dev Kit
- Open source
- Upstream
- Std features & performance

OS Apps and Tools

Linux Stack/FS/KVM

Kernel Drivers

User Space

Kernel Space

User Space

Kernel Space

Middle-ware

Demo Apps

NADK-API

NW Services

High-Level Drivers

Runtime Services

Foundation Libraries

Freescale Platforms—QorIQ processors built on Layerscape architecture

Packet processing apps

Common services, drivers
API for advanced features and performance tuning

Rob Oshana, 10/16/13
Base Software Development Kit

- Targeted for General SW development (a.k.a. everyone)
  - May include NW Applications

- Everything is upstream
  - No deviations

- Don’t invest in middleware
  - Don’t force HW features into middleware framework (QoS, LAG)
  - Don’t add new middleware (e.g. ASF)
  - Optimize within bounds of middleware

- Invest in drivers
  - Ensure F-Lib compliance
  - Ensure middleware compliance

- Evaluate and migrate non-compliances to user-space – e.g. ASF, L2-switch
### SDK 1.5 (Dec)
- **Processor and board**
  - C290 rev 1, C290PCle board
  - T4240/160 rev 2, P5040 rev 2.1, P1010 rev 2
  - End support for B4860 rev 1, P3041 and P2041 rev 1.1, P4080 rev 2.0, P1010 rev 1

### New Features
- SDK 1.4.5 changes plus ...
- Libvirt uprev
- KVM Hardware Table-walk, Topaz
- LRAT (T4240, B4860)
- SKMM, PK Calculator (C290)
- OpenSSL SEC offload
- Ethernet: DPAA offload aware net device, CPU Hotplug
- ASF: T4240, BSC913x
- USDPAA: Threads share buffer pools, SRI0 port 2, IPSec extended sequence
- DPAA Offload: P2041, add IPSec
- SA extended statistics, extend IPSec for SA modify
- XFI and 10GBASE-KR (T4240)

### Environment
- Same as SDK 1.4 except: U-Boot 2013-07

### SDK 1.6 (May)
- **Processor and board**
  - T2080 rev 1, T1040 rev 1, LS1020/21, T4240RDB (rev 2)
  - T4240 rev 1 removed

### New Features
- ARM Yocto enablement
- ARM Toolchain
- ARM images and binary ISO
- ARM updates to user manual
- Endianness updates to drivers
- Ethernet: DPAA 802.1Qbb (T4240)
- Ethernet: “Wake on LAN” support (T1040)
- Power Mgmt: Deep sleep (T1040)
- PCIe SR-IOV (T4240)
- Interlaken (T4240)
- HiGig (T4240)
- Data Compression Engine (T4240)

### Environment
- Kernel 3.12 (tentative)
- U-Boot 2014.01 (tentative)
- Gcc 4.8 (tentative)
- Yocto 1.5 (tentative)
- Depends on community

### SDK 1.7 (Nov)
- **Processor and board**
  - LS1021/0 updates
  - LS2xxx
  - B3xxx

### New Features
- LS reference software libraries
- AIOP core libraries for LS
- AIOP core/app library updates
- LS reference apps
- USDPAA for LS
- KVM/Containers for LS
- Management complex
- SEC enablement for LS
- ARM drivers upstream

### Environment
- Same as SDK 1.6
**SMP multicore Linux as you know it for ARM and Power**

- Freescale SoC support within broad ecosystem (kernel.org, Linaro, Yocto)
- Thousands of packages in ecosystem (tools, servers, management, etc.)
- One source base for all architectures
- Familiar programming and debug (C, C++, gdb, etc.)
- Functionality via Linux, not proprietary APIs
- Full-featured networking and device subsystem
- RT patch
- 64b (ARMv8 and Power)
- big-little (ARM)
Virtualization support in standard Linux

- KVM
- Containers
- Access isolation
- Performance isolation (via name spaces, cgroups, etc)
- Direct assignment of devices for performance
  - To containers
  - To KVM guests
  - To standard user space processes
- Isolation via IO-MMU

Emerging in standard embedded Linux, an area of Freescale strength

HW devices can be directly accessed by containers, VMs, and processes— not just the host kernel. It means load/store to device, use DMAs, etc.

