FTF 2016
TECHNOLOGY FORUM

LS1012A, LS1024A, LS1043A CUSTOMER TRAINING

QorIQ LS1043A APPLICATION SOLUTION KIT (IoT, NAS, RGW)

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PUBLIC USE

ABSTRACT

- This session provides a demonstration led by the instructor that showcases how to develop end products using the Application Solution Kit (ASK) for QorIQ LS1043A processors.

AGENDA

- ASK Description
- Designing with LS1012A, LS1024A, or LS1043A ASK
- Using the ASK to Make RDB Binaries
- Adding and Installing a Package
- Adapting the ASK for Your Hardware
- ASK Documentation

ASK DESCRIPTION

Software Products and Services

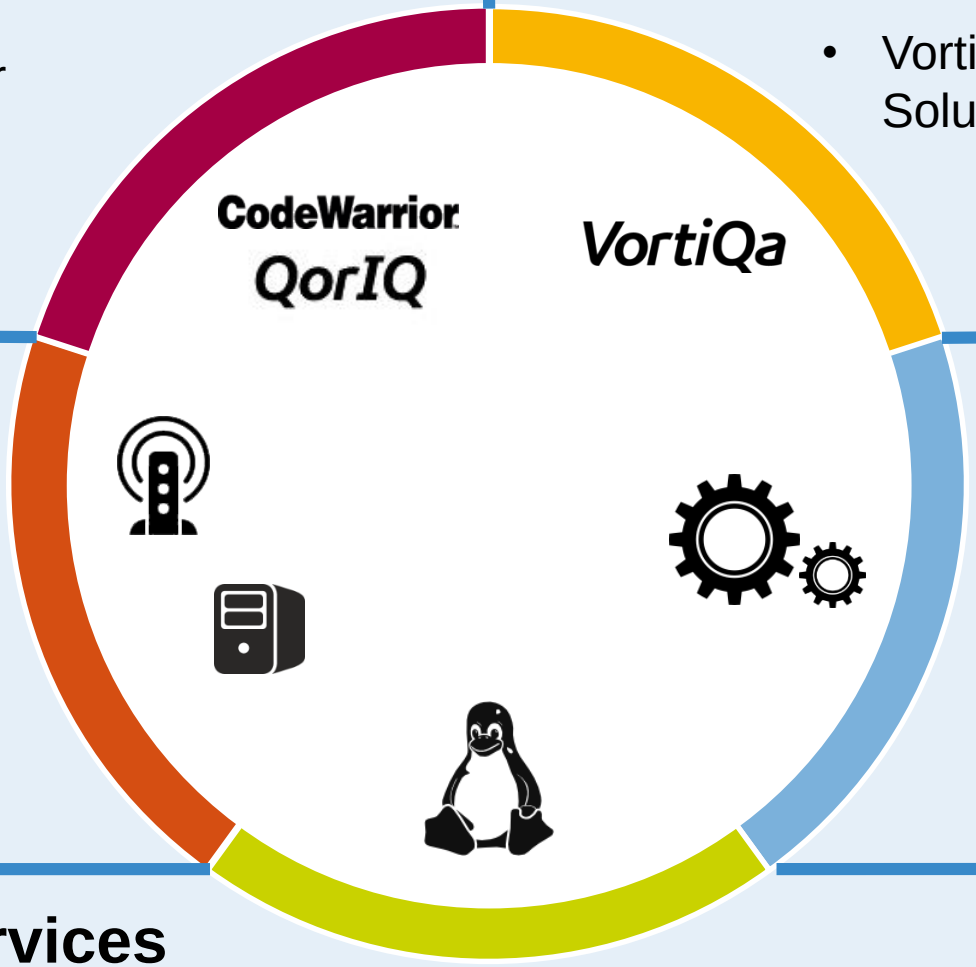
Visit us in the Tech Lab – #247

Development Tools

- CodeWarrior

Runtime Products

- VortiQa Software Solutions



Solutions Reference

- IOT Gateway
- OpenWRT+

Integration Services

- Security Consulting
- Hardened Linux

Linux® Services

- Commercial Support
- Performance Tuning

Accelerate **Customer Time-to-Market**

Deliver **Commercial Software, Support, Services and Solutions**

Simplify **Software Engagement with NXP**

Create **Success!**

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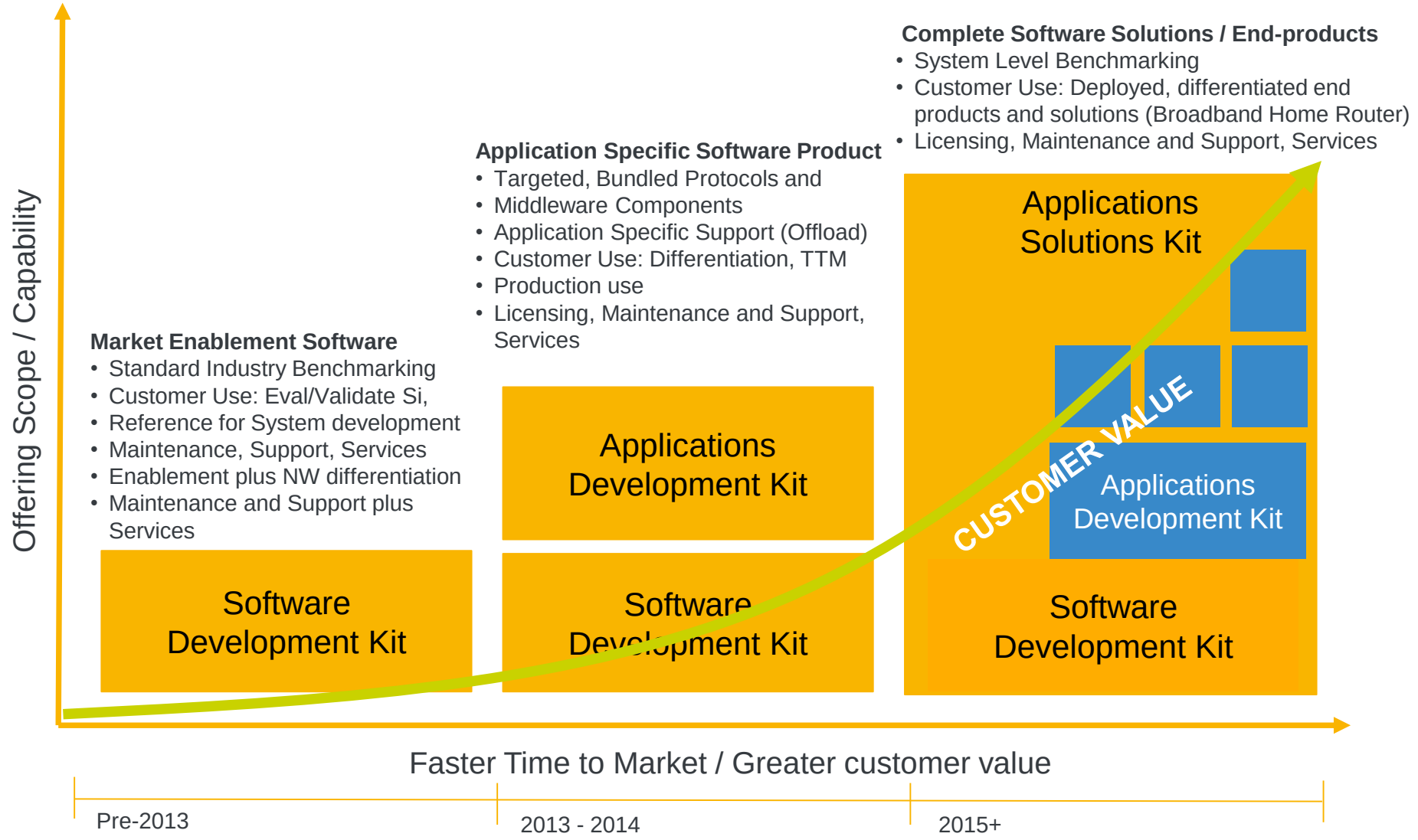
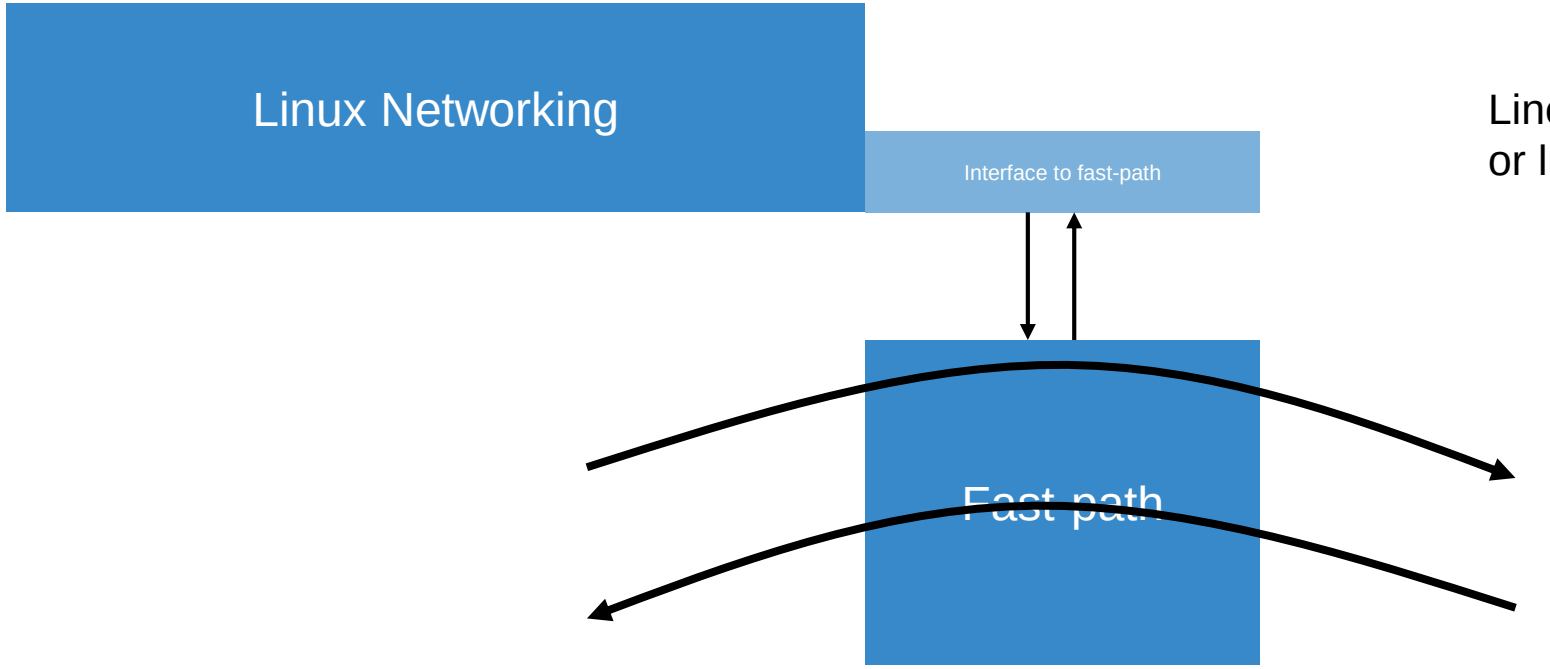
SDK vs. ADK vs. ASK



