



FTF 2016
TECHNOLOGY FORUM

ONL/ONIE ON QorIQ AND QorIQ LS SERIES

FTF-DES-N1842

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MAY 17, 2016

PUBLIC USE



AGENDA

- What is ONL/ONIE
- Why ONL/ONIE in NXP
- Backport – Kernel Rebase
- ONL/ONIE Development and Upstreaming
- Plan & Roadmap
- Summary

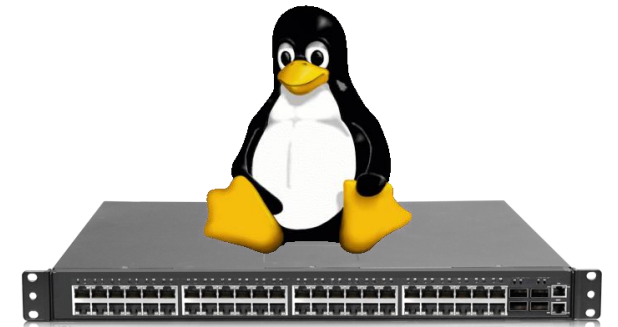


WHAT IS ONL/ONIE

ONL is a Linux Distribution for Bare Metal Switches

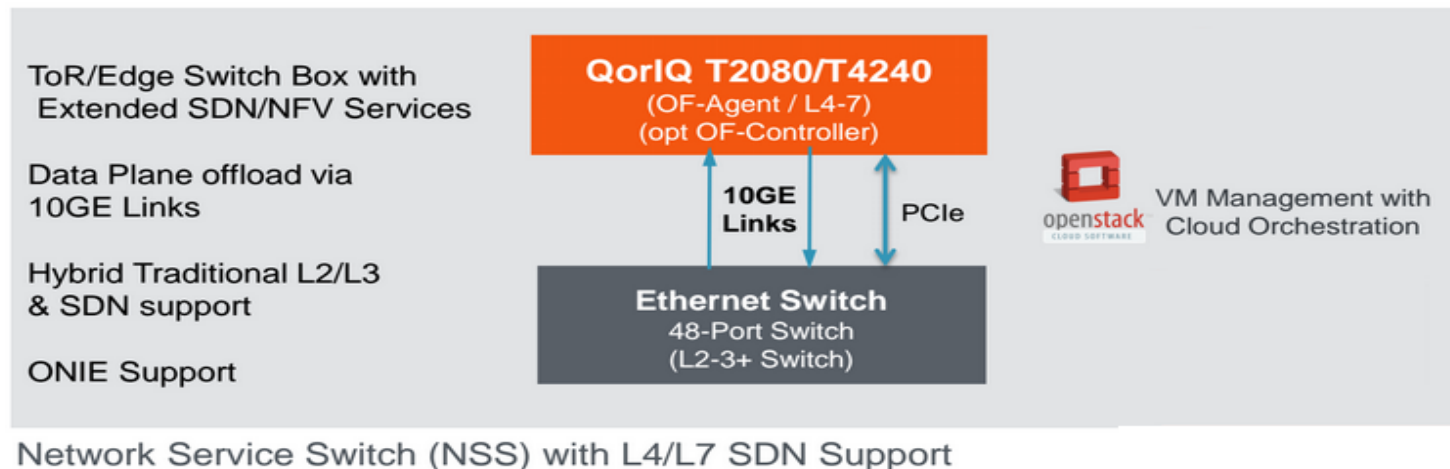
- A collection of software packages, utilities, drivers, and abstractions to run on OCP, bare metal, “brite box” hardware
 - i.e., a “NOS” that ONIE would install
 - Network forwarding devices built from commodity components
- ONL uses ONIE to install onto on-board flash memory
- Open Network Linux is a part of the Open Compute Project and is a component in a growing collection of open source and commercial projects

<http://opennetlinux.org/>



Why Not Use an Existing Linux Distribution

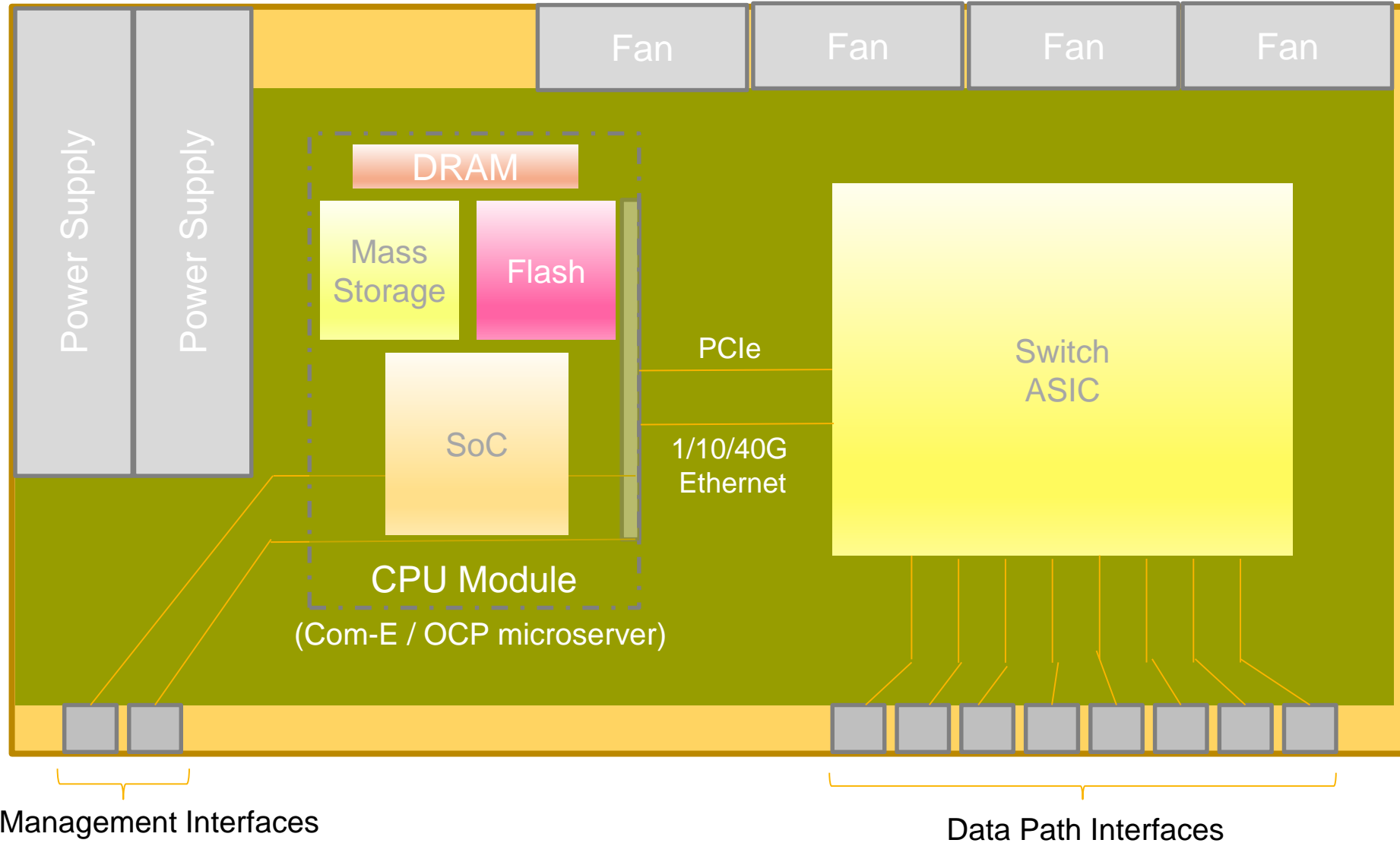
- Does build on existing distribution – Debian Wheezy
- Need to create ONIE installers for many platforms
- Need to manage switch-specific hardware (e.g., SFPs)
- Switches are very similar to servers, but not quite



