Timesys University

Learn Embedded Linux by Building a Vending Machine Device

ARROW ELECTRONICS, INC.

LOGIC PD™

TEXAS INSTRUMENTS

timesys®

Timesys Staff

- **Answering your questions today are:**

Al Feczko
Technical Pre-Sales/Sales
al.feczko@timesys.com
412 325 6390

Maciej Halasz
Product Management
maciej.halasz@timesys.com
412 325 6313

Theresa Kisha
Marketing Communications
theresa.kisha@timesys.com
412 325 6362

We Are Building a …

A clue

We Are Building a …
Coffee Vending Machine!

Building a Coffee Vending Machine with LinuxLink — Agenda

- **Module 1**
  How to assemble and deploy an initial BSP and setup development environment with the matching SDK
- **Module 2**
  How to build a modern User Interface for a Vending Machine using Qt Embedded for Linux
- **Module 3**
  How to enhance your Vending Machine application to control external devices via GPIO lines
- **Module 4**
  How to optimize, test and integrate the solution for fast boot and quick deployment

Module 1

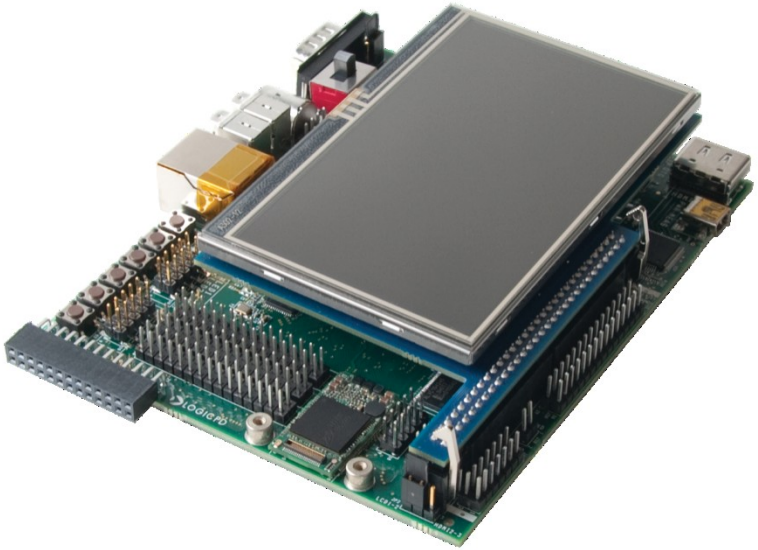
- **Your Development Environment**
- **Embedded Linux Primer**
- **Where do I start my Linux design — Product Requirements**
- **Assemble a custom BSP using the LinuxLink Web Edition**
  - Reflect product requirements
  - Produce complete Linux design
  - Learn how to find information
- **Application/System Development environment setup with an SDK**
- **Deploy the images on the LogicPD DM3730 Torpedo SOM**

Your Development Environment:

Session Hardware/Software Requirements

What We Need to Build Our Product

- **A Host Machine**
  - Linux is the best – any recent version is ok
  - Windows is fine, but you'll need a VirtualBox with a Linux installation
- **Cross-development environment**
- **Linux source code for the product**
  - Bootloader
  - Linux kernel
  - APIs
- **Various Linux utilities e.g. mkimage**
- **IDE with WYSIWYG for faster development**
- **A Development Kit**