Increased performance via host kernel bypass.
Freescale Linux SDK is a complete Linux development environment (Linux distribution)

- Based on industry standard Yocto/Poky.
- Embedded-style (cross-compilation but native tools also provided)
- Source code provided

Linux SDK main contents:
- GNU tools
- Package system
- Build System
- Kernel source
- Bootloader source
- Package sources
- Hypervisor package sources
- Freescale Network SW packages

Everything needed to boot and run Linux

- Bootloader image
- Kernel image
- Customizable file system
- Hypervisor images (optional)
- Freescale optimized package images (optional)

Generates
Yocto/Poky

- Widely-supported community project to create tools supporting the creation of Linux distributions.

Freescale Linux SDK

Poky provides package systems, many standard packages, and build recipes for them based on open embedded.

Freescale augments Poky from Yocto with support for Freescale-specific features and packages.

Participating Organizations*
- Cavium Networks
- Dell
- Enea AB
- Freescale Semiconductor
- Intel
- LSI
- Mentor Graphics
- Mindspeed
- MontaVista Software
- OpenEmbedded eV
- Panasonic
- NetLogic Microsystems
- RidgeRun
- Secret Lab Technologies
- Sakoman, Inc.
- Texas Instruments
- Tilera
- Timesys
- Wind River

*http://www.yoctoproject.org/community/participating-organizations
Freescale SDK Is Unified

- One SDK supports all P and T series, and selected other networking SoCs)
- Single source base used for all
- Versions (kernel, etc.) consistent across all
- Freescale ARM-based networking SoCs will be supported by the same unified SDK, ensuring consistency between PA and ARM.
- Power SoCs—big-endian (per Power ecosystem)
- ARM SoCs—little-endian (per ARM ecosystem)
QorIQ SDK 1.5 Schedule

• Milestones (all dates 2013)
  - Feature Freeze: 1-Nov
  - Code Freeze: 29-Nov
  - Release date: 19-Dec
QorIQ SDK 1.5 Environment

- Environment
  - No change compared to SDK 1.4 *except for U-Boot
  - Build Tools: Yocto 1.4
  - Toolchain: GCC 4.7.x and eglibc 2.15
  - Linux kernel version 3.8
  - U-Boot version 2013-07 (upgraded)

- Yocto toolchain
  - Ability to compile with external FSL prebuilt toolchain within Yocto
QorIQ SDK 1.5 Processor & Board Support

• C290 rev 1 and C290PCIe card
  – Carry over features from one-off releases made for C29x plus
  – Silicon and C290PCIe board support
  – Secure Key Management Module (SKMM) and PK calculator
  – Secure Boot
QorIQ SDK 1.5 Processor & Board Support

• T4240 rev 2.0
  – Key silicon errata workarounds to be conditional
  – Rev 1 support remains (to be removed in Spring 2014)
• T4240 XFI and 10GBASE-KR
  – Platform: Modified T4240QDS with XFI support (internal only)
  – 10GBASE-KR Interoperability with Broadcom
• T4240 PCIe performance measure module in PCIe EP driver
  – SR-IOV compatible, SR-IOV support coming in later SDK release.
• B4860: L1 defense
  – Ability to restart the DSP and L1 software without having to restart the entire SoC
QorIQ SDK 1.5 Processor & Board Support

- P5040 rev 2.1
  - Confirmed working using SDK 1.4 – no changes required, replaces rev 2.0
  - MEM_PLL_CFG recommended updates
- P1010 rev 2 and P1010RDB-PB
  - Support for rev 2 silicon and upgraded board
- P4080 8x1G, SerDes 0x16 update
- QSGMII-RISER
  - Supports both QSGMII and standard SGMII, replaces existing SGMII-RISER
  - Affects all boards that support SGMII-RISER: P4080DS, P3041DS, P5020DS, P5040DS, T4240QDS, B4860QDS
- EOL support for various silicon revisions
  - For B4860 rev 1, 3041 and P2041 rev 1.1, P4080 rev 2.0, P1010 rev 1
  - Primarily a testing and documentation statement - no code changes planned.
QorIQ SDK 1.5 Core and Virtualization Features