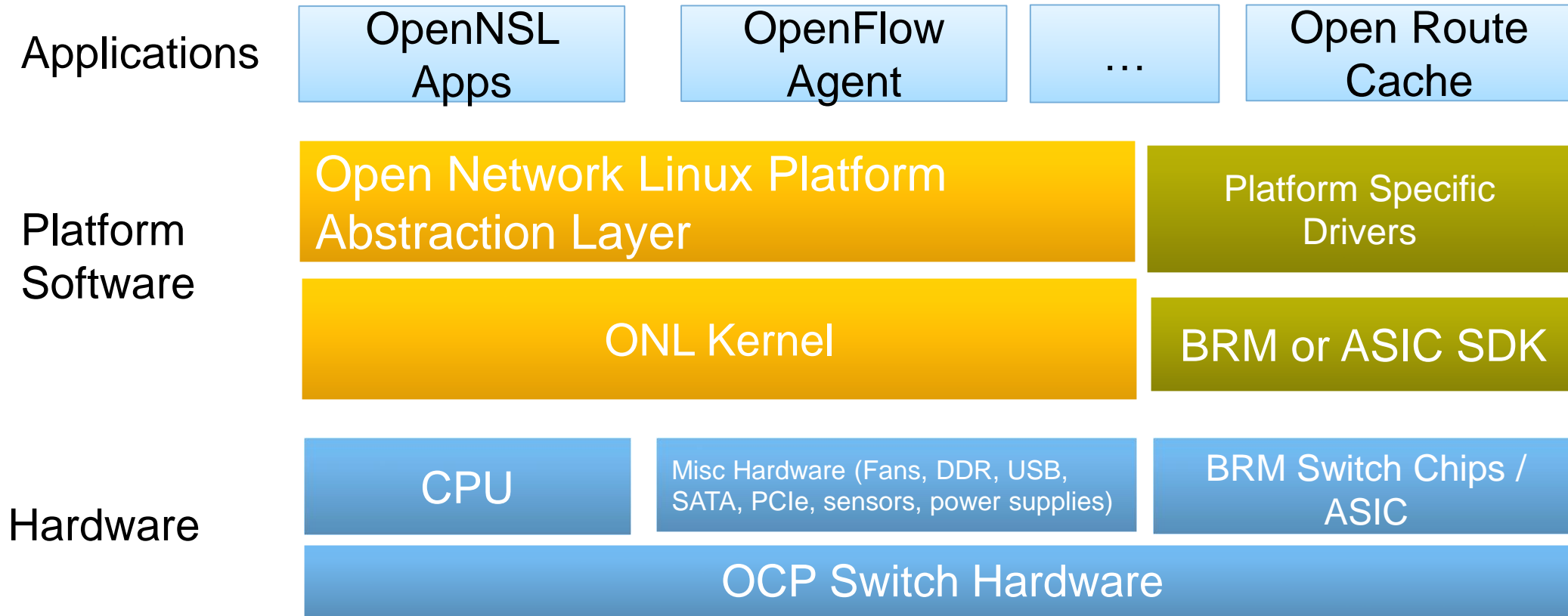
Why Use ONL?

- **Help ecosystem focus on innovation**
 - Many annoying software details to run an OCP switch
 - Building platform drivers not high value asset; should be common
- **Enables a reference NOS implementation**
 - Hardware without software is useless
 - Package up details and best practices into one place
- **Help bootstrap the Open ecosystem and OCP adoption**
 - Allows commercial companies and DIY-folks to build OCP-based products faster

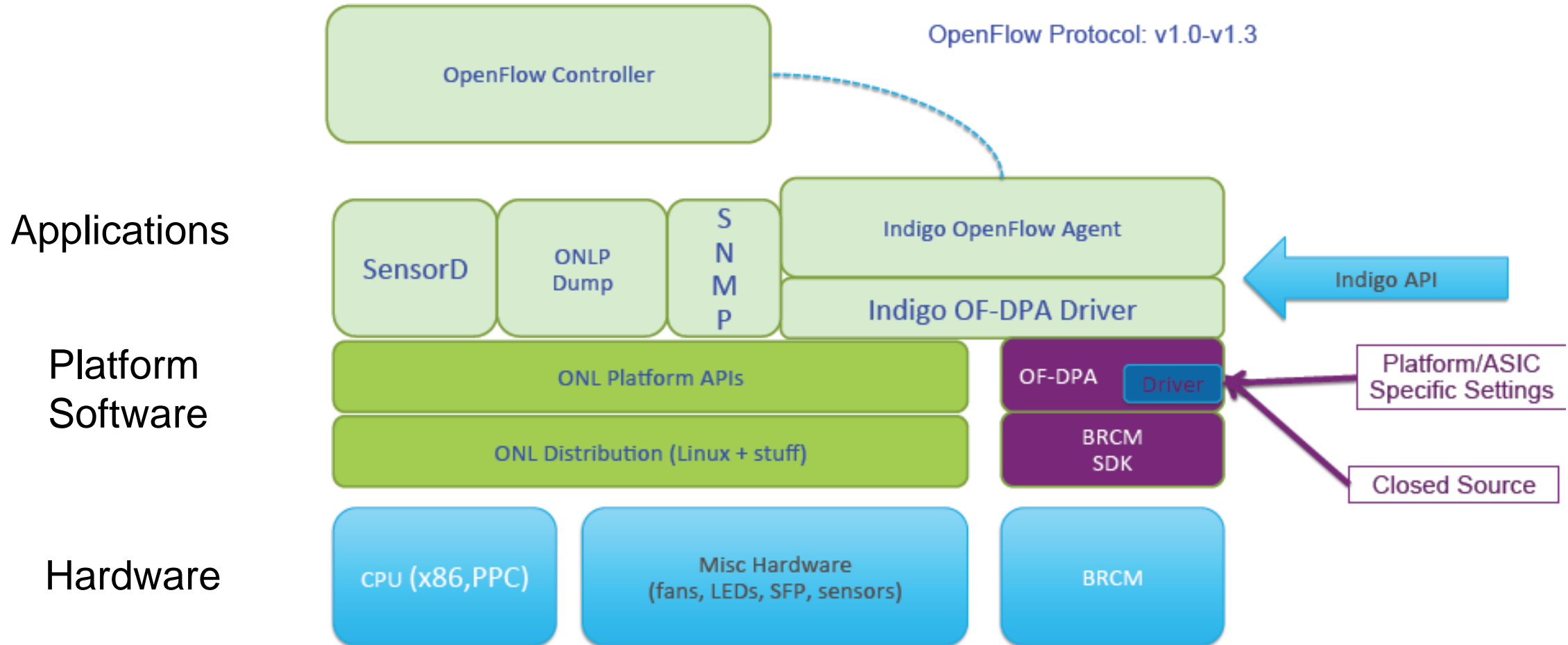
Bare Metal Switch



ONL Architecture



ONL With OpenFlow Agent



Supported Hardware - I

Quanta

| Device | Ports | CPU | Forwarding | ONL Certified | In Lab | ORC | OF-DPA | OpenNSL | SAI |
|----------------------|----------------|-------------------------|-------------------------------|---------------|--------|-----|--------|---------|-----|
| QuantaMesh T1048-LB9 | 48x1G + 4x10G | FreeScale P2020 | Broadcom BCM56534 (Firebolt3) | Yes | Yes | Yes | No | No | No |
| QuantaMesh T3048-LY2 | 48x10G + 4x40G | FreeScale P2020 | Broadcom BCM56846 (Trident+) | Yes | Yes | Yes | Yes | No | No |
| QuantaMesh T3048-LY8 | 48x10G + 6x40G | Intel Rangely C2758 x86 | Broadcom BCM56854 (Trident2) | Yes* | No | No | No | No | No |
| QuantaMesh T5032-LY6 | 32x40G | Intel Rangely C2758 x86 | Broadcom BCM56850 (Trident2) | Yes* | No | No | No | No | No |

Accton/Edge-Core

| Device | Ports | CPU | Forwarding | ONL Certified | In Lab | ORC | OF-DPA | OpenNSL | SAI |
|-------------------|----------------|-------------------------|-------------------------------|--------------------|--------|-----|--------|---------|-----|
| Accton AS4600-54T | 48x1G + 4x10G | FreeScale P2020 | Broadcom BCM56540 (Apollo2) | Yes | Yes | Yes | Yes*** | Yes*** | No |
| Accton AS5600-52X | 48x10G + 4x40G | FreeScale P2020 | Broadcom BCM56846 (Trident+) | Yes | Yes | Yes | No | No | No |
| Accton AS5610-52X | 48x10G + 4x40G | FreeScale P2020 | Broadcom BCM56846 (Trident+) | Yes | Yes | Yes | No | No | No |
| Accton AS5710-54X | 48x10G + 6x40G | FreeScale P2041 | Broadcom BCM56854 (Trident2) | Yes | Yes | Yes | Yes*** | Yes*** | No |
| Accton AS6700-32X | 32x40G | FreeScale P2041 | Broadcom BCM56850 (Trident2) | Yes | Yes | Yes | No | No | No |
| Accton AS5712-54X | 48x10G + 6x40G | Intel Rangely C2538 x86 | Broadcom BCM56854 (Trident2) | Yes | Yes | Yes | Yes*** | Yes*** | No |
| Accton AS6712-32X | 32x40G | Intel Rangely C2538 x86 | Broadcom BCM56850 (Trident2) | Yes | Yes | Yes | Yes*** | Yes*** | No |
| Accton AS5812-54T | 48x10G + 6x40G | Intel Rangely C2538 x86 | Broadcom BCM56864 (Trident2+) | Yes | Yes | No | No | No | No |
| Accton AS5812-54X | 48x10G + 6x40G | Intel Rangely C2538 x86 | Broadcom BCM56864 (Trident2+) | Yes | Yes | No | No | No | No |
| Accton AS6812-32X | 32x40G | Intel Rangely C2538 x86 | Broadcom BCM56864 (Trident2+) | Yes | Yes | No | No | No | No |
| Accton AS7712-32X | 32x100G | Intel Rangely C2538 x86 | Broadcom BCM56960 (Tomahawk) | Yes | Yes | Yes | Yes*** | Yes*** | No |
| Accton Wedge-16X | 16x40G | Intel Rangely C2550 x86 | Broadcom BCM56864 (Trident2+) | Work In Progress** | Yes | No | No | Yes | No |