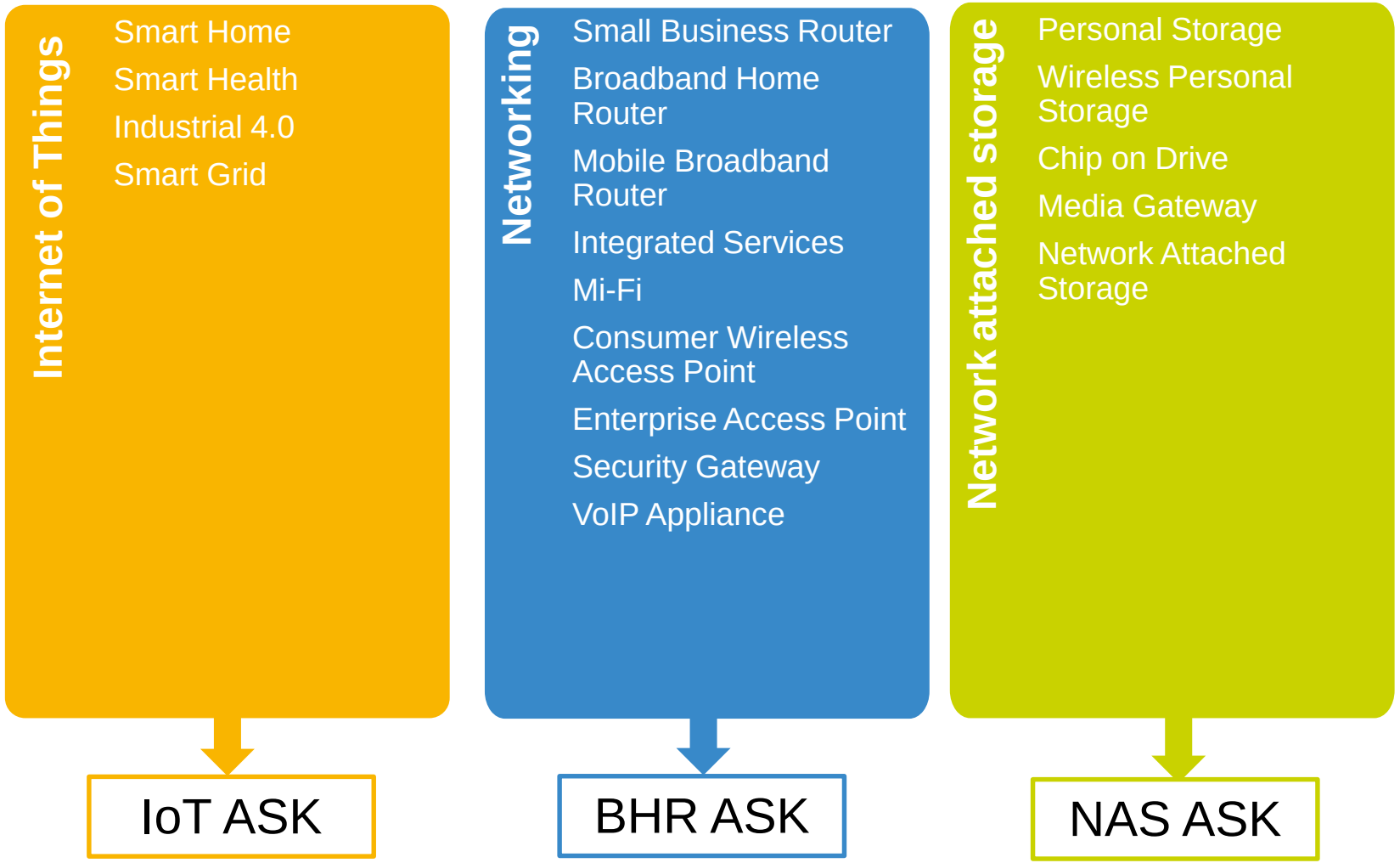
Why Use the ASK

- Production-tested targeted packages
  - Can give a real head-start on end-product
- Gives access to BHR and NAS Fast Path, VoIP binaries and supporting software



