ELC 2014

Making a Splash: Digital Signage Powered by the MinnowBoard MAX and the Yocto Project

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Agenda

- Digital Signage
- MinnowBoard MAX
- Yocto Project

Digital Signage

Background and Motivation

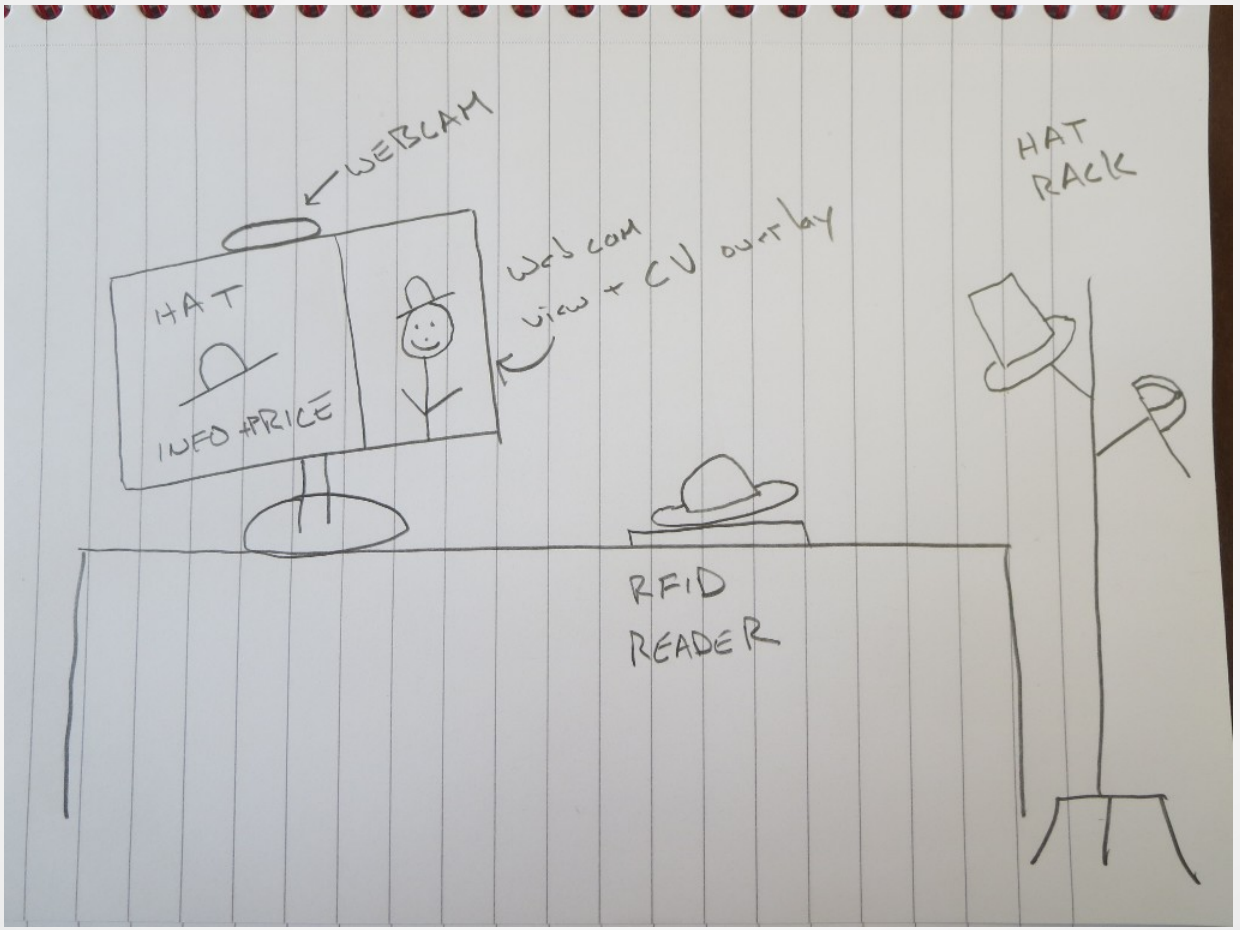
- Digital signs help us satisfy our need for information in our modern, data-driven lives
- Digital signs are moving into retail businesses, and can offer **interactivity** to create improved engagement with customers
- Digital signs have evolved beyond basic grids of information and now often include advanced user interface design

Why Use Web-Based Technologies?