- **CPU**
  - MMU Hardware Tablewalk (T4240 and B4860)

- **Power Management**
  - PW20 (T4240 and B4860)
  - Drowsy Altivec Power Management features (T4240 and B4860)
  - CPU Hotplug for networking (see Linux Networking)

- **Virtualization**
  - Libvirt uprev
  - KVM Hardware Table-walk (T4240, B4860)
  - Topaz LRAT (T4240, B4860)
  - KVM: Assign pass-through devices back to host once the KVM guest exits
QorIQ SDK 1.5 Linux Networking Features

- Unified DPAA ethernet driver
  - Single, unified driver to be used for termination and forwarding
  - Removal of build time (kernel config) option
- DPAA networking support for CPU Hotplug
  - Ability to remove and add cores in SMP and retain networking interfaces
- Prepare DPAA ethernet code for upstream
- Change license type for config/policy files
  - Will switch from FSL to open source license
QorIQ SDK 1.5 ASF and USDPAAPP Features

• ASF
  - Migrate existing ASF functionality to BSC913x and T4240
  - ASF to become the default networking configuration for best out of box networking performance

• USDPAAPP Hello Reflector App – short circuit cores
  - Add mode where all the frames are reflected back unmodified from FMAN directly without reaching cores. Useful to validate FMAN hardware configuration and its ability to withstand line rates.

• USDPAAPP IPSEC app should support extended sequence number
  - Each tunnel configured in IPSEC app should optionally support extended sequence number. This came out while engaging with a critical customer engagement.

• USDPAAPP Huge Page support
  - Change memory allocation to utilize hugetlbfs

• USDPAAPP SRA: Ability to specify SRIO port 2
  - Add srio port 2 support and payload can be specified in SRA application
QorIQ SDK 1.5 DPAA Offload Features

- **DPAA Offload** – Add support for P2041
- **DPAA Offload** - Add support for IPSec SA extended statistics counters
  - Extend the IPSec statistics per SA with new counters for 1) Number of packets received for inbound SA and 2) Number of packet sent for outbound SA
- **DPAA Offload** - Extend the IPSec support for SA modify ASF
  - Extend API to support sequence number and NAT port update for a specific SA. Needed in order to support IPSec High Availability.
- **Linux networking**: DPAA hardware offloading aware Ethernet net device
  - Provides support for advanced DPAA offloading features: IPSec offload, Virtual Storage Profile based zero-copy frames between USDPA and kernel stack or OH checksum offload.
- **USDPA**: DPAA offloading aware Ethernet net device' (oNIC) in Reflector
  - New net device created for Offline Port, resembles Shared-MAC net device. Uses the OP offloading capabilities (e.g. CSUM offload and VSP based buffer copy offload) and can work with DPAA offload driver.
QorIQ SDK 1.5 Other Features

- **OpenSSL SEC Offload**
  - Defined: Crypto operation SEC offload support for symmetric cipher, digest via Cryptodev interface
  - Processors with SEC 4.0 or later: C29x, P1010, P4080, P3041, P2041, P5020, P5040, T4240, B4860

- **Support SDHC after IFC boot (P1010)**
  - Enables SDHC after booting from IFC

- **U-Boot: Add multiple USB controller support**
What is Virtualization?