Line-rate throughput with little or limited additional CPU load

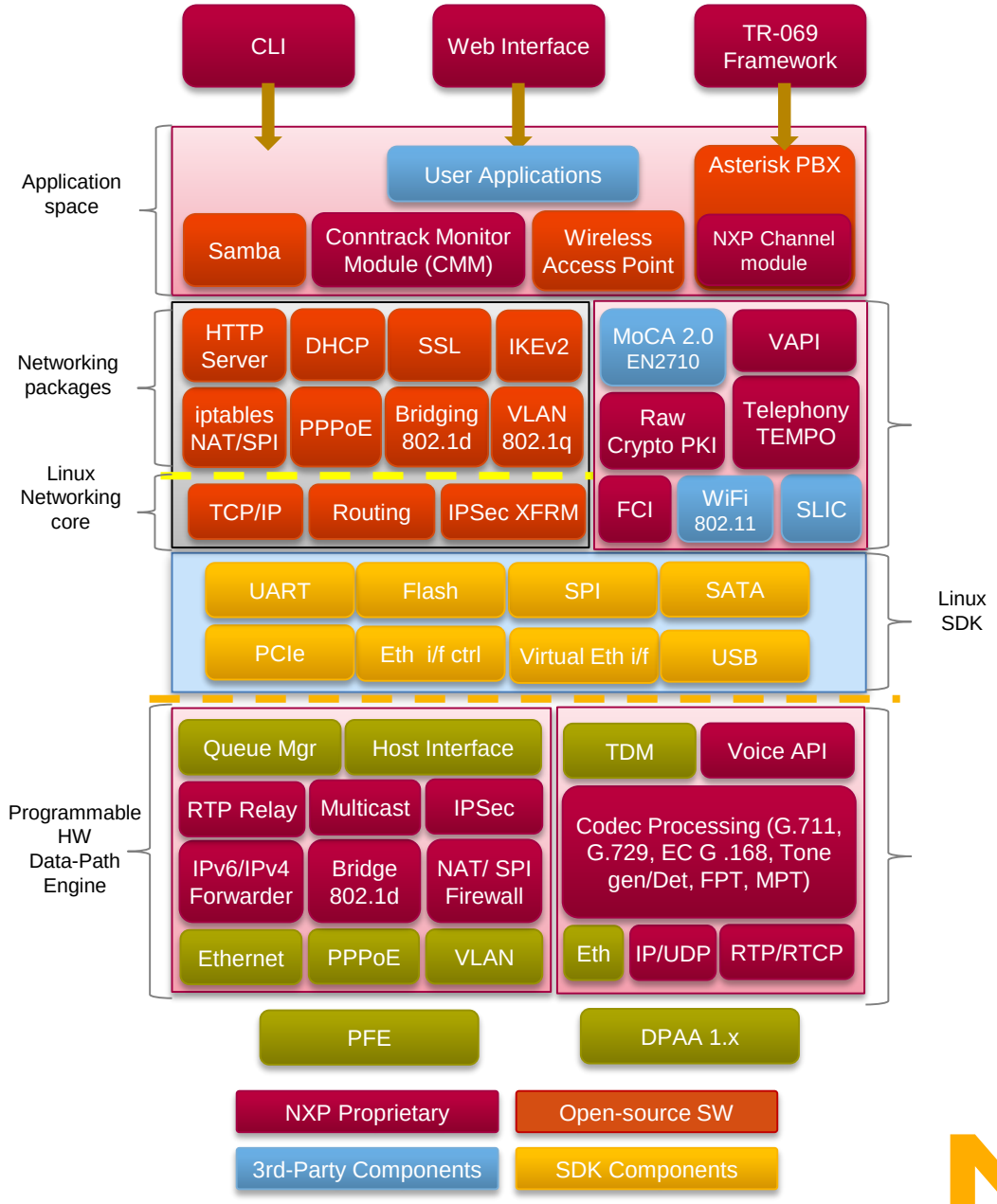
Application Solution Kits (ASK) – LS1



BHR Application Solution Kit

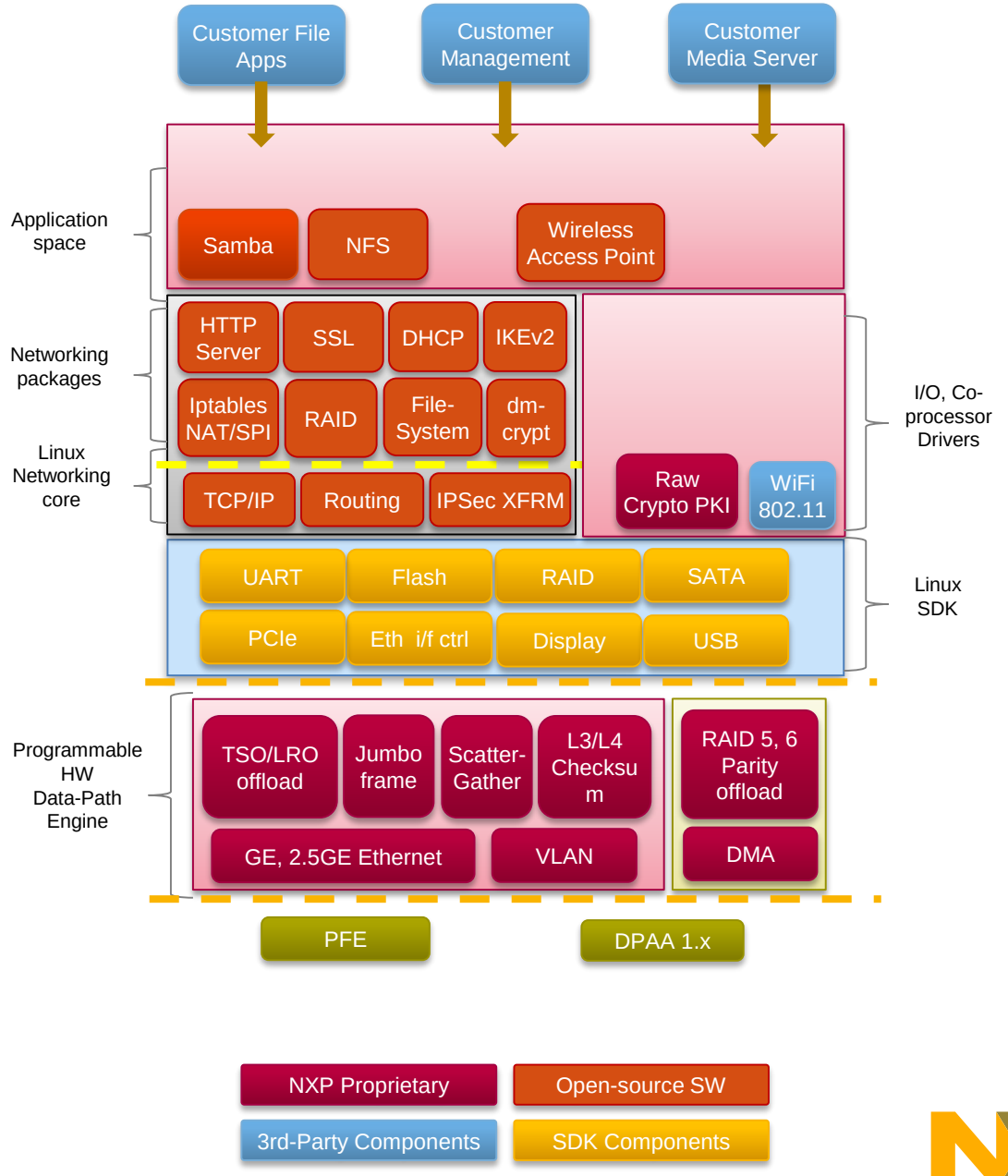
- Turnkey Market Specific Solutions
  - Application, Middleware and SDK integration
  - Full-featured and optimized
  - Deployable directly or via ODM partners
  - Systems Integration and Customization

- Target Markets
  - Multi-Service Gateways
  - Enterprise/Access Gateways
  - WLAN Access-points
  - Consumer/Prosumer NAS
  - Intelligent NIC adapters
  - IoT Gateways