Supported Hardware - II

DNI/Agema

| Device | Ports | CPU | Forwarding | ONL Certified | In Lab | ORC | OF-DPA | OpenNSL | SAI |
|-----------|----------------|-----------------|-----------------------------|---------------|--------|-----|--------|---------|-----|
| AG-7448CU | 48x10G + 4x40G | FreeScale P2020 | Broadcom BCM56845 (Trident) | Yes | Yes | Yes | No | No | No |

Dell

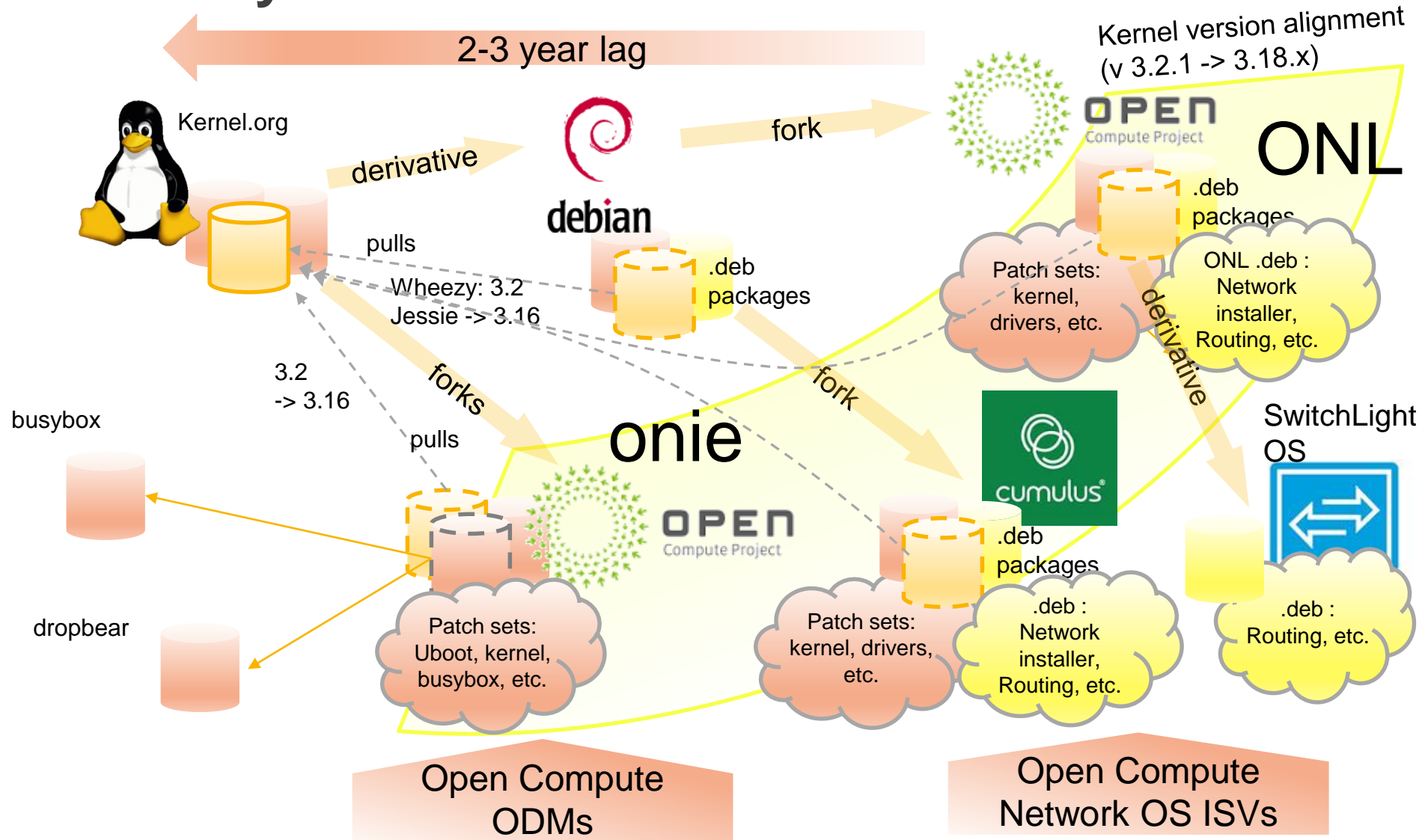
| Device | Ports | CPU | Forwarding | ONL Certified | In Lab | ORC | OF-DPA | OpenNSL | SAI |
|----------|----------------|------------------|------------------------------|---------------|--------|-----|--------|---------|-----|
| S4810-ON | 48x10G + 4x40G | FreeScale P2020 | Broadcom BCM56845 (Trident) | Yes | Yes | Yes | No | No | No |
| S4048-ON | 48x10G + 6x40G | Intel Atom C2338 | Broadcom BCM56854 (Trident2) | Yes | Yes | Yes | No | No | No |
| S6000-ON | 32x40G | Intel Atom S1220 | Broadcom BCM56850 (Trident2) | Yes | Yes | Yes | No | No | No |
| Z9100-ON | 32x100G | Intel Atom C2538 | Broadcom BCM56960 (Tomahawk) | Yes | Yes | No | No | No | No |

Interface Masters Technologies, Inc.

| Device | Ports | CPU | Forwarding | ONL Certified | In Lab | ORC | OF-DPA | OpenNSL | SAI |
|--------------------|-----------------|---------------|------------------------------|--------------------|--------|-----|--------|---------|-----|
| Niagara 2948X12XLm | 48x10G + 12x40G | Intel/AMD x86 | Broadcom BCM56850 (Trident2) | Work In Progress** | No | No | Yes*** | Yes*** | No |
| Niagara 2960X6XLm | 60x10G + 6x40G | Intel/AMD x86 | Broadcom BCM56850 (Trident2) | Work In Progress** | No | No | Yes*** | Yes*** | No |
| Niagara 2972Xm | 72x10G | Intel/AMD x86 | Broadcom BCM56850 (Trident2) | Work In Progress** | Yes | No | Yes*** | Yes*** | No |
| Niagara 2932XL | 32x40G | Intel/AMD x86 | Broadcom BCM56850 (Trident2) | Work In Progress** | No | No | Yes*** | Yes*** | No |
| Niagara 2948X6XL | 48x10G + 6x40G | Intel/AMD x86 | Broadcom BCM56850 (Trident2) | Work In Progress** | No | No | Yes*** | Yes | No |

<http://opennetlinux.org/hcl>

ONL/ONIE Ecosystem



WHY ONL/ONIE IN NXP

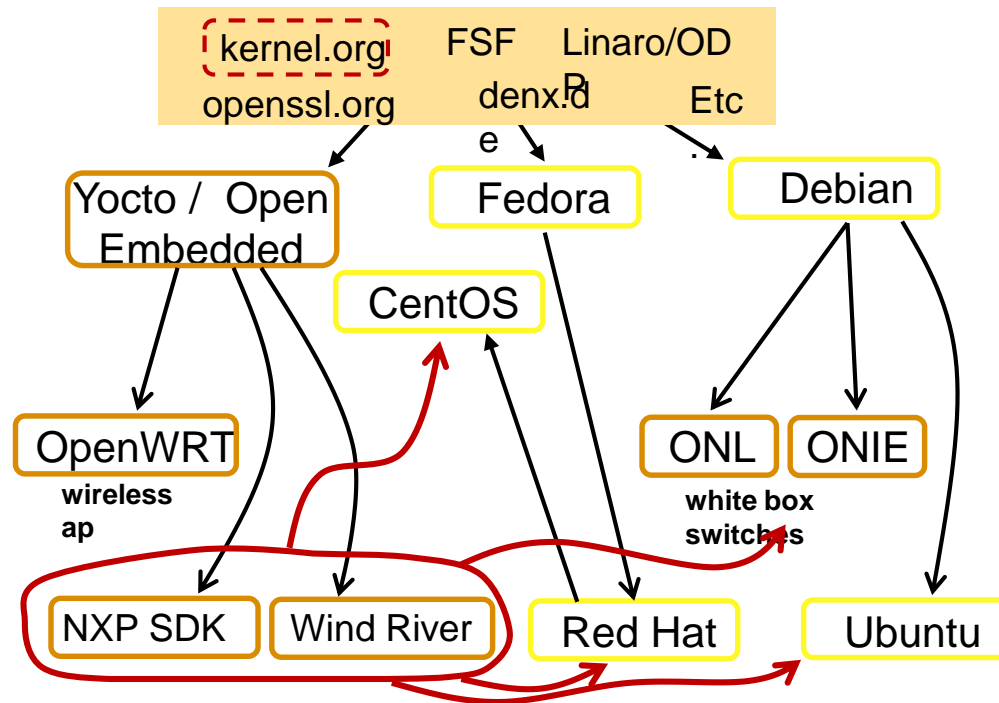


Changing Requirements for Linux Distributions

- Requirements are changing due to technology shifts and convergences
 - NFV
 - Appliance / Server convergence
- Suggested NXP responses
 - Rebalance team goals more to enabling ecosystem distributions via basic enablement “upstreaming”
 - Resource allocation for special-purpose distributions.
 - Eventually, budget for commercial Enterprise distributions.
- Note: Discussion is what Linux distribution customers demand, not value-add software on top of Linux

Linux Distribution Requirements Shift

- Demand broadens away from embedded (and NXP SDK) towards enterprise and some enterprise-derived special purpose distributions.
- Biggest reason is convergence of network appliances & servers but also
 - **Server ecosystem dominance in ARMv8**
 - **More powerful SoCs**
 - **Intel encroachment (WB switches)**
 - **Ease of use in some cases**
 - **Standardization**