- **Virtualization** – Hardware and software technologies that provide an abstraction layer that enables running multiple operating systems on a single computer system
A hypervisor is a software component that creates and manages virtual machines which can run operating systems.
Type 1 and Type 2 Hypervisors

- Common usage:
  - Type 1 – hypervisor runs only OSes
  - Type 2 – hypervisor is based on conventional OS

- My opinion: The distinction is not helpful
- No meaningful conclusions can be drawn by these labels
- For further info:
Virtualization Use Cases

Consolidation

Security/Sandboxing

Utilization

Fail Over

Dynamic Resource Management
Freescale Virtualization Technologies

- KVM is a Linux kernel driver
- User space tool, QEMU, is used in conjunction with KVM
- Solution is open source
- Number of virtual machines is only limited by available resources (CPU cycles, memory)

- Lightweight framework for partitioning an SoC
- Best of both worlds—bare metal performance with enforced partitioning, fully architected approach to meeting AMP requirements
- Solves many headaches of running multiple unsupervised OSs
- Threads appear as cores to OS

- Containers provide OS level virtualization
- Provides low overhead, lightweight, secure partitioning of Linux applications into different domains
- Can control resource utilization of domains—CPU, I/O bandwidth
Consolidation Overview

- Multiple processors/boards
- Unsupervised AMP
- Topaz (Supervised AMP)

- KVM
- Linux Containers
- USDPA

= hardware  = OS  = App
Unsupervised AMP

• Good performance, but at cost of fragility and complexity
• Agreement by all OSes required on how memory and I/O devices are partitioned
• Cooperation by all OSes required for initializing & managing global resources
• Complexities: boot sequence, OS reboot, error management, debugging
Freescale Embedded Hypervisor (Topaz)

- A lightweight framework for partitioning an SoC

- Gives you the best of both worlds—bare metal performance with enforced partitioning and fully architected approach to meeting AMP requirements

- Solves many of the headaches of running multiple unsupervised OSes

- Threads appear as cores to OS
KVM - Overview

- KVM/QEMU—open source virtualization technology based on the Linux® kernel
- Run virtual machines alongside Linux applications
- VMs are fully isolated from rest of the system
- Number of VMs supported limited only by available resources (CPU cycles, memory)
- Virtual I/O capabilities
Linux Containers Overview

- Containers provide OS level virtualization
  - Provides low overhead, lightweight, secure partitioning of Linux applications into different domains
  - Can control resource utilization of domains—CPU, I/O bandwidth
  - Linux Containers is based on a collection of technologies including kernel and user-space components.
USDPAA

• Infrastructure to build Linux®-based networking applications
• Bare metal performance with the rich APIs available in Linux
Combining Technologies

• These technologies are not mutually exclusive:
  - Run USDPAA on a Linux guest on Topaz
  - Run USDPAA in a Linux container
  - Run a KVM virtual machine in a Linux container
Consolidation: Benefits

- Cost savings—bill-of-material, power
- Flexibility

- Examples
  - Combine multiple domains—control plane, data plane
  - Migration — move to new hardware, preserve investment in software
    - Run legacy software alongside new software
    - Add Linux® to a system
  - Provide an isolated environment where untrusted software can run
  - High availability — active/standby configuration without additional hardware
Consolidation Overview

Multiple processors/boards

Unsupervised AMP

Topaz (Supervised AMP)

KVM

Linux Containers

USDPA
User space technology
Security enablement
Security Enablement

Basic GPL Solution

- Customer Application
  - OpenSSL Library
  - C29x
  - SEC
  - Kernel Drivers
  - RTA

High Performance Custom Solution

- Customer Application
  - Webserver / Storage Server / Banking etc.
  - OpenSSL Library
  - C29x – QorIQ + x86 + Layerscape
  - SEC – QorIQ DPAA + Layerscape
  - C29x Driver
    - Network Driver (SKMM)
    - PEX + DMA Driver (SKMM, PKC)
  - Unified SEC API
    - PKC
    - Symmetric Crypto, Cipher
    - Protocol - SSL, TLS, IPSec, USPDCP etc.
  - RTA
  - QM/BM
  - NADK
  - Power Management