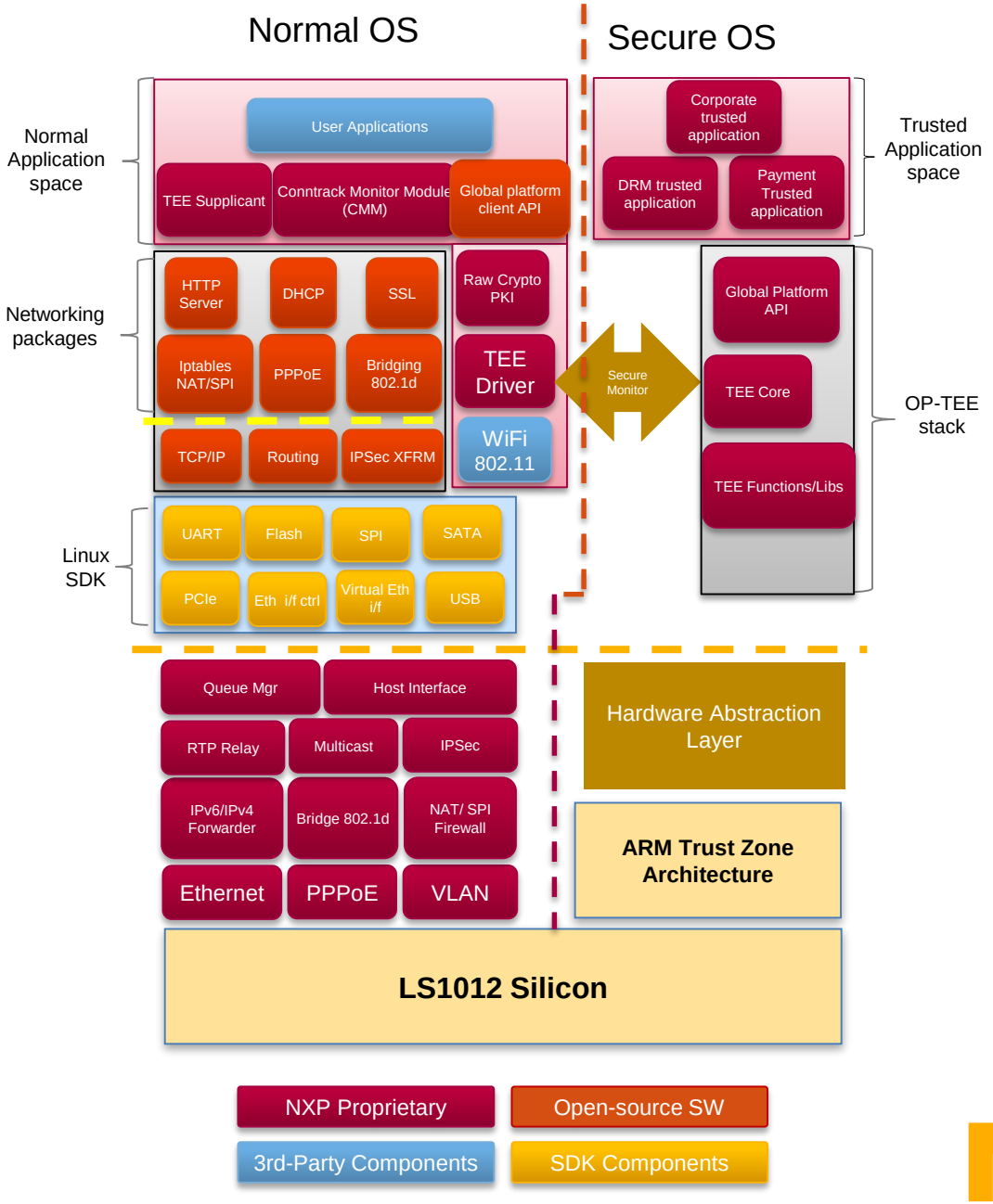
Consumer NAS ASK

- Key Highlights
  - HW offload delivers best-in-class NAS performance
  - Rich set of RAID & file-system support
  - Secure storage and secure access of data
  - Optional VPU(ZN200) integration for hardware transcoding – delivers up to 4 simultaneous HD channels
  - Offloads
    - LRO/TSO, Jumbo-frame, checksum
    - RAID parity calculation, DMA
  - Highly optimized storage stack
    - Samba, NFS, HTTP, SSL
    - RAID 0, 1, 5, 6, JBOD support



IoT ASK (Preliminary Info)

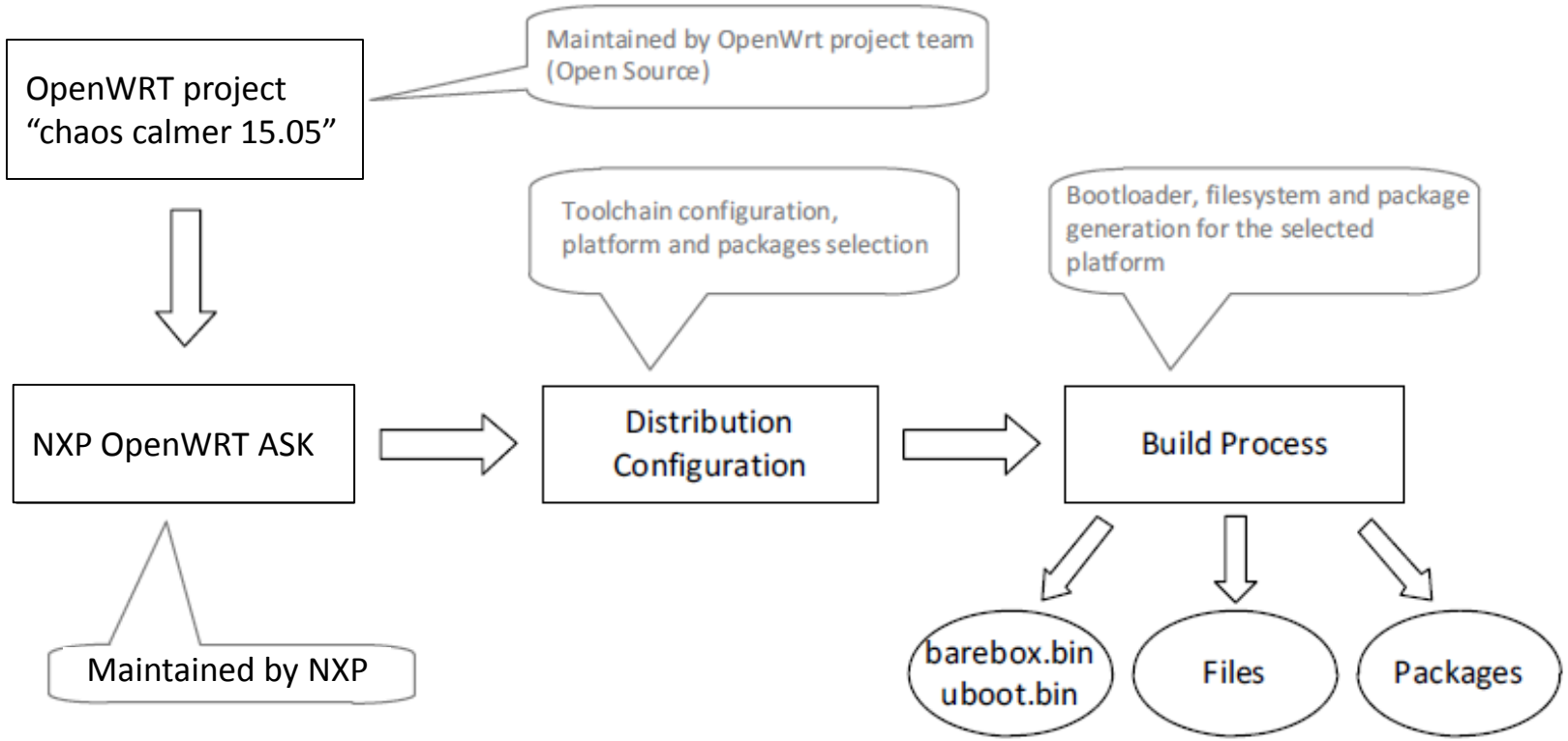
- ARM Trustzone® execution environment
- SEC engine with symmetric and asymmetric crypto support
- Full-featured Op TEE stack
  - Secure OS
  - Secure key management
  - Global platform API support
- Networking and upper application layers
  - Feature rich and optimized networking stack
  - Optional Pre integrated Partner OSGi and JVM layers for quick Time to Market
- Available later 2016