Demand for embedded still exists

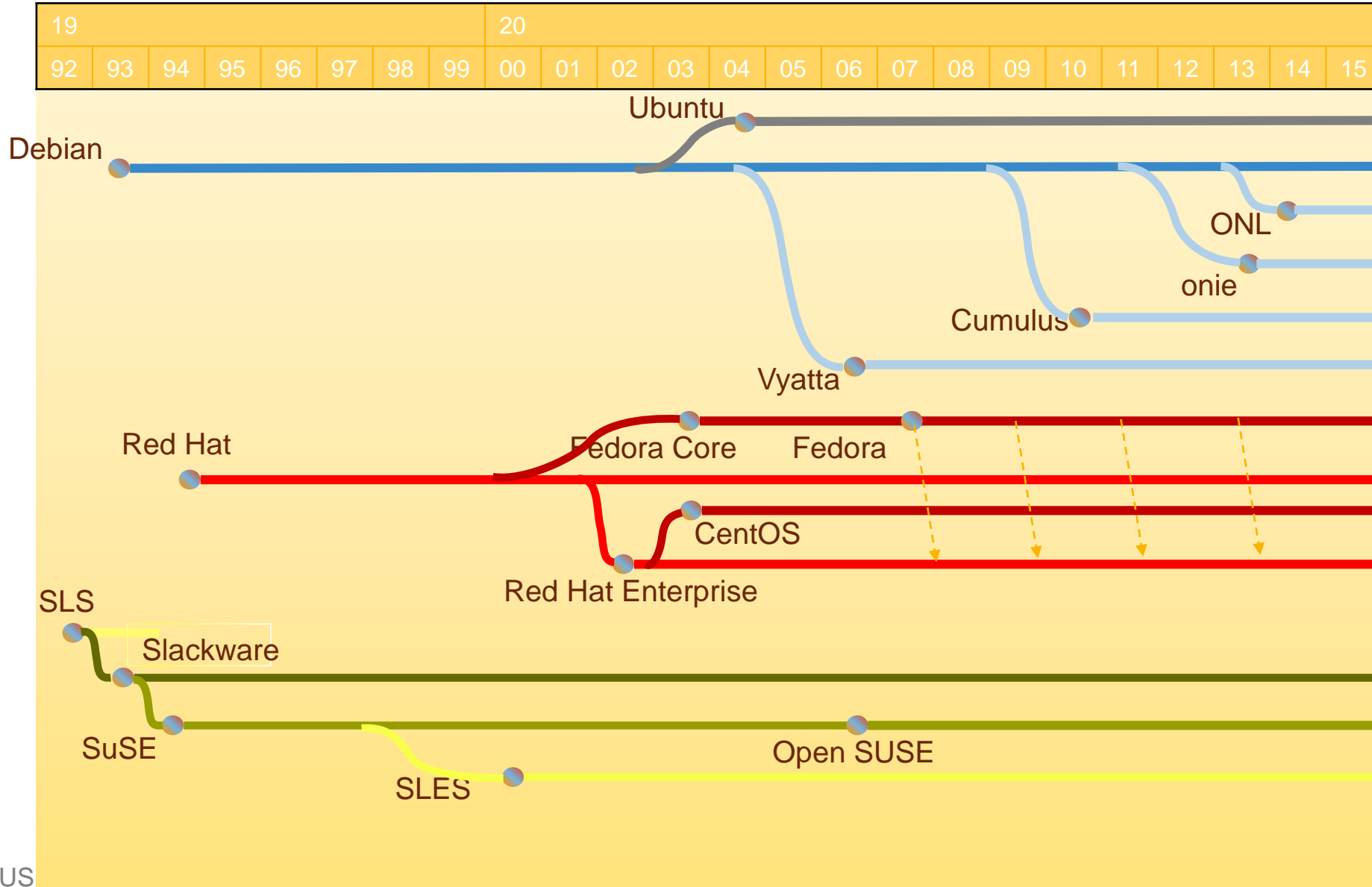
Details of the Changes

- **Server ODMs, OEMs and operators require a single stable image for consolidating all of their server equipment**
 - One unified asset to deploy to all of their equipment (of the same type)
 - Control OPEX related to validation of platforms and management of equipment
- **Embedded Solutions (Yocto, Linaro, Enea) insufficient (for this usage)**
 - Server users (e.g. carrier operators) use automated provisioning to perform a one-time install of a certified Enterprise image to white box & NFV servers
 - Requires inclusion of QorIQ platform support and drivers (esp. net driver)
- **Rely on commercial distributions**
 - Linux kernel and suite of server applications certified to work against it
 - Kitchen sink approach : distribution contains all the platform software the operator may conceivably need, pre-built (i.e. in binary form) and pre-tested
 - Long-term support provided against a stable (i.e. well-tested in field) configuration
- **Limited set of vendors:**
 - Red Hat (primary)
 - Canonical (new entrant – largest platform vendor for OpenStack cloud): Ubuntu
 - SUSE (predominantly Europe)

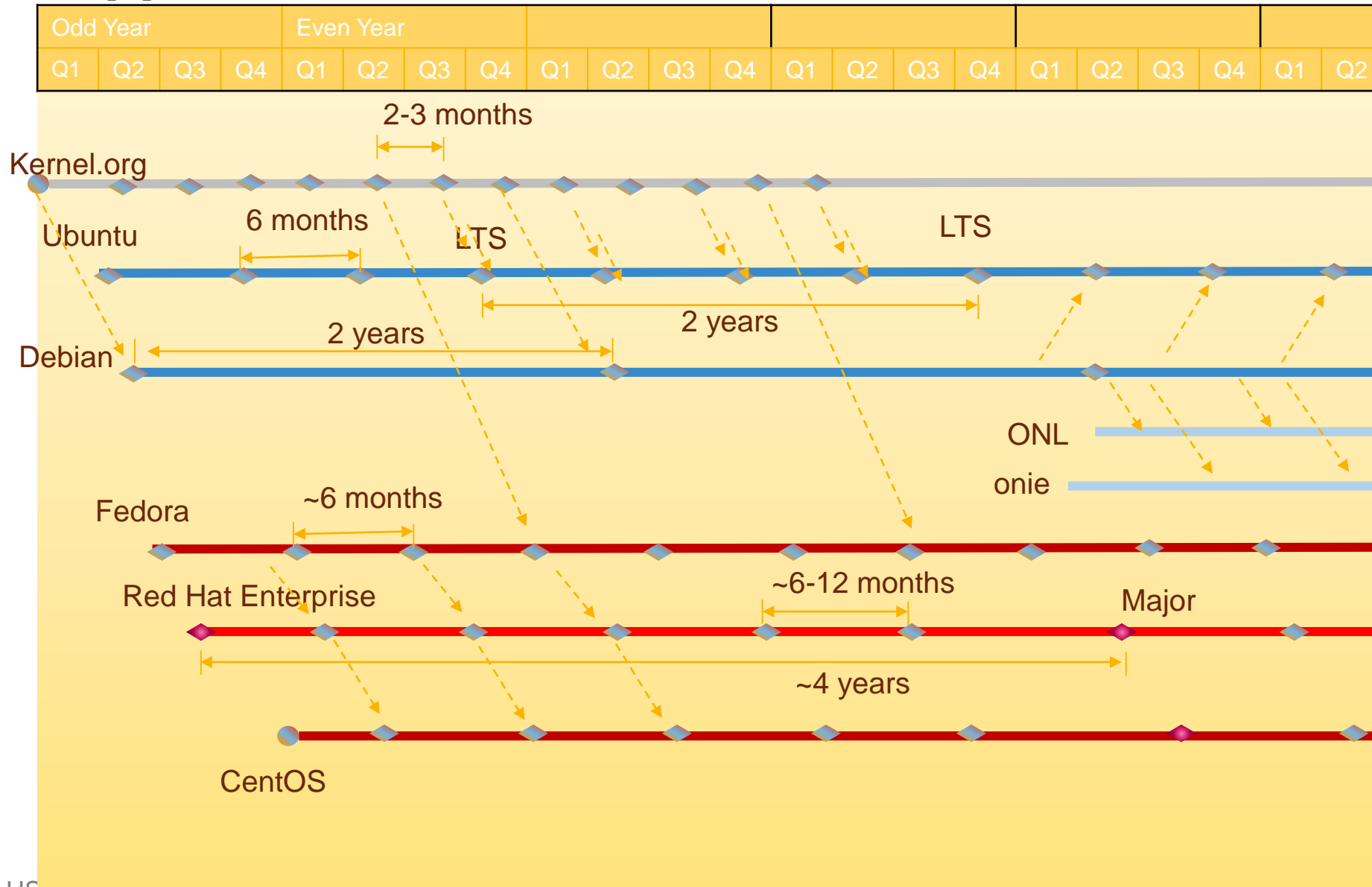
Distributions

- **Two key components**
 - Linux kernel – standardized to a stable configuration / revision level
 - Root file system – containing user space applications and dynamically loadable kernel modules for standard drivers
- **Commercial distributions usually rely on kernels and user space packages derived from an upstream community-driven distribution (feeder)**
 - E.g. Debian, Slackware, Gentoo
 - Generally share build tools, package management system, etc. with progenitor
 - Frequent cross-pollination between feeder and derivative (i.e. not strictly a *fork*); e.g. derivative re-bases off new feeder releases, bug fixes, enhancements submitted upstream
 - Some commercial distros sponsor community distros; e.g. Red Hat → Fedora, CentOS
- **All derive from a release branch of the mainline kernel.org linux kernel development tree**
 - Often distinguished by how closely they track to kernel.org releases
 - Community distributions typically released more frequently and closer to kernel.org releases
 - Enterprise distros focus on stability with less frequent releases – based on long-term support “branches”