Your Workstation Setup

Ethernet/Serial

USB

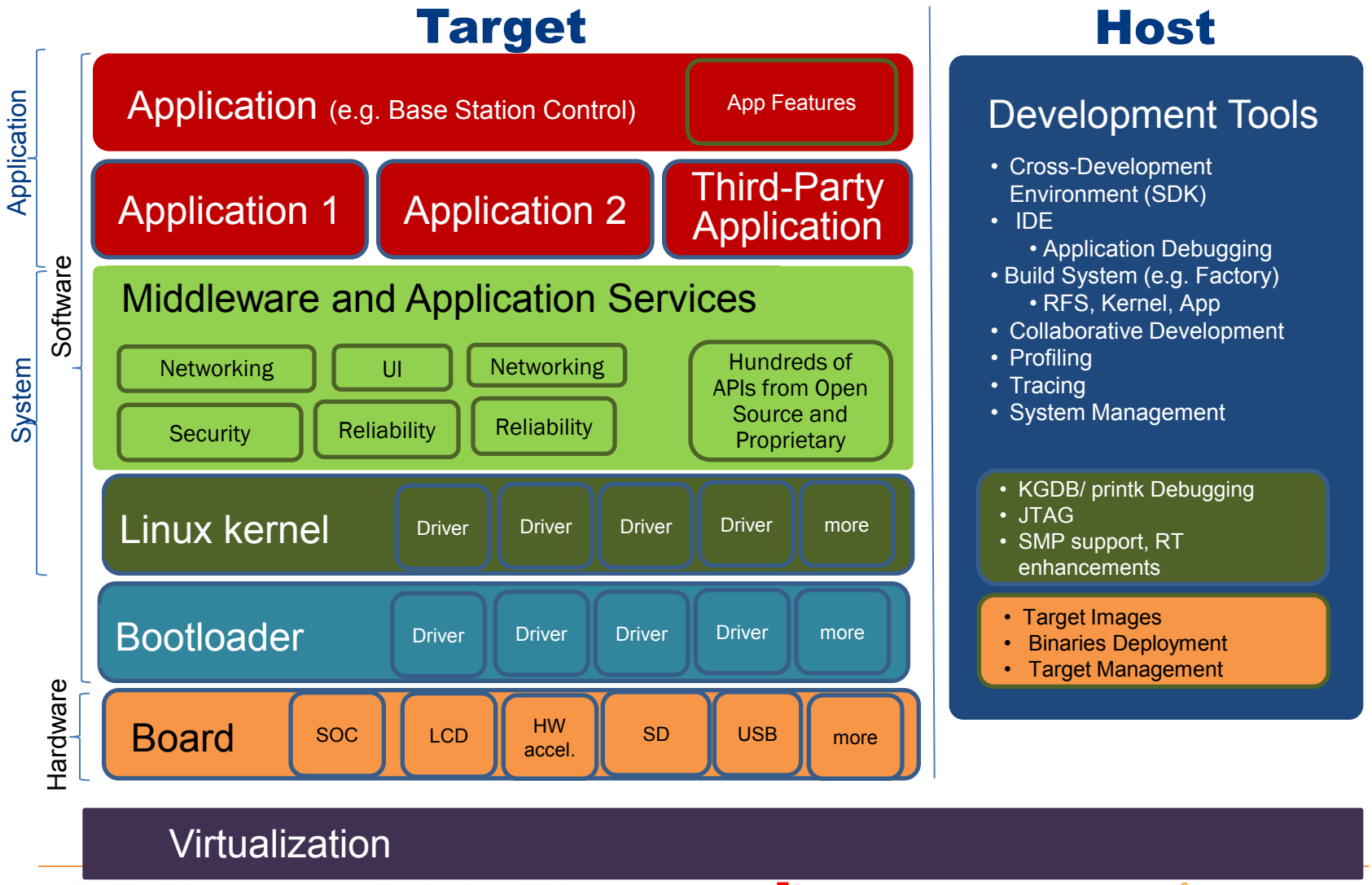
- **Development Environment**
  - Cross tools
  - IDE
- **Exercises**

Having Fun Yet?

- Question bucket
- Rules: For every correct answer you can draw a price from our surprise bucket
- First person who completes each individual exercise gets a prize