DESIGNING WITH LS1012A, LS1024A, AND LS1043A ASK

OpenWRT ASK

- Complete build and development environment
- Includes sources from the level of microloader, right up to user applications, e.g. Media server, Web GUI
- New features and applications can be added
  - Often ready-made package sources are already on OpenWRT repository



Example Packages in OpenWRT ASK

- Includes:
  - DHCP server, DNS Resolver, ebtables, ethtool, Firewall (IPv4 and IPv6) and NAT, FTP Server, Httpd, IGMP Proxy, ip (Routing Control utility), ipsec-tools, IPv6 DNS Server Discovery Daemon, IPv6 MLD Proxy, IPv6 Multicasting Routing Daemon, IPv6 Routing Advertisement Daemon, net-tools-rarp, Network Interfaces, NTP Client, PPP (PPP Daemon), rp-pppoe relay
- More complete list in software documentation
- New packages are easy to add via OpenWRT package framework

Release Archive Overview

- There are 2 archives that are provided in the ASK
  - `src-openwrt-ls1043a_0.7-rc1.tar.bz2`
  - `dl-openwrt-ls1043a_0.7-rc1.tar.bz2`

- `src-openwrt-ls1043a_0.7-rc1.tar.bz2:`
  - Default board configuration files
  - Makefiles, configuration files, patch files and scripts to build the toolchain, tools, kernel, packages, and generate the final images

- `dl-openwrt-ls1043a_0.7-rc1.tar.bz2:`
  - Default downloads from OpenWRT and other repositories
  - Build system uses this directory of compressed images first before going to the web
  - Makes additional downloads unnecessary

The Linux Kernel

- Central part of the software bundle
- Takes care of most low-level hardware functions, interrupt handling, task scheduling, low-level interface to fast-forward engine
- Where most of the network packet processing is done
- Code running inside the kernel can be compiled within the kernel image, or as a separate module loaded when necessary:
  - In the latter case, the kernel module sources can also be kept and compiled separately from the whole Linux source tree
- Modified by NXP to:
  - Add support for booting on supported NXP devices
  - Support the various RDB H/W interfaces (Ethernet, SPI, PCIe, SATA, Flash memory, UART, GPIOs…), and external devices (e.g. L2 switch, WiFi, SLICs)
  - Improve performance in certain areas (mostly network processing)
- Kernel version 3.19.3 currently used in latest LS1043A ASK

Preparing the Development Environment

- Run "`make menuconfig`" to check pre-requisites on your machine
  - Install missing packages e.g. `sudo apt-get install <package_name>`
  - git, automake 1.11.1, autoconf 2.65, auto-tools-dev 20050803.1, cpp, cvs, ctags, flex , g++, gcc, kernel 3.2.x, libtool 2.2.6b, libncurses5-dev, libncurses5, make 3.81, uuencode, zlib1g, zlib1g-dev, subversion , gawk, perl & python, lzop
- Approximate required disk space for compiling the OpenWrt stable source is 8 GB

- Build the system without super user privileges:
  - Running as "root" user not recommended to compile and install the software

- Suggested to use Ubuntu 12.04 or later versions for development environment
  - There is no limitation, other Linux distro's can be used
  - Ubuntu14.04 LTS is fine

Directory Tree Overview

- On the Ubuntu system, as non-root, uncompress the code release files

```
$ tar xfj dl-openwrt-ls1043a_0.7-rc1.tar.bz2
$ tar xfj src-openwrt-ls1043a_0.7-rc1.tar.bz2
```

  - This creates and populates two directories: `dl` and `src-openwrt-ls1043a_0.7-rc1`
- Make a symbolic link from the src build directory (aka <buildroot>) to the dl directory

```
$ cd src-openwrt-ls1043a_0.7-rc1
$ ln –s ../dl .
```

  - If you see downloads happening during make of the default config, check the link is there

- Three main directories are created as the src tarball is uncompressed
  - `toolchain`
    - Contains the Makefiles and associated files for all software related to the cross-compilation tool chain
  - `target`
    - Contains the items for a specific embedded platform, e.g. kernel patches
  - `package`
    - Contains all the Makefiles and scripts for the packages available within the distribution.