- Customer SSL Library
- Commercial SSL Library

- Highly optimized for key application & HW
- Licensable & customizable
- More features and performance
Power Management
### Power Management Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Hardware applicable</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPUfreq</td>
<td>Enable the operating system to scale the CPU frequency up or down at runtime in order to save power.</td>
<td>P1-P5, T4/B4</td>
<td>SDK1.3.1</td>
</tr>
<tr>
<td>CPU hotplug</td>
<td>Each core of multi-core chips can be enabled or disabled individually.</td>
<td>P1-P5, T4/B4</td>
<td>T4/B4: SDK1.3.1, PH30: SDK1.4</td>
</tr>
<tr>
<td>sleep</td>
<td>Suspend when power on, namely Power-On Suspend in Linux. It features high wake latency.</td>
<td>P1-P5, T4/B4</td>
<td>SDK1.3.1</td>
</tr>
<tr>
<td>deep sleep</td>
<td>Suspend to ram when power on, namely Power-On Suspend-to-RAM.</td>
<td>MPC8536</td>
<td>SDK1.3</td>
</tr>
</tbody>
</table>

### Feature List with priority

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Hardware applicable</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>wake on GPIO</td>
<td>Wake on changes of level on GPIO pins.</td>
<td>P1022, P3-P5, T4/B4</td>
<td>T4/B4: SDK1.4, Other: SDK1.3</td>
</tr>
<tr>
<td>wake on external interrupts</td>
<td>Other devices can wake the system by sending signal to [IRQ0:11] pins. Such as the EVENT button and RTC on board.</td>
<td>P1-P5, T4/B4</td>
<td>T4/B4: SDK1.4, Other: SDK1.3</td>
</tr>
<tr>
<td>power monitor</td>
<td>Deep Sleep (chassis v2)</td>
<td>T1040</td>
<td>SDK1.4+</td>
</tr>
<tr>
<td>thermal monitor (on-chip TMU)</td>
<td>Benchmarking</td>
<td>All</td>
<td>SDK1.4+</td>
</tr>
<tr>
<td>CPU topology and SCHED_PM</td>
<td>Demos and solutions</td>
<td>All</td>
<td>SDK1.4+</td>
</tr>
<tr>
<td>Autosleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU power management</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Additional Features

- **DEVDISR support**: Provide friendly interface in u-boot/kernel to disable unused IP blocks in the SoC.<br>Available in all SDK versions.
- **Runtime PM**: Disable specific device when it is not used, and enable it automatically when it is used later.<br>Available in all SDK versions.
- **PowerTOP**: Tool to measure how efficient the Power Management features are used to save power. Useful for tuning software on system level.<br>Available in all SDK versions.
- **PM QoS**: Provide interface to set application specific QoS expectation on latency and throughput, so that devices can enter proper states that guarantees the QoS requirement.<br>Available in all SDK versions.
- **Device PM states**: Add or make use of the PM feature for device which has it’s own PM states like PEC, USB, SATA, Ethernet, etc.<br>Available in all SDK versions.
- **FLIB support**: Provide library code for PM features that can be used not only in Linux but also bareboard environment and other Oses.<br>Available in all SDK versions.
Freescale software components

Linux device model
- pm_ops
- runtime_pm_ops
- wakeup source
- Clock
- Power domain
- Qos

SoC platform support
- Power domain
- Clock domain
- Core topology

Core support
- e500v2 PMC
- e500mc RCPM
- e6500 new states

Device drivers
- Suspend hooks
- Runtime_pm hooks
- wakeup source hooks
- PM Qos hooks
- TMU driver
- MPIC timer driver
- Power Monitor

Misc
- hwmon

PM core
- Suspend

CPU mgmt
- CPU freq
- CPU idle
- CPU hotplug
- SCHED_PM

Freescale Domain

Already done
In development
In Planning
Power Monitor integration
compatibility with CPU hotplug

Deep Sleep core support
Driver compatibility with DS
Auto response

ARM core states
Thermal Monitor (TMU)

HW design review and discussion

Benchmark
PowerTOP
Power-aware Scheduler

Optimizations
Low power boot
Thermal Mgmt

LS-1
LS-2
Generic

PowerTOP
Power-aware Scheduler

LS-2 Deep Sleep
AIOIP compatibility

Upstream patches

Power TOP
Power-aware Scheduler

2013
2014
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct

SDK 1.5
T1040 0.3
LS-1 EAR-3
SDK 1.6

Proposal
Planning
Execution
Finished

Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct

Power Monitor integration
compatibility with CPU hotplug

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Low power boot
Thermal Mgmt

LS-1
LS-2
Generic

PowerTOP
Power-aware Scheduler
Networking Application Development Kit
Network Application Development Kit