Advantages:

- Users can quickly adapt to to web-based interface styles
- Clean separation of back-end data architecture and UI design
- Large pool of talented web application engineers
- Web toolkits including JavaScript animation libraries are mature and have been optimized for performance

“Heads-up” Demo Concept



Embedded Board Selection

Some factors to consider when considering browser-based embedded platforms for digital signage:

- Strong CPU and graphics performance to run DHTML animations
- Boot disk options
- Level of custom integration required
- Tradeoff between hardware capabilities and engineering cost / time to market

Meet MinnowBoard MAX

OHAI!

Embedded Board Selection

- Strong CPU and graphics performance
- Offers x86 PC standards, multi-core options, and Gigabit Ethernet
- Media flexiblity: can boot from microSD card, SATA disk, mSATA SSD, USB 3.0
- Save engineering/developer time with ability to run demanding applications (e.g, OpenCV using high level languages)
- Open Hardware design can be adapted or integrated into custom solutions

minnowboard.org

MinnowBoard MAX Specs

- $99: Bay Trail E3815 1.46 GHz (single-core, 64-bit, VT-x), 1 GB RAM
- $129: Bay Trail E3825 1.33 GHz (dual-core, 64-bit, VT-x), 2 GB RAM
- DDR3 RAM
- Intel HD Graphics (w/ open source Linux drivers)
- Micro-HDMI w/ HDMI audio
- 10/100/1000 Ethernet
- SATA2 3.0 Gbps, microSD via SDIO
- USB Host Ports: 1x USB 3.0, 1x USB 2.0
- 8 GPIO (2 support PWM), I2C, SPI, I2S Audio, 2 UARTS
- High-speed expansion connector w/ PCIe 1x, SATA2, USB 2.0 x1, JTAG

Yocto Project Introduction

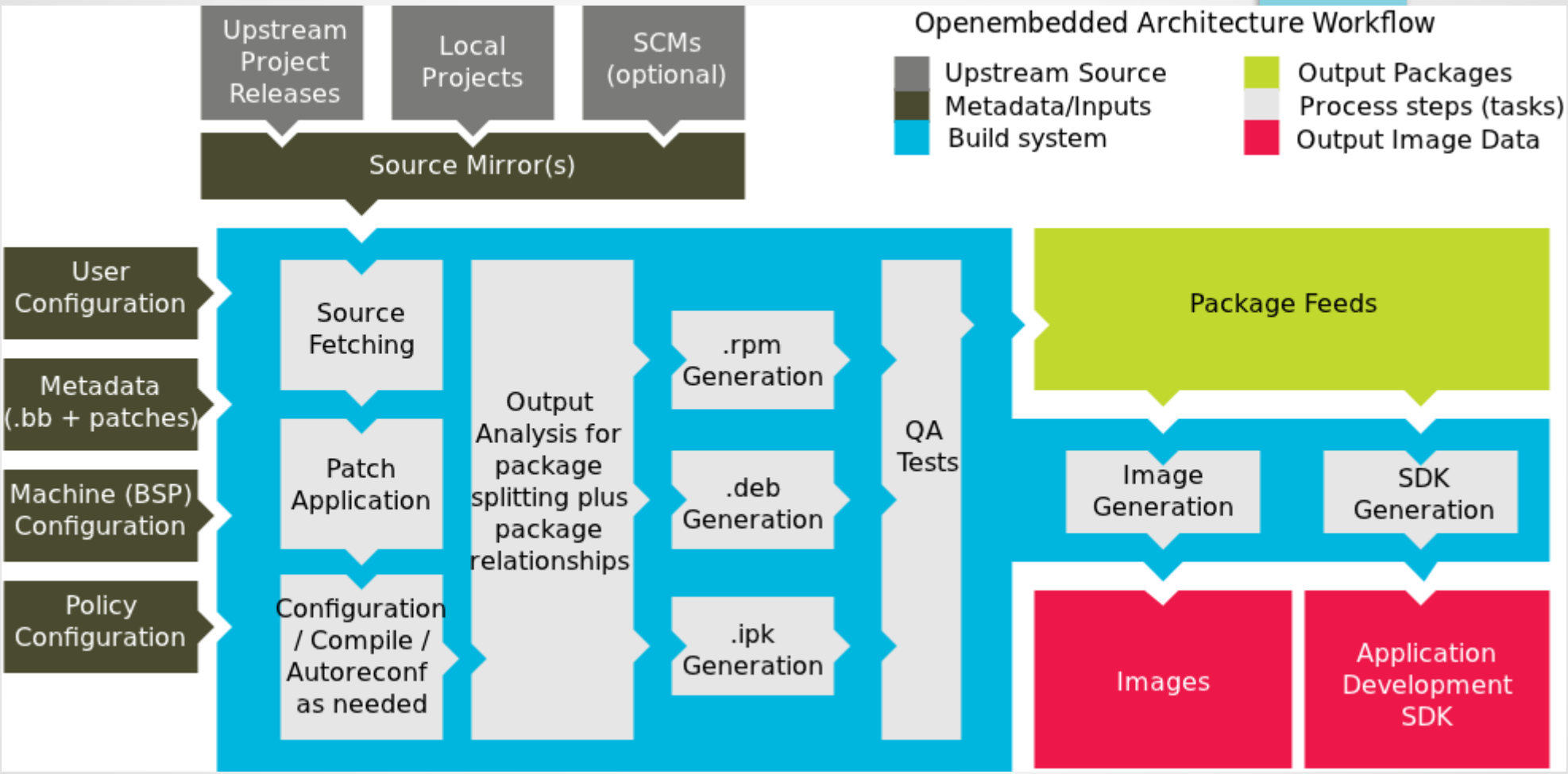
- Flexible framework for developing Linux-based embedded OSes
- Centered around the OpenEmbedded build system – uses BitBake and recipe metadata
- Offers a powerful layer-based architecture to easily configure software stacks and swap BSPs
- Allows you to define your own Linux distribution and make policy decisions on how your embedded OS will function
- Supports all major architectures – ARM, x86(-64), MIPS, PPC