- Note
  - Both the target and package steps use `build_dir` as a temporary directory for compiling
  - Anything downloaded by the toolchain, target, or package steps will be placed in the "dl" directory

Directory Tree Overview

- `toolchain`
  - At build time, the following two new directories are created
    - `toolchain` which is a temporary directory used for building the tool chain for a specific architecture
    - `staging_dir` where the resulting toolchain **“binaries”** are installed
  - There is no need to do anything with the `toolchain` directory unless a new version of one of these components is added
- `target`
  - `target/linux/<device_name>` is platform-specific and contains the kernel .config file and kernel patches for the device being used
  - `target/linux/imagebuilder` describes how to package a firmware for a specific platform
- `package`
  - Most of the firmware is packaged as .ipk modules (e.g. applications, drivers, libraries) which can be installed on a running system – more on this later !
  - This can provide new features or remove features to save space

Directory Tree Overview

- `bin`: contains the final binary images created during the build process
- `build_dir`: non toolchain source code and compiled images
- `configs`: configuration files for reference and development boards
- `dl`: all of the OpenWrt source code packages
- `docs`: OpenWrt documentation
- `include`: Default core makefiles (*.mk) for OpenWrt (e.g. kernel, packages, filesystem)
- `packages`: OpenWrt and NXP generated makefiles and source code patches
- `scripts`: scripts supporting the build makefiles
- `staging_dir`: compiled toolchain, including library includes, used to compile the rest of the distribution
- `tools`: necessary tools to build the image

USING THE ASK TO MAKE RDB BINARIES

Openwrt Configuration File

- In the NXP ASK OpenWrt distribution, there are pre-configured `.config` files for the development and reference platforms
- These files contain the hardware and software configuration parameters to operate the board
- Developers may use these configuration files as a template in order to generate the OpenWrt image
- Current platforms supported
  - LS1043A RDB: `config-ls1043a-rdb, config-ls1043a-qds` (NXP internal hardware)

- Pick the appropriate config file for your board, and copy into buildroot as `.config`:

```
$ cd src-openwrt-openwrt_ls1043a_0.7-rc1
$ cp configs/config-ls1043a-rdb .config
```

Customizing Openwrt Options with `make menuconfig`

- Menuconfig is a menu-driven configuration tool (using ncurses) to select all features
- The developer can select the targeted platform, which versions of the toolchain to use, and what packages to install into the firmware image
  - Toolchain (e)glibc 2.19 is supported by default
- Similar to the Linux kernel configuration
- Menu options for configuring an OpenWrt build
  - Long list of features, sorted into different sections
  - Selecting items from the menu by pressing the y, m, or n keys
    - **<y> - will be compiled and included in the firmware image**
    - **<m> - will be compiled but not included in the image, may be used for a later, runtime install**
    - **<n> - will not be compiled or included**

- Running it:

```
$ cd sdk-openwrt-openwrt_ls1043a_0.7-rc1
$ make menuconfig
```

- Note that running `make menuconfig` first runs a pre-requisite check on your build machine.
  - You have to ensure this check passes before the build will continue
- When in Menuconfig, use '/' to search for a particular config item

- To generate the RDB binaries, don't change the config, but save on quitting Menuconfig

Building Everything

- Launch the build:

  ```
  $ make
  ```

- This will take a while; around 1 hour the first time, depending on build machine
- If some package sources are needed, they will be downloaded from the OpenWRT repository or the Internet, but all defaults are already in `dl`
  - If Internet access is through a proxy, set the 'http_proxy' environment variable
    - Package download is done with wget
- Locations of the resulting binaries for bootloader, kernel, rootfs, and packages:
  - `bin/ls1043a-glibc/`
- The file system tree generated by OpenWrt includes:
  - all packages marked as <*> in menuconfig
  - Linux kernel image
  - voip firmware where applicable (/`lib/firmware/voip.axf`)
  - Fast-path binaries where applicable

Some Specific Make Commands

- Select the number of compilation machine CPU cores to be used for make
  `$ make -j n`
- Verbose make output
  `$ make V=99`
- Recompile the kernel
  `$ make V=99 target/linux/{clean,compile}`
  `$ make V=99 target/linux/install`
- Compile a specific package (see later)
  `$ make V=99 <package_Makefile_location>/compile`
  `e.g. make V=99 package/openwrt/net/tcpdump`
- Clean up a specific package
  `$ make V=99 package/openwrt/net/tcpdump/clean`
- Clean up compilation
  `$ make clean`
  - Deletes contents of the directories /bin and /build_dir
  - Does not remove toolchain, nor does it clean architectures/targets other than those selected in .config
- Start again from scratch...use with care !
  `$ make distclean`
  - nukes everything you have compiled or configured and also deletes all downloaded feeds contents and package sources.
  - **CAUTION**: In addition to all else, this will erase build configuration (<buildroot_dir>/.config), toolchain, and all other sources.
  - Atfer using this, you’re back to the point where you’ve just uncompressed the supplied src and dl tarballs.

Build Procedure Summary

- Step 1
  - Decompress the ASK tarball files

```
$ tar xfj dl-openwrt-ls1043a_0.7-rc1.tar.bz2
$ tar xfj src-openwrt-ls1043a_0.7-rc1.tar.bz2
```

- Step 2
  - Create link to the dl directory

```
$ cd src-openwrt-ls1043a_0.7-rc1.tar.bz2
$ ln –s ../dl .
```

- Step 3
  - Copy and rename the configuration file at the top level

```
$ cp configs/config-ls1043ardb .config
```