- **Targeted for NW Application development**
  - Specific customers willing to use new API/env for licensing, debug or performance concerns

- **Restructure USDPA & PSP**
  - **USDPA**
    - Low-level driver for data I/O only.
  - **PSP**
    - Separate out NW services as optional middleware
    - Separate applications and change to library mode
    - **High-Level drivers**
      - New high-level drivers based on MC NW objects

- **Distribution**
  - Support is chargeable
Multicore Deployment Use Cases
Multicore Software Selection Guide

AMP (>1 OS)

Multicore Programming Model?

SMP (1 OS)

Multicore OS Framework?

No FSL support, use 3P

Choose OS

unsupervised

Choose OS and acceleration technology

Supervised Modes

FSL Embedded HV (Topaz)

KVM HV

Containers

Third Party

Control plane

Control or data plane?

What type of Linux?

FSL SMP Linux

Partner (Mentor)

Other 3P

Roll your own

Acceleration Needed?

yes

ASF

FMAN programming

microcode

what type of small Exec?

third party

Third party

USDPA

SDOS for PA

FLIB

unsupervised
Leggo Brick mentality

Decide on a programming model

...to select a MC SW solution....

...that's composed from a set of MC leggo bricks

ASF
FLIB
KVM
SEC

USDPAA

Linux
Example 1: KVM with USDPA and ASF Software Reference Architecture
Example 2: USDPA Running on FSL Linux Software Reference Architecture
A Linux Distribution (Distro): A Complete Linux Kit

- Linux is an open-source integration of many components from many sources, most of which are architecture-independent and don’t originate with Freescale.

- Customers (and FSL internally) cannot use Linux without a complete kit.
  - Many distros exist.
  - Some customers create their own.
  - Major FSL SW must be usable with arbitrary distros.
  - But FSL also must use and ship one.
  - FSL choice: Yocto

- Major FSL component
- Pass-through from other source
The Yocto Project™ is an open source collaboration project that provides templates, tools and methods to create custom Linux-based systems for embedded products regardless of the hardware architecture.

- FSL proprietary
- Decision to not do our own distro internally

System Builder

- Partner w/ MG
- Poor OOBE
- Not ready for prime time

LTIB

- Industry standard
- Large adoption
- Large industry investment

Yocto

- Engaged in Yocto community since June
- MG also moving to Yocto (working jointly)
- Field team transparency and feedback
- Beta version by end of 2011
- Full incorporation into SDK 1.2 in April 2012

Participating Organizations

- Cavium Networks
- Dell
- Freescale Semiconductor
- Intel
- LSI
- Mentor Graphics
- Mindspeed
- MontaVista Software
- Open Embedded eV
- Panasonic
- NetLogic Microsystems
- RidgeRun
- Secret Lab Technologies
- Sakoman, Inc.
- Texas Instruments
- Tilera
- Timesys
- Wind River
### Distributing Linux: Three Primary Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Approach</th>
<th>When to Use</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native on Eval Board</td>
<td>Provide evaluation boards with complete native GNU Tool environments right on the board.</td>
<td>Desire zero “getting started” effort to building and running FSL and standard OSS</td>
<td>Easy to use.</td>
</tr>
<tr>
<td>Yocto (Complete)</td>
<td>This embedded distribution helps customer create entire Linux system. Package both as ISO image and also in virtual machine.</td>
<td>Need a tool to generate a complete Linux environment including tailored file system.</td>
<td>Complex, but very flexible and powerful.</td>
</tr>
<tr>
<td>A la Carte</td>
<td>Simplify customer access to just the major Freescale-created Linux components. Perfect for integration into Linux distributions from other sources, home-brew or 3rd party. Supports fast delivery of patches.</td>
<td>Desire to integrate Freescale Linux components into a Linux development environment that the customer already has.</td>
<td>Simple when the customer is also the integrator.</td>
</tr>
</tbody>
</table>
Software Services
Networking Software and Services Group