Embedded Linux Primer

Embedded Linux Reference Model

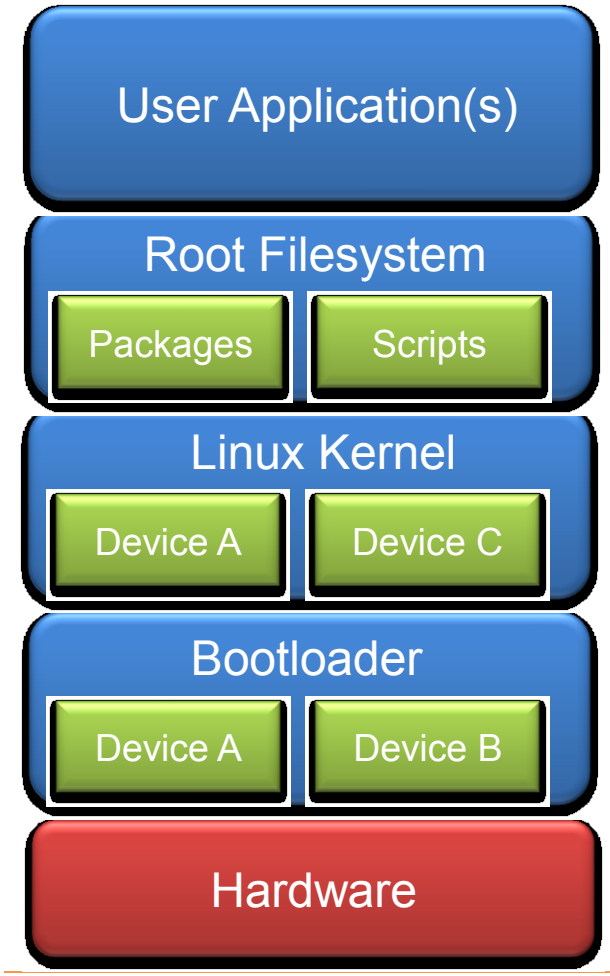


Embedded Linux Challenges

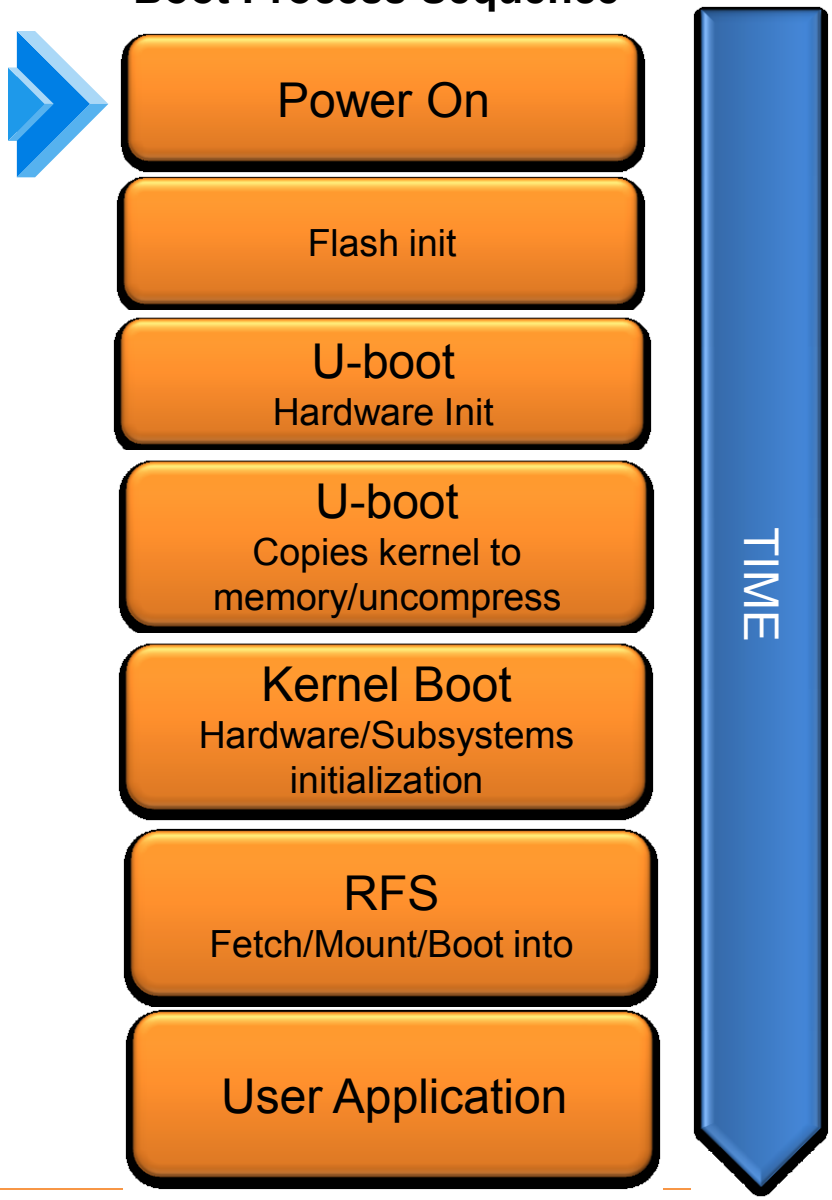
- **Assembling a Linux platform can be very complex**
  - The code is “free,” but…
  - Achieving a consistent and repeatable build can be challenging
- **Difficult to keep pace**
  - More than 40,000 independent sources on the Web
  - Maintained by thousands of developers
- **Difficult to pick the right combinations**
  - Hidden dependencies, abandoned projects
  - Numerous revision conflicts
- **Difficult to find tools that work**
  - Many open source tools are available
  - Difficult to assemble the associated patches and libraries
- **Limited-to-no support**