Yocto Project Build System Overview

OpenEmbedded = BitBake + metadata

- **OpenEmbedded** – build system used by the Yocto Project
- **BitBake** – a task executor and scheduler
- **Metadata** – task definitions
  - **Configuration (*.conf)** – global definitions of variables
  - **Classes (*.bbclass)** – encapsulation and inheritance of build logic, packaging, etc.
  - **Recipes (*.bb)** – the logical units of software/images to build

Build System Workflow



Example Recipe – ethtool_2.6.36.bb

SUMMARY = "Display or change ethernet card settings"

DESCRIPTION = "A small utility for examining and tuning the settings of your ethernet-based network interfaces."

HOMEPAGE = "http://sourceforge.net/projects/gkernel/"

LICENSE = "GPLv2+"

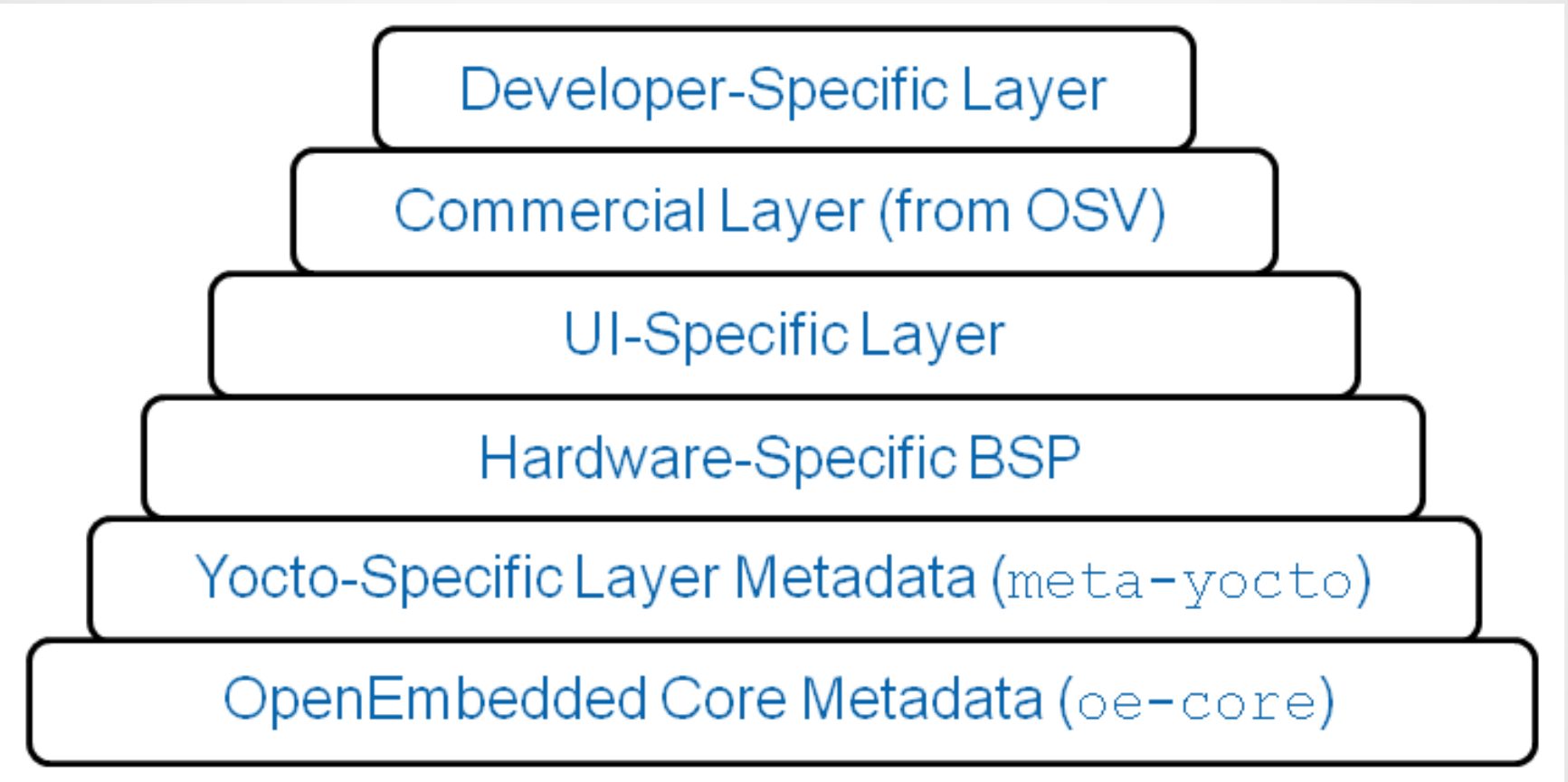
SRC_URI = "${SOURCEFORGE_MIRROR}/gkernel/ethtool-${PV}.tar.gz"

inherit autotools

Standard Recipe Build Steps

- Building recipes involves executing the following functions, which can be overridden when needed for customizations
  - **do_fetch**
  - **do_unpack**
  - **do_patch**
  - **do_configure**
  - **do_compile**
  - **do_install**
  - **do_package**

OpenEmbedded Layers



The meta-web-kiosk Layer

Includes an image recipe *core-image-web-kiosk.bb* which:

- Boots up to Xorg
- Starts the Midori web browser in fullscreen mode
- Goes to a configured URL

To discover more layers and recipes you can use with the Yocto Project, take a look at the OpenEmbedded metadata index:

http://layers.openembedded.org

The Heads-Up Demo Custom Layer

Includes heads-up-demo-image.bb which contains:

- RFID support
- WebCam support
- open cv support
- x264 & webm codecs support

Designing for Security

- Digital signs that display remotely-hosted data should be hardened against potential attacks
- Use cryptographic network protocols – HTTPS, TLS, SSH – certificate validation is your friend
- Custom handshake protocols can raise the bar but amount to “security through obscurity”
- Ensure there is sensible degredation behavior if the security tests fail or the content server is not available

Try to Avoid This...

Summary

- Digital Signage Solution
  - Web based, Interactive, Media rich
- MinnowBoard MAX
  - Meets the heavy computing demand
  - Improves time to market by using readily available s/w
  - Open Hardware Design
- Yocto Project
  - Create your own Embedded Linux solution
  - Optimal reuse because of the Layered architecture

Resources

- Yocto Project Home: http://yoctoproject.org
- Yocto Project New Developer Tutorial Screencast: http://vimeo.com/36450321
- Web-kiosk Layer for OpenEmbedded: http://layers.openembedded.org/layerindex/branch/master/layer/meta-web-kiosk/
- MinnowBoard MAX Announcement: http://www.minnowboard.org/meet-minnowboard-max/
- Meta-heads-up demo layer: http://git.yoctoproject.org/cgit/cgit.cgi/poky-contrib

Thank you !

Questions?