Family Tree of Key Enterprise / Network Distributions



Release Approaches



ARMv8 Support Status

| Distribution | ARMv8 Status | Release | Date |
|--------------|--|-------------------|-----------------|
| Fedora | Supported† (secondary architecture) | 21 | December 2014 |
| Debian | Supported | “Jessie” | June 2015 |
| Ubuntu | Supported | 14.10‡ † 15.04 | Oct 2014 |
| CentOS | Alpha | 7.1 | June 2015 |
| RHEL | Preview | 7.1 | Upcoming (2015) |

† Does not support ARMv8 processors with GIC500 in legacy mode (key interoperability issue)

‡ Long-term support release – next official LTS not for 2 years



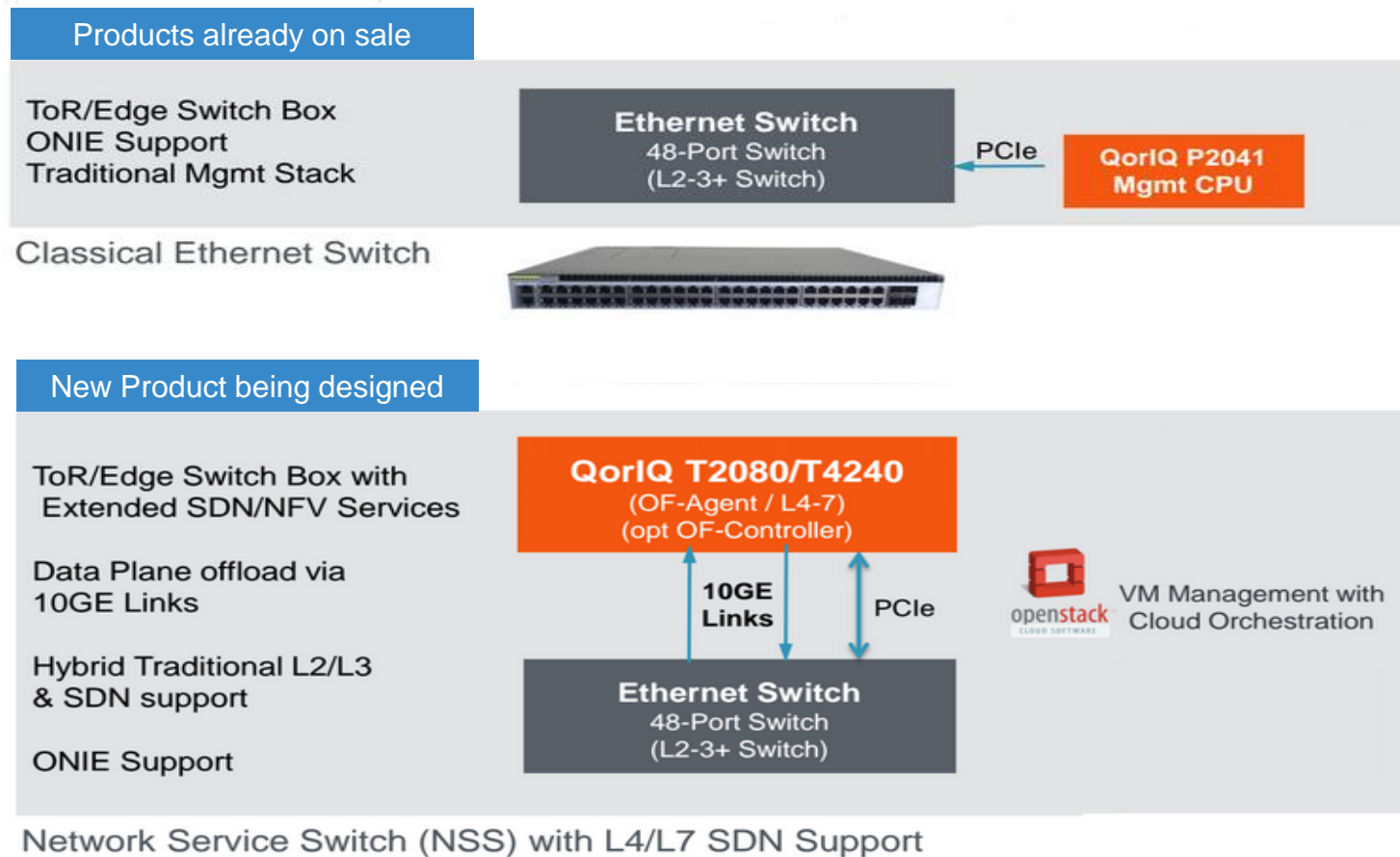
QorIQ Power Support Status (QorIQ non-DPAA Only)

| Distribution | PPC Status | Release | Date |
|---------------------------------|---|----------------------------|--------------------------|
| Fedora | 32-bit support EOL (F17) Power Architecture-based 64-bit | Fedora Core 4 Fedora 8? | June 2005 2007? |
| Debian | Supported | 2.2† “Jessie”‡ | August 2000 June 2015 |
| Ubuntu | EOL (community supported) | n/a | n/a |
| CentOS | EOL (CentOS 5) | n/a | n/a |
| RHEL OpenPower (thru IBM) | EOL (RHEL 6) † Supported ‡ | n/a RHEL 5.11 | n/a 2014 |

† 32-bit Power Architecture- based

‡ Power Architecture-based 64-bit platform support; with user space compatibility issues

White Box Switch Reference Offerings with NXP Processor



Accton will launch a 32X100G Switch based on LS2080A in the mid-year.

BACKPORT – KERNEL REBASE

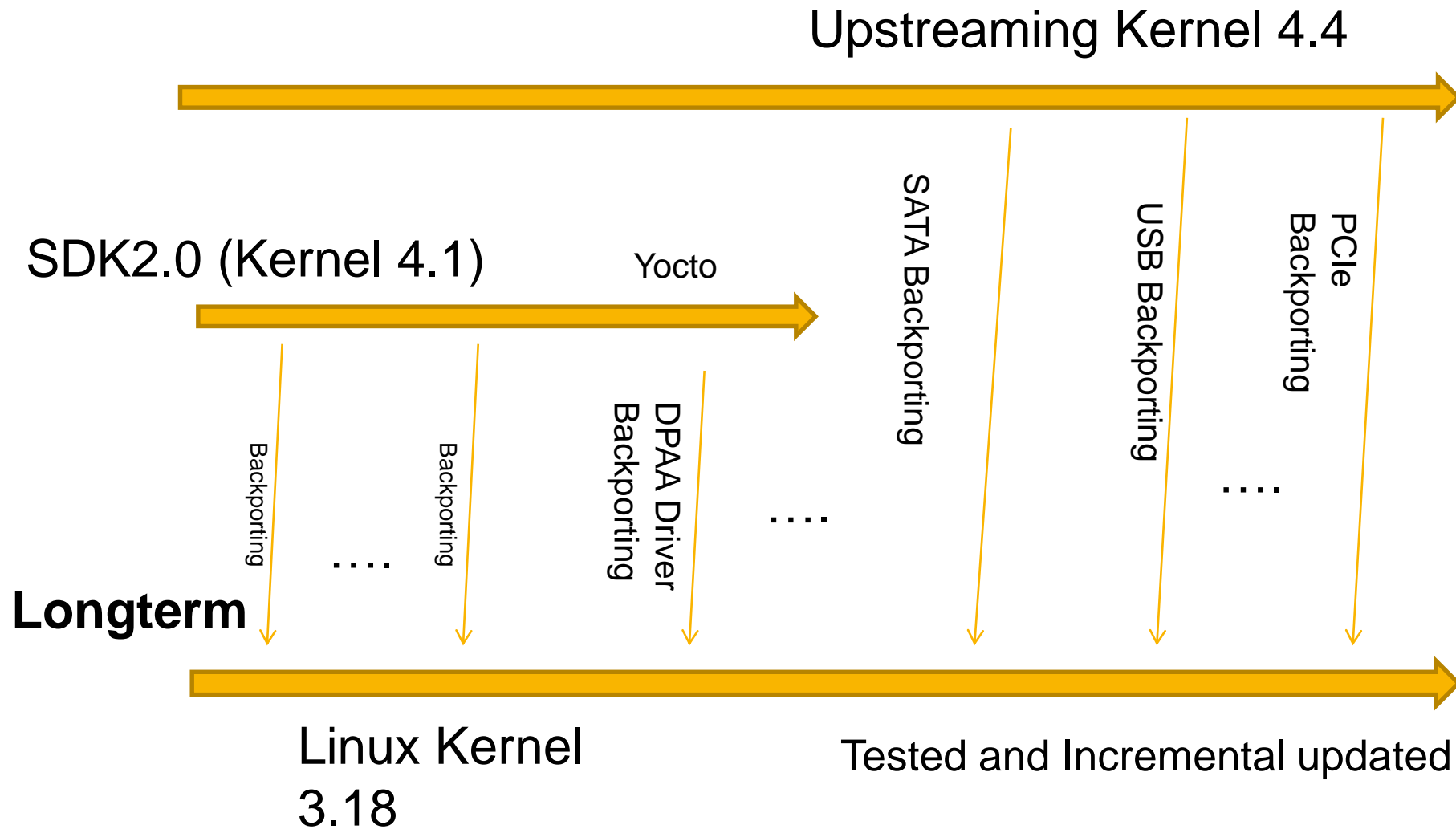


Kernel Version Gap

- Kernel version in latest ONL: 3.18
- Kernel version in latest ONIE: 4.1
- Latest long term kernel version in community: 4.4.
- Latest kernel version in NXP Linux SDK
 - SDK1.9: 3.12
 - SDK2.0: 4.1