Boot Process in Brief

Typical Linux System Structure



Boot Process Sequence



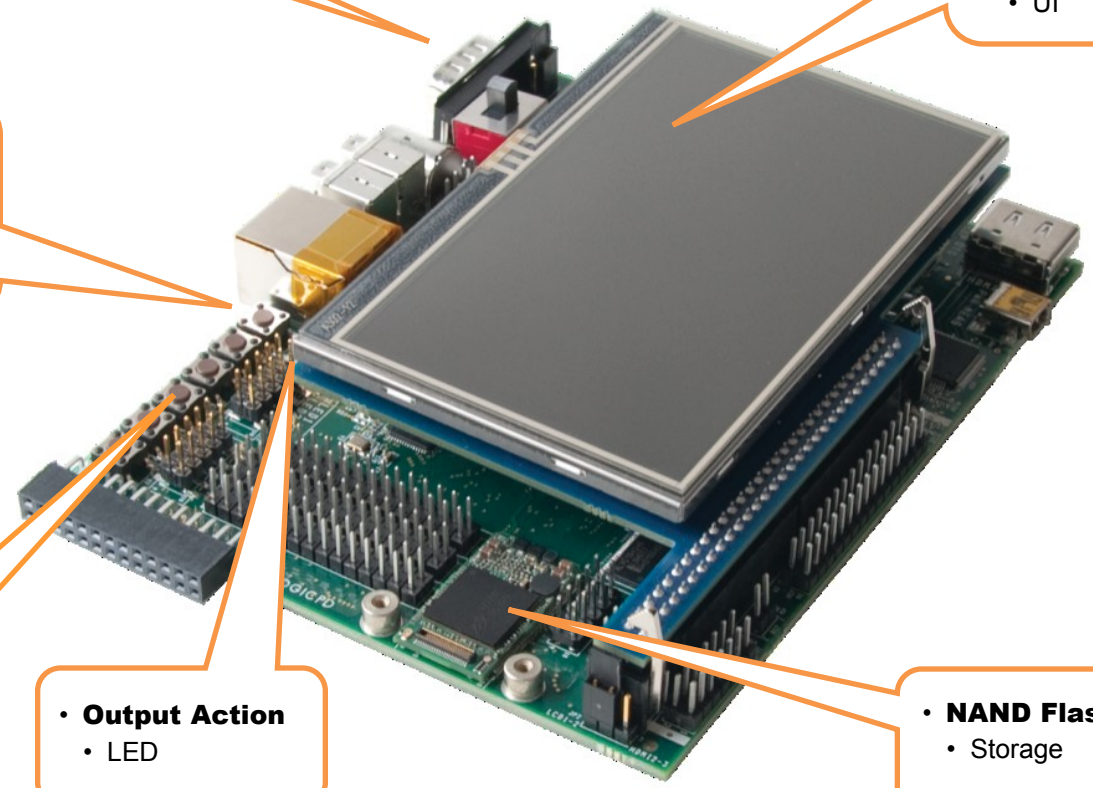
Product Requirements — Where Do I Start My Linux Development?