- **Accelerate** Customer Time to Market
  - Speed Adoption of Multicore / new technologies
  - Dedicated expert staff with access to software and SoC teams

- **Deliver** Commercial Software, Support, Services and Solutions
  - Commercial Software: VortiQa, CodeWarrior, Processor Expert
  - Packaged and Customized services

- **Simplify** Software Engagement with Freescale
  - Consolidate Freescale software and solutions
  - Streamline business processes

- **Create** Success!
  - Partner with customers
  - Leverage *your* strengths, add *our* capabilities
## Networking Software and Services Group

### Development Tools
- CodeWarrior
  - IDE
  - Debug
  - Compiler
  - Trace
- QorIQ Optimization Suite
  - Scenarios Tools
  - DDRv

### Runtime Products
- VortiQa Software Products
  - Application Identification Software (AIS)
  - Open Networking Switching Framework
  - Platform Services Package (PSP)
  - Mobile Transport

### Solutions Reference
- Storage Controller
- SDN Switch
- Wireless LAN
- Data Concentrator
- Smart Converged Gateway
- Digital Signage

### Linux® Services
- Commercial Support
- Frozen Branch
- Application Specific Hardening
- Feature Acceleration

### Integration Services
- Systems Consulting
- Design Services
- Porting
- Migration

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**CodeWarrior**

**QorIQ**

**VortiQa**

**Linux®**

**Integration Services**

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Segment Solutions
SSL: Differentiated Segment Solutions – Enterprise AP Gateway

- Market Aligned
- Differentiated High Performance Segment-Specific Solutions
- Near market ready designs – leverage R&D efforts
- Feedback to internal teams, improve future NPIs performance

Turnkey, Market-Ready Time-To-Market
- Provide Level2/Level 3 support on turnkey solutions

Differentiated System Performance
- Solution Performance with low CPU utilization
- Evaluate Wi-Fi, SSL/DTLS/VPN performance
- Tradeoffs - x1 vs x2 cores, DDR size, speed
- Tradeoffs on CPU clock, platform clock speed & power consumption

Multi-Service Gateway
- Storage Server (NAS, SAN)
- Video Media Server
- ISR (Integrated Service Router)
- Universal Communication Gateway
- BSC9131 Femto-WLAN Gateway

Differentiated Platform Solutions (DPS)
- Converged IOT Gateway – Wi-Fi, 3G/4G, sensor network (IOT)
- Scalable, Portable open-source Platform runs on any QorIQ, Qconverge, PowerPC devices (e.g. P101x, P1020x P1022./1013, P1023 /P1017, P1025 etc)

Enterprise Cloud AP Gateway

- Winner of 2012 Australian and New Zealand Smart Metering Conference – “Best Networking and Communication Product Award”
- Winner of 2011 Broadband World Forum: Infovision Award – Smart multi-core, multi-service Business Gateway
- 2012 Innovator of the Year by ECD Magazine for the core agnostic platform approach to Wireless Smart Gateways
Network Applications
Market Driver - The need for identifying and controlling web applications traffic at the edge of business network

• Trends
  - Application Identification becoming a key component of security appliances.
  - Explosive adoption of smart devices in business.
  - Need for device & application recognition as Application usage increases substantially.
  - Need for right policy enforcement for effective utilization of network bandwidth in businesses.

Highlights:
• User space Network Application using PSP middleware
• Configurable detection schema for full deep packet inspection or partial inspection for higher performance
• In-house Signature development & distribution infra.
• Nearly 1700 application features detection – Social Networking, P2P, Business Apps, Games, Streaming etc

Status:
• Released on QorIQ T4240, P4080, P2020, P1020
• Traffic Characterization and Encrypted traffic detection in progress.
• Release v3.0 scheduled for Sept, 2013
Market Driver - The need for an elastic expansion of virtual network services on dynamic demand

- Trends
  - Virtual network appliances replacing legacy hardware
  - Enterprises are adopting Cloud Computing technologies
  - Elasticity - Dynamic scale in and scale out of virtual network appliances based on Network Traffic Load.
  - Reduction of CAPEX & OPEX
  - Cloud orchestration for OpenFlow/Software Defined Networks