Backport is needed

Kernel Backport



Platform and Core Support

- Take T2080 as example, it contains 4 dual-thread e6500 Power Architecture processors organized in one cluster and it can only run 64-bit kernel.
- For this type backporting, we use both module analysis method and bisection method. Module analysis method can help us finish the early stage of backporting and bisection method can help to find out the bug as quickly as possible.
- The key patches as followed. (focused on e6500, 64-bit kernel, dual-thread and platform support)

```
From a2From 8815fFrom 899ed094e12ebc62e1f148a6a7b7From e9bf3a0a78a27d5d7a0710fb7ea26a6a808e8148 Mon Sep 17 00:00:00 2001
From: KFrom: KumaFrom: Andy Fleming <afleming@freescale.com>
Date: FDate: Thu, 20 Apr 2015 13:49:28 +0800
Subject: Subject: [PATCH 36/37] Add support for B4860QDS board support
Subject: [The general idea is that each core thread into the secondary thread eventually wait in the secondary appropriate bit in the smca to be pointer will set that bit in the the core/thread to boot. We also U-Boot normally does for CPUs (1) extract from FreeScale QorIQ SDK
Signed-off-by: Shaveta Leekha <shaveta@freescale.com>
Signed-off-by: Andy Fleming <afle...>
Signed-off-by: Zhao Chenhui <chen...>
Signed-off-by: Li Yang <liyang@freescale.com>
Signed-off-by: Scott Wood <scottw...>
Signed-off-by: Li Jingyu <b41874@freescale.com>
arch/powerpc/platforms/85xx/Kconfig | 14 ++++
arch/powerpc/include/asm/cputab1 | 1 +
arch/powerpc/include/asm/reg_hoo | 70 ++++++
arch/powerpc/kernel/exceptions-6 | 125 ++++++
arch/powerpc/kernel/head_64.S | 19 +++++
arch/powerpc/kernel/prom.c |
arch/powerpc/kernel/setup-common |
arch/powerpc/kernel/setup_64.c |
arch/powerpc/platforms/85xx/mpc...
```



DPAA Driver Backport

- DPAA driver is on the way of upstreaming.
- Need to backport from NXP SDK2.0.
- In order to make the DPAA related networking driver work, we need follow modules at least: QBMAN, FMAN, PAMU, PME and etc.
- Simply replacing the driver folder cannot make the driver work.

The real difficulty lies in connecting DPAA driver and other components of kernel, such as SKB, IOMMU and etc.

fsl_qbman: Add drivers for the Freescale DPAA Q/Man

extract from FreeScale QorIQ SDK

```
Signed-off-by: Geoff Thorpe <Geoff.Thorpe@freescale.com>
Signed-off-by: Bharat Bhushan <Bharat.Bhushan@freescale.com>
Signed-off-by: Bogdan Hamciuc <bogdan.hamciuc@freescale.com>
Signed-off-by: Hai-Ying Wang <Haiying.Wang@freescale.com>
Signed-off-by: Jeffrey Ladouceur <jeffrey.ladouceur@freescale.com>
Signed-off-by: Jia-Fei Pan <Jiafei.Pan@freescale.com>
Signed-off-by: Kumar Gala <galak@kernel.crashing.org>
Signed-off-by: Priyanka Jain <Priyanka.Jain@freescale.com>
Signed-off-by: Vakul Garg <vakul@freescale.com>
Signed-off-by: Emil Medve <Emilian.Medve@Freescale.com>
Integrated-by: Li Jingyu <b41874@freescale.com>
```

Diffstat

| | | | |
|------------|-----------|--|------|
| -rwxr-xr-x | [-rwr-r-] | drivers/staging/Kconfig | 2 |
| -rwxr-xr-x | [-rwr-r-] | drivers/staging/Makefile | 1 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/Kconfig | 217 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/Makefile | 26 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_config.c | 702 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_debugfs.c | 120 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_driver.c | 503 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_high.c | 1055 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_low.h | 524 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_private.h | 161 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_test.c | 56 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_test.h | 91 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_test_high.c | 181 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/bman_test_thresh.c | 196 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/dpa_alloc.c | 699 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/dpa_sys.h | 329 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/dpa_uio.c | 190 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/fsl_usdpaa.c | 1562 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/fsl_usdpaa_irq.c | 275 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/qbman_driver.c | 86 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/qman_config.c | 1208 |
| -rwxr-xr-x | | drivers/staging/fsl_qbman/qman_debugfs.c | 1600 |

Driver Support - PCI/PCIe, SATA, USB etc.

- Different from DPAA related driver, the patches for PCI/PCIe, SATA, USB etc have been upstreamed already.
- They should be backported from the upstreaming kernel.
- There are numerous patches for this type of driver because of the large gap between kernel versions. Simply applying all the related patches between the two versions is inefficient. Need to pick up the key patches individually and apply them accordingly.

Backport Procedure

The key point in backport procedure - The specific platform and driver should be upgraded, but the kernel shouldn't!

- Code Architecture
- Function Interface
- Driver Model

```
commit cc50fad2fee92520ee279e47e3e3222f6536d4d6
Author: Li JingYu <b41874@freescale.com>
Date: Tue Mar 4 13:20:15 2014 +0800

fmd: backport some interfaces to old version
```

```
diff --git a/drivers/net/fman/Makefile b/drivers/net/fman/Makefile
index 7115296..07edaf0 100755
--- a/drivers/net/fman/Makefile
+++ b/drivers/net/fman/Makefile
@@ -4,7 +4,7 @@
diff --git a/drivers/net/fman/src/xx/xx_linux.c b/drivers/
index 57d2a48..84e9c10 100755
--- a/drivers/net/fman/src/xx/xx_linux.c
+++ b/drivers/net/fman/src/xx/xx_linux.c
@@ -354,14 +354,14 @@ uint32_t XX_DisableAllIntr(void)
{
    unsigned long flags;

-   local_irq_save_nort(flags);
+   local_irq_save(flags);

    return (uint32_t)flags;
}

void XX_RestoreAllIntr(uint32_t flags)
{
-   local_irq_restore_nort((unsigned long)flags);
+   local_irq_restore((unsigned long)flags);
}

- static int fm_port_remove(struct platform_device *of_dev)
+ static int fm_port_remove(struct of_device *of_dev)
{
    t_LnxWrpFmPortDev *p_LnxWrpFmPortDev;
    t_LnxWrpFmDev *p_LnxWrpFmDev;
@@ -1342,13 +1341,10 @@ static const struct of_device_id fm_port_match[] = {
MODULE_DEVICE_TABLE(of, fm_port_match);
#endif /* !MODULE */

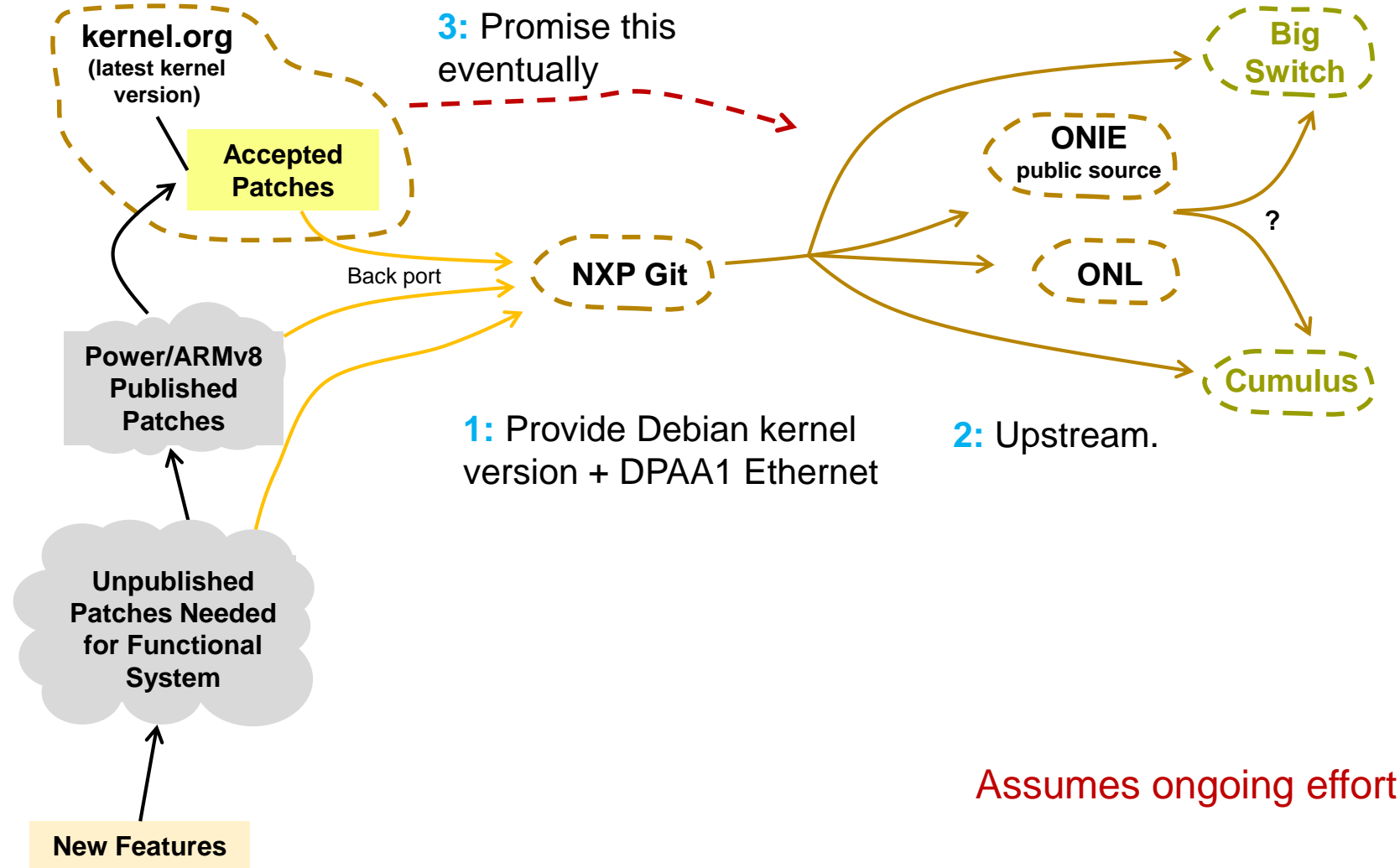
- static struct platform_driver fm_port_driver = {
-     .driver = {
-         .name = "fsl-fman-port",
-         .of_match_table = fm_port_match,
-         .owner = THIS_MODULE,
-     },
+ static struct of_platform_driver fm_port_driver = {
+     .name = "fsl-fman-port",
+     .match_table = fm_port_match,
+     .owner = THIS_MODULE,
+     .probe = fm_port_probe,
+     .remove = fm_port_remove
};
```