Requirements – First Glance

Coffee Vending Machine Features:

- **GUI with the following features:**
  - Coffee selection screen
  - Purchase screen
  - Coffee brewing screen
- **Interaction with external devices via GPIO**
  - Coffee Dispensing — Onboard connected LED
- **Multithreaded implementation (optional)**
- **Early user communication (splash screen)**
- **Boot fast from external SD card**

Project Requirements (LogicPD DM3730)



- **Serial port communication**

- **SD Card**
  - Filesystem
  - Boot

- **Graphics**
- **Touchscreen**
- **Applications**
  - Calibration
  - UI

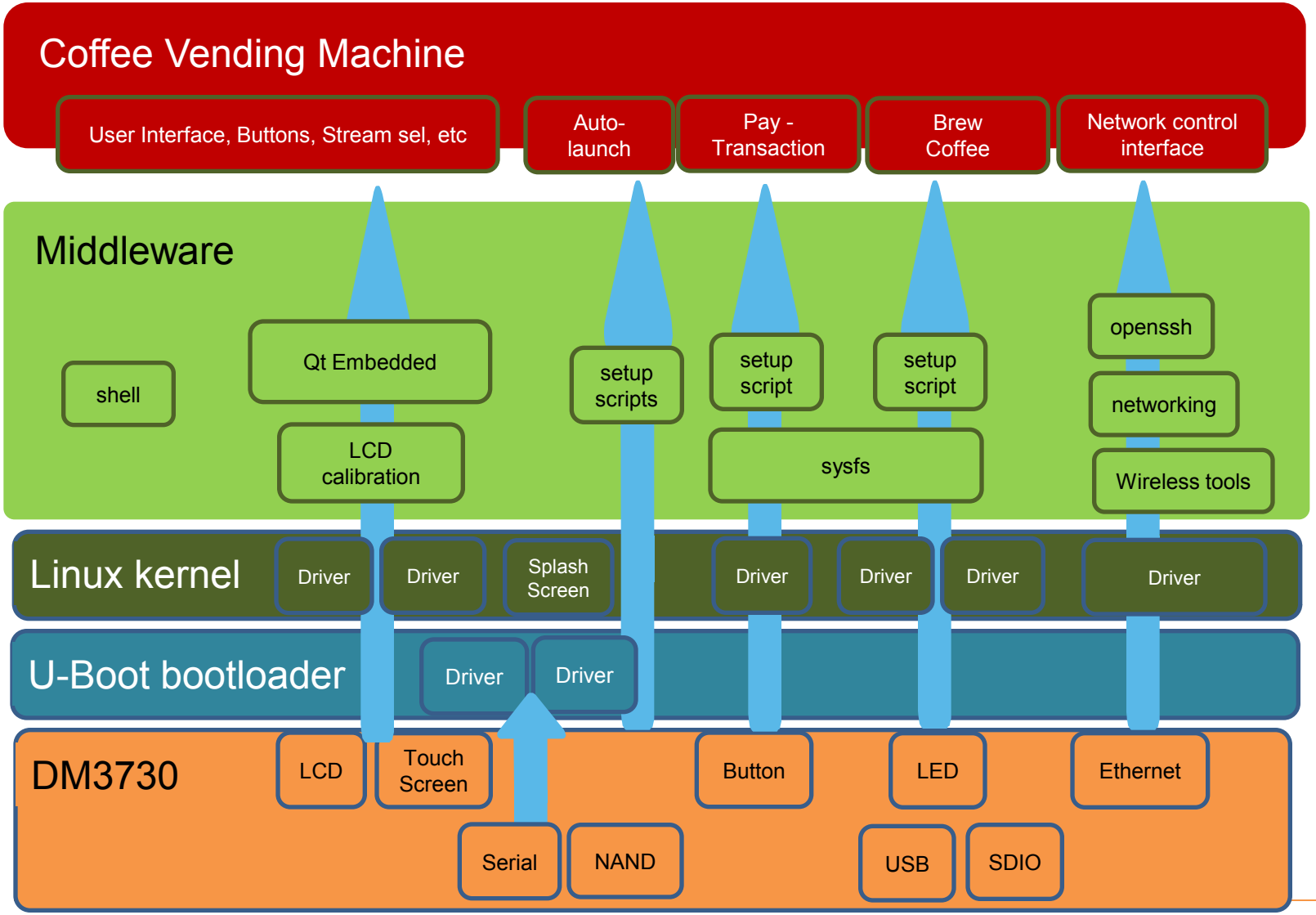
- **EEthernet**
  - Secure Connection
  - Transfer (FTP/SCP)
  - Console (Telnet/SSH)