Highlights:
- Freescale QorIQ platforms work as Compute Nodes.
- Brought up Web Proxy and Open Cart virtual network function on Open Stack Grizzly compute node.
- Active participation in the OpenStack forum. Proposing new ideas blue prints & sharing software with the community
- Demonstrated at the ONS-2013, China Roadshow

Status:
- OpenFlow Controller Integration with OpenStack - Neutron
- Cloud Resource Discovery Service development for OpenFlow/SDN Network deployments
- Next release on Dec, 2013
Market Driver - *Data center and clouds embracing this promising and disruptive new technology to improve network manageability and reduce operational cost*

- **Trends**
  - Enterprises are fast moving to cloud for network services.
  - Cloud operators adopting network virtualization for scalability, flexibility and cost reduction.
  - General purpose switch market reducing considerably in favor for SDN based switches for better manageability and improved cost.

**Highlights:**
- Support for Openflow 1.3 protocol
- Plugfest validated for Interoperability
- Application extensions for L3-L7
- Integration with Open Stack and VXLAN
- Customer demos in China & Taiwan Road shows

**Status:**
- North Bound APIs published for application integration
- Release-1 targeted for Q1 2014 (IP Fwd, IPSec)
- Final release targeted for Q4 2014 (Firewall, QoS)
Tools
Freescale’s Developer Tools Organization - DevTech

- History
  - 1985: Origins as Metrowerks, recognized as Gold Standard for Mac/Desktop Development Tools
  - 1996: Entered embedded development market
  - 1999: Acquired as an independent subsidiary of Motorola’s Semiconductor Products Sector
  - 2002: Acquired Embedix (Lineo), established Linux Solutions Group
  - 2002: Acquired Applied Microsystems Corporation, expanded product offering to add board bring-up and code analysis capabilities
  - 2005: Fully integrated as part of the TSO organization, focused on enablement tools and software

- **CodeWarrior Development Studio®**
  - Complete Development, Debug and Analysis Suite
  - Linux and Run-time Technology
    - Development Tools (kernel & application)
  - Reference and evaluation boards
  - Customer Support, Product Maintenance
Complete Development Solution

**Algorithms**
- IDE
- Build
- Simulate

**OS & Drivers**
- OS & Driver Packages
- Stop Mode Debug
- Trace

**Applications**
- Debug Agents
- Trace
- SDKs

**Test & Refine**
- Test Server
- Profiling
- Code Coverage

Freescale Development Tools
Leverage the Ecosystem & Augment with Freescale

- Off-the-shelf ARM tools
  - ARM DS-5 or any ARM Coresight-Aware tools “just work”

- Augment ARM tools with Freescale plug-ins and stand-alone tooling
  - ARM tools act as a pipe for Freescale trace and debug

- CodeWarrior enables debug of Freescale cores
  - AIOP & Accelerators
  - Fit within ARM Coresight
Packet Analysis Tool

• **Customer Benefits**
  - Complexity abstraction and ease of use
  - Enables key use cases:
    - Packet-Oriented System Level Performance Analysis
    - SoC Data Plane Configuration Debug
    - Packet Processing Latency Analysis
    - Packet Processing Critical Resource Monitoring

• **Target areas:**
  - SoC debug/analysis feature enablement
  - Linux Systems
  - Analysis data interpretation and visualization

• **Users**
  - External Customers
  - Freescale internal developers
Layerscope A IPO Scheduler Analysis Tool

**Customer Benefits**
- Customer can see a time line of A IPO Program execution.
- Visualizes task timelines
- Provides resource centric visualization for both cores and accelerators.
- Presents task statistics
- Customer can select time ranges and the viewer presents utilization statistics over the selected range.

**Technology**
- Today built on top of the simulator
- Will be moved to Emulator
- Linux Systems
- Analysis data interpretation and visualization

**Users**
- Freescale Designers and validation team
- Freescale internal developers
- External Customers

We have a prototype today