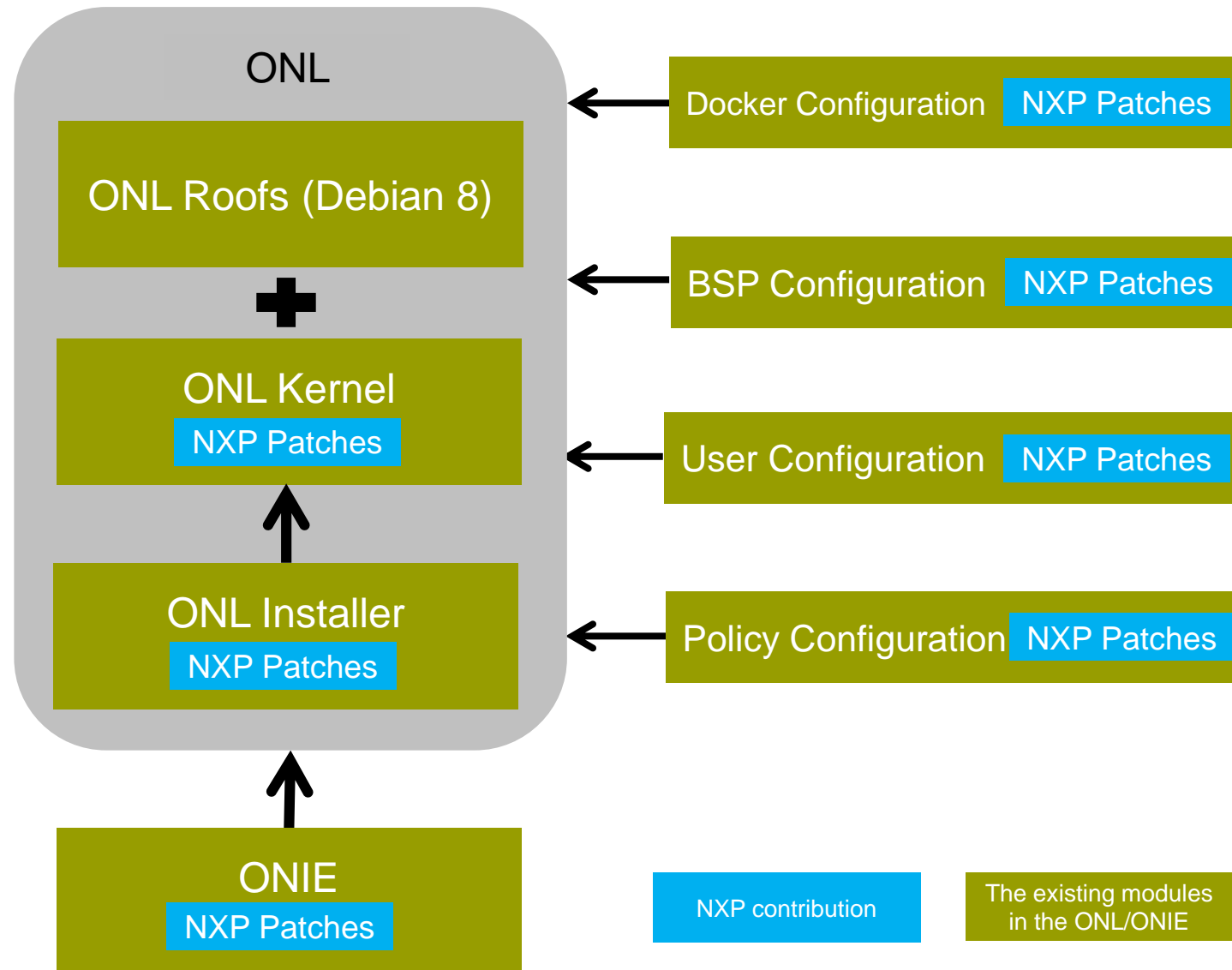
ONL/ONIE DEVELOPMENT AND UPSTREAMING

General Process

PoR DPAA1 Upstreaming



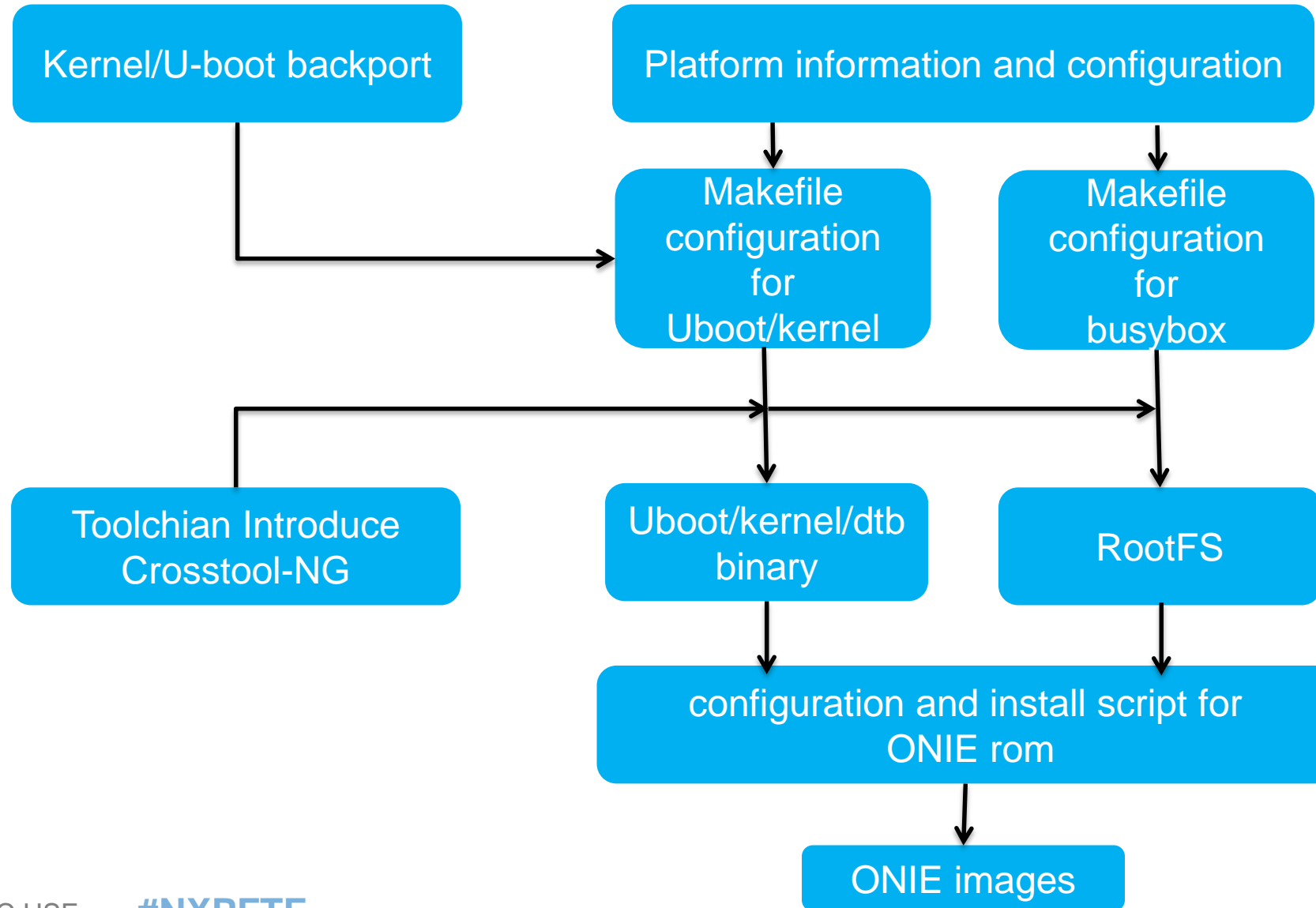
Key Modification Needed



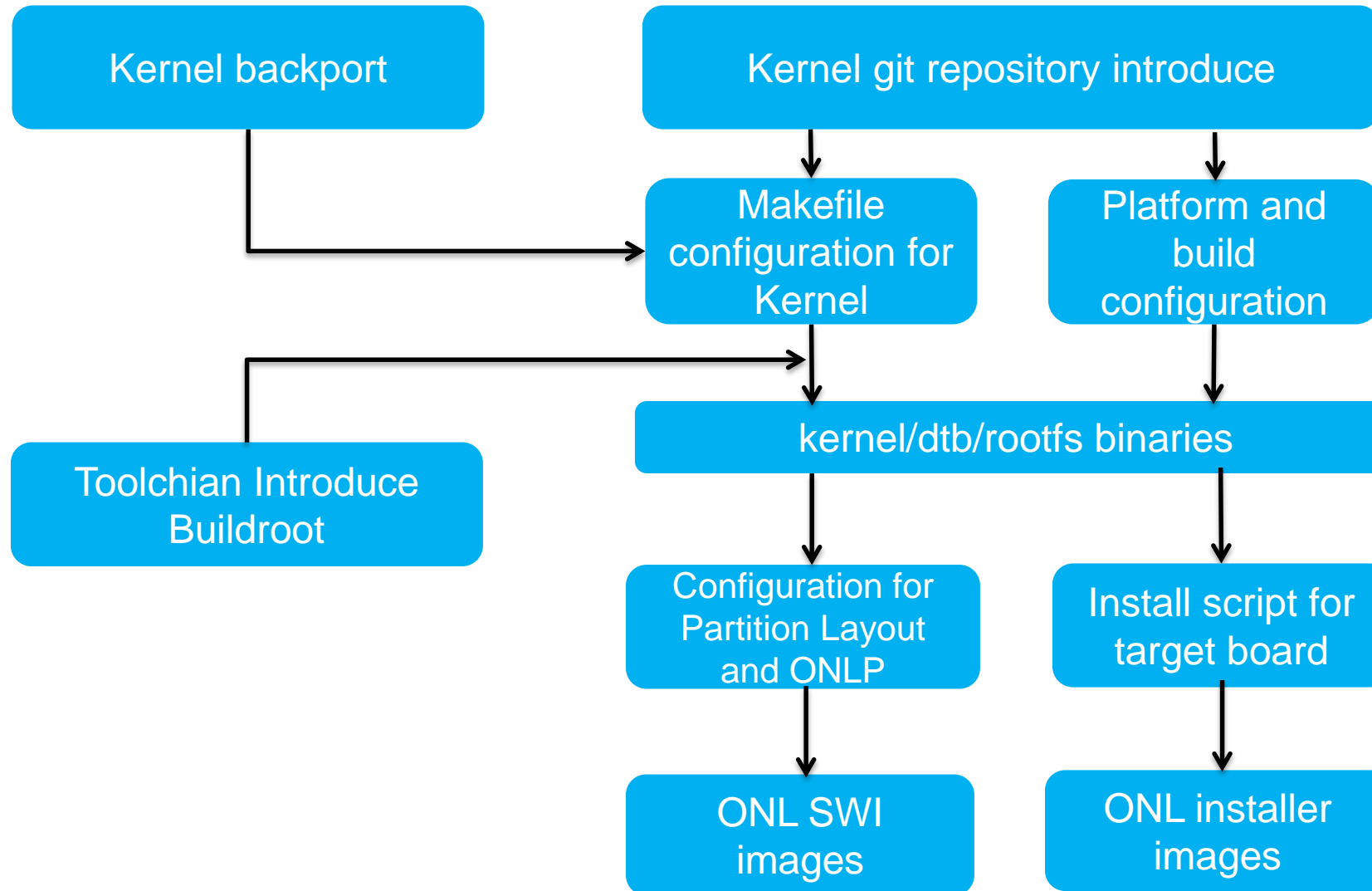
Feature List

- Platform support
- DDR Memory
- Serial Console support
- 1G/10G network port.
- USB host.
- PCIe Host bus.
- IFC NOR.
- IFC NAND.
- SD/MMC
- GPIO
- I2C

ONIE Development Process for New Platform



ONL Development Process for New Platform



PLAN & ROADMAP



Plan for T2080

| ID | Task Name | Duration | Start_Date | Finish_Date | Predecessors |
|----|---|----------|-------------|-------------|--------------|
| 1 | New ONL warmup and build environment setup | 10 days | 14-Mar-16 | 25-Mar-16 | |
| 2 | T2080 backport to 3.18 | 10 days | 14-Mar-16 | 25-Mar-16 | |
| 3 | Backport testing and issue fixing | 5 days | 28-Mar-16 | 1-April-16 | 2 |
| 4 | ONL configuration development for T2080 | 5 days | 28-Mar-16 | 1-April-16 | 1 |
| 5 | ONL Installer development for T2080 | 5 days | 5-April-16 | 11-April-16 | 4 |
| 6 | Test case design and automation scripts development | 10 days | 12-April-16 | 25-April-16 | |
| 7 | ONL development for T2080 | 15 days | 12-April-16 | 30-April-16 | 5 |
| 8 | ONL testing and issue fixing | 5 days | 4-May-16 | 10-May-16 | 7 |
| 9 | Legal reviewing and patch submission | 3 days | 11-May-16 | 13-May-16 | 8 |

 Key Milestones



Plan for LS2080A

| ID | Task Name | Duration | Start_Date | Finish_Date | Predecessors |
|----|--|----------|-------------|-------------|--------------|
| 1 | ONIE development for LS2080A | 10 days | 5-April-16 | 18-April-16 | |
| 2 | ONIE testing and patch submission | 5 days | 19-April-16 | 25-April-16 | 1 |
| 3 | LS2080A backport to 3.18 | 20 days | 28-April-16 | 24-May-16 | |