- **Input Action**
  - Button

- **Output Action**
  - LED

- **NAND Flash**
  - Storage

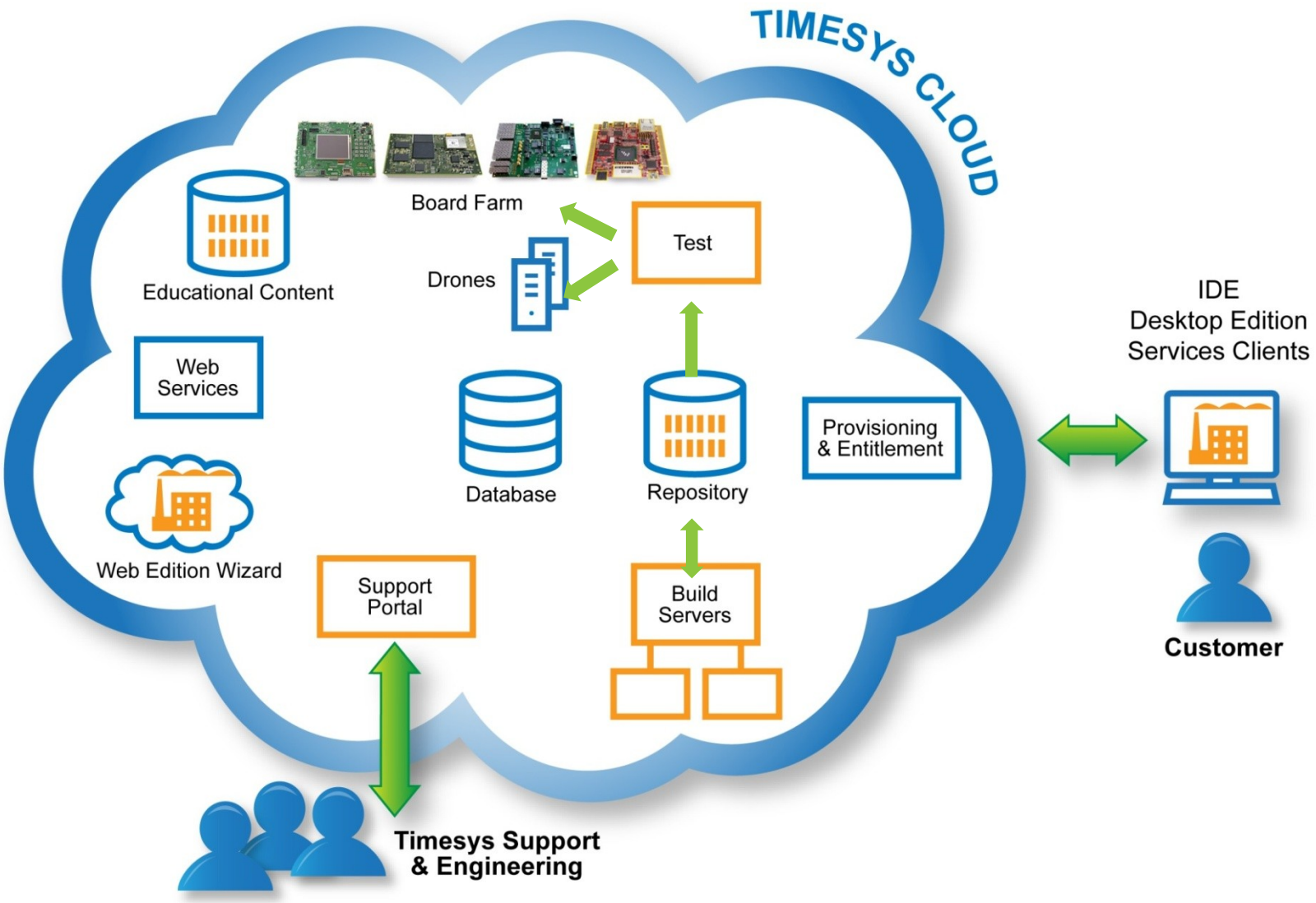
Coffee Vending Machine (Blueprint)