- Step 4
  - Customize or inspect the build options

```
$ make menuconfig
```

- Step 5
  - Run the make command to build the code

```
$ make
```

ADDING AND INSTALLING A PACKAGE

Enable new feature via Menuconfig

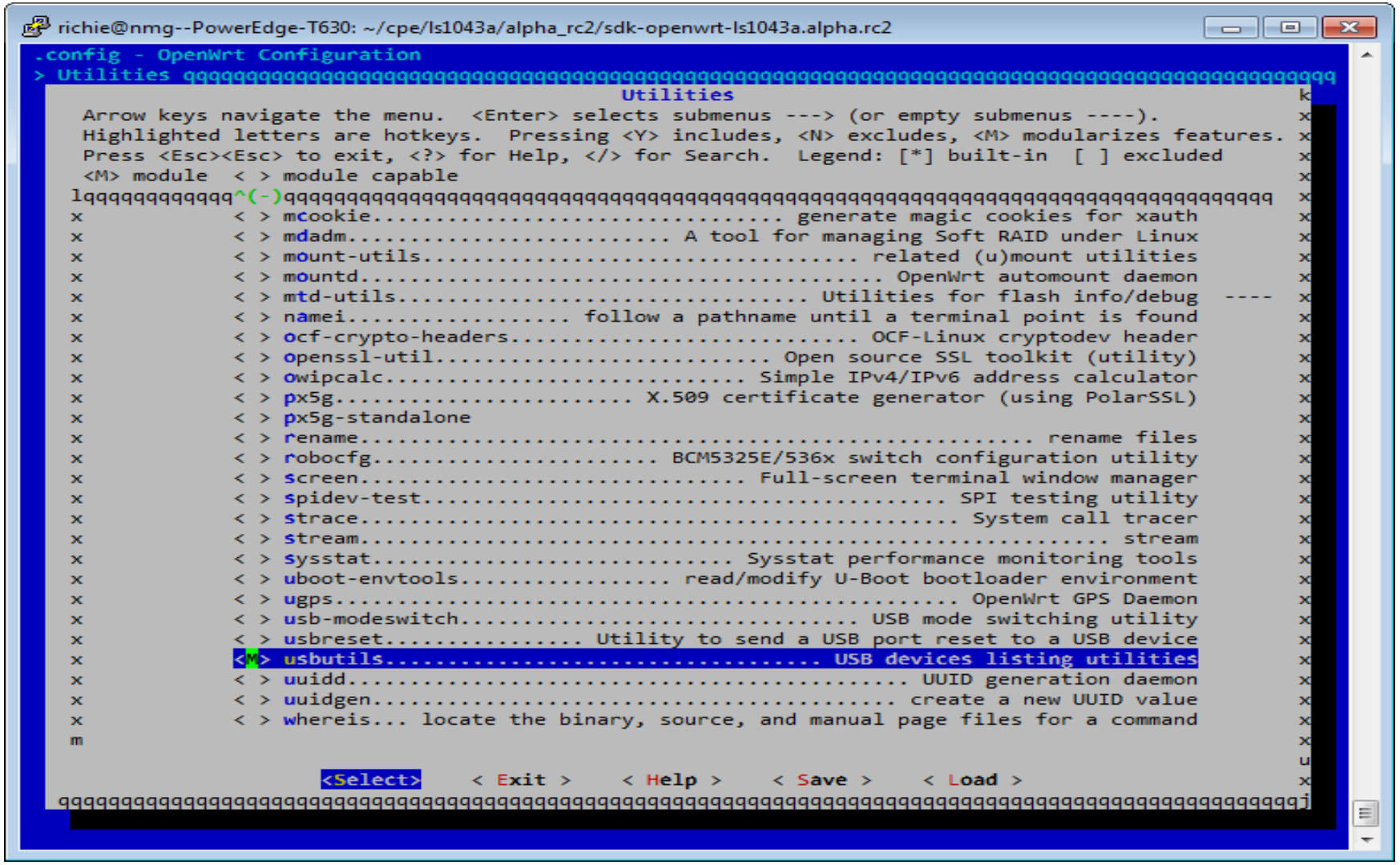
- Not all available items are enabled in a default ASK build
- Plenty of Menuconfig items can simply be enabled and built
- Make process downloads new package from online repo, confirms MD5 and builds it
- Example of USB-utils, which includes ‘lsusb’ command

```
$ make menuconfig
```

- Under ‘Utilities’ Menu, scroll down to ‘usbutils’, hit <spacebar> until ‘<M>’ is seen.
- Hit <ESC> and select <Yes> to save config.

```
$ make V=99 package/utils/usbutils/compile
```

Menuconfig showing usbutils selected



New package and any needed libs are built

- The resulting package and library installables are placed in .../bin/packages directory

```
richie@nmg--PowerEdge-T630:~/cpe/ls1043a/0.7/src-openwrt-ls1043a_0.7-rc1$ ls -lht bin/ls1043a-glibc/packages/base/
total 4.7M
-rw-r--r-- 1 richie richie 203K Apr  8 10:49 usbutils_007-1_ls1043a.ipk
-rw-r--r-- 1 richie richie  26K Apr  8 10:49 libusb-1.0_1.0.19-1_ls1043a.ipk
```

- Take the new .ipk's, transfer to board (e.g. scp, USB), and install

```
opkg --install <package_name>
```

- It will tell you if you need to install a pre-requisite package (e.g. libusb in this case) first

Example of USB-utils package Makefile

- The key item needed is the Makefile

usb_utils_ls1043_Makefile

Get Package from OpenWRT Packages Repository

- https://downloads.openwrt.org/sources/
  - Shows packages already available for OpenWRT
  - Only Makefile, ‘files’ directory, and ‘patches’ directory & contents needed

openwrt_transmission_Makefile

```
$ make V=99 packages/<new_package>/compile
```

- .ipk(s) are placed under .../bin

- Example of ‘transmission’ bittorrent client
  - https://github.com/openwrt/packages/tree/master/net/transmission
  - Put these in .../packages/openwrt/network directory

- Easiest, create a local clone of the openwrt git repos:

```
$ git clone git://git.openwrt.org/12.09/openwrt.git
$ git clone git://git.openwrt.org/12.09/packages.git
```

  - and copy transmission package files from here into buildroot

Use Existing Makefile as Template

- If there isn’t an existing OpenWRT Makefile, use an existing one from .../packages/ as a template.
- Don’t forget to enable it in menuconfig
- To make things easier, download the source tarball into .../dl first, and check the MD5 manually

ADAPTING THE ASK FOR YOUR HARDWARE

Device Tree

- LS1043A ASK OpenWRT is based on source code from the LS1043A yocto-SDK
  - Does not use Yocto distribution
  - Modify for specific hardware per Yocto documentation
    - Primarily making sure the kernel device tree matches the hardware

Board File (LS1024A Example)

```
/* ------------------------------------------------------------------
 *  NOR device
 * ------------------------------------------------------------------ */
#if defined(CONFIG_MTD_COMCERTO_NOR)

static struct resource comcerto_nor_resources[] = {
        {
                .start  = NORFLASH_MEMORY_PHY1,
                .end    = NORFLASH_MEMORY_PHY1 + SZ_64M - 1,
                .flags  = IORESOURCE_MEM,
        },
};
```

- Modify board file to match desired hardware config

ASK DOCUMENTATION

ASK Documentation

- Software Documentation
  - Programmer's Guide
  - Architecture Manual
  - VAPI User Guide (html)
  - MSP API
  - Debug Guide

- OpenWRT has a great Wiki...

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