| 4 | Backport testing and bug fixing | 5 days | 25-May-16 | 31-May-16 | 3 |
| 5 | ONL configuration development for LS2080A | 10 days | 16-May-16 | 27-May-16 | |
| 6 | ONL Installer development for LS2080A | 10 days | 30-May-16 | 3-June-16 | 5 |
| 7 | Test case design and automation script development | 5 days | 6-June-16 | 10-June-16 | |
| 8 | ONL development for LS2080A | 20 days | 6-June-16 | 4-July-16 | 6 |
| 9 | ONL testing and bug fixing | 5 days | 5-July-16 | 11-July-16 | 8 |
| 10 | Legal review and ONL patch submission | 3 days | 12-July-16 | 14-July-16 | 9 |

 Key Milestones



Plan for Upstreaming Maintenance

| ID | Task Name | Duration | Start_Date | Finish_Date | Predecessors |
|----|---|----------|------------|-------------|--------------|
| 1 | Track the status on ONL community for Comments handle and patch maintaining | 40 days | 15-July-16 | 9-Sep-16 | |

Plan for LS1043A ONIE

| ID | Task Name | Duration | Start_Date | Finish_Date | Predecessors |
|----|--|----------|-------------|-------------|--------------|
| 1 | LS1043A backport to U-boot -2015.10 | 5 days | 28-March-16 | 1-April-16 | |
| 2 | LS1043A backport to Kernel-4.1 | 10 days | 5-April-16 | 18-April-16 | 1 |
| 3 | ARMv8 Toolchain support in ONIE | 10 days | 28-March-16 | 11-April-16 | |
| 4 | ONIE configuration and development for LS1043A | 10 days | 12-April-16 | 25-April-16 | 2, 3 |
| 5 | ONIE testing and bug fixing | 5 days | 26-April-16 | 30-April-16 | 4 |
| 6 | Legal review and patch submission to ONIE community. | 3 days | 4-May-16 | 6-May-16 | 5 |
| 7 | Comments handle and push patches be accepted by ONIE community | 15 days | 9-May-16 | 27-May-16 | 6 |

 Key Milestones



SUMMARY



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