Exercise 1:

Assemble a Custom BSP Using the LinuxLink Web Edition

LinuxLink Architecture



Exercise Details

- **Identify the initial set of requirements:**
  - All needed software to simply boot a reference board
  - Build a BSP for development
- **Build a custom BSP and a matching SDK**
  - Use LinuxLink Web Interface
- **Starting with a small Linux design and building it up per your requirements provides you with a small embedded design with only the features you need.**

Account Login info

- **We have accounts setup specifically for Timesys University**
  - https://linuxlink.timesys.com
  - Login with the following credentials:

    U: labuserX where X is 1-20

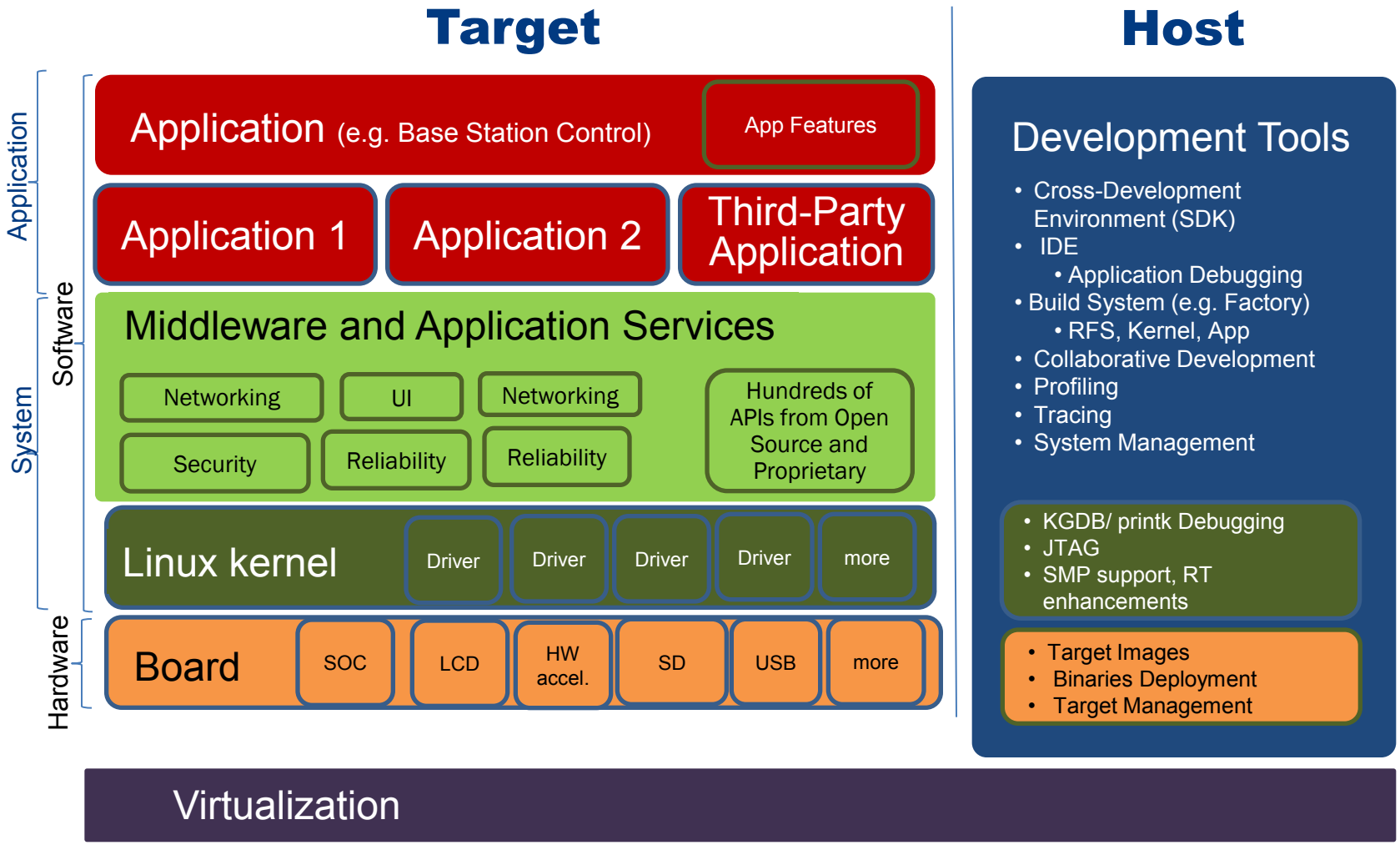
    P: lab123
- **You can register for a free personal account**
  - http://www.timesys.com/register

Requirements Helper

Feature	What I need	Where to select
Linux kernel	Latest, 2.6.3x kernel	Linux kernel
Cross-Toolchain	GCC, Binutils, GDB	Toolchains
C Library	glibc	Toolchains
Networking	dropbear	Packages
System initialization	busybox	Packages

Application/System Development Environment Setup with an SDK

Embedded Linux Reference Model



Embedded Linux Reference Model

Host

Development Tools

- Cross-Development Environment (SDK)
- IDE
  - Application Debugging
- Build System (e.g. Factory)
  - RFS, Kernel, App
- Collaborative Development
- Profiling
- Tracing
- System Management

- KGDB/ printk Debugging
- JTAG
- SMP support, RT enhancements

- Target Images
- Binaries Deployment
- Target Management

Development Environment Setup

Can find instructions for how to setup the board

Build Output

To learn how to boot your target board with the build output, read this doc.

Filename	Size (kb)	Description
uImage-2.6.32-ts-armv5l (md5)	2108	Kernel Image
rootfs.tar.gz (md5)	2536	Root Filesystem
	DIR	Bootloader
	DIR	Individual Software Packages
	DIR	Individual Software Sources
timesys-development-environment.sh (md5)	143312	SDK Installer, contains kernel, RFS, and toolchain
	56396	Toolchain Archive
factory.tar.gz (md5)	3476	Factory Build System
BUILD-SUMMARY.txt	4	Build Summary

Runtime images Can be used to run Linux on the target

Software Development Kit (SDK)

- Install on your host PC

Desktop Factory tools

- Install on your host PC

The SDK will setup your complete Linux cross-development environment including:

- Compiler
- APIs header files and libraries

Exercise 2:

Setup Your Application Development Environment

Exercise Details

- **Setup your own development environment**
  - Cross-toolchain
  - IDE
  - Libraries and header files
- **The goal**
  - Easily develop your value add software

Exercise Details

- **Install an SDK from a build output**
- **For your convenience the SDK has been downloaded for you**
  - /media/<USB key number>/TSU-LAB/exercise_2
- **Install it with the command:**
  - sh <SDK name.sh>
- **Look at a directory structure**
- **Verify toolchain with command:**
  - <fully qualified path to toolchain's gcc> -###

The installed version is also available under: [TSU-LAB]/SDK

Exercise 3:

Deploying Linux Using NFS

Exercise Details

- **Run the custom BSP on the target**
  - U-Boot bootloader
  - Linux kernel
  - Network mounted RFS
- **The goal**
  - Easily modify all aspects of your RFS
  - Easily deploy and test your application

Exercise Details

Services already preset for you

- NFS server
- DHCP server (local subnet)
- TFTP server (/tftpboot)
- Timesys offers getting started guides to walk you through the process

Load U-boot

```
losh> ifconfig sm0 dhcp                //get an ip address from your dhcp server
losh> load elf /tftp/10.0.0.1:u-boot   //load u-boot image using tftp
losh> exec -                           //run u-boot
```

Setup U-Boot environment to load/run a Linux kernel

```
> setenv bootfile uImage               //image to load
> setenv ipaddr 10.0.0.10              //your local IP
> setenv  serverip 10.0.0.1            //server IP
> saveenv                              //store variables in NAND
> Setenv rootpath <rfs full path>      //specify path to nfs exported rfs
> run nfs boot                         //boot the image using pre-set command
```

Module 1 — Summary

- **Learned about the DM3730 LinuxLink – needed for all exercises**
- **Reflected initial product requirements in Linux BSP and SDK**
- **Built a custom BSP with LinuxLink Web Edition**
  - Experiment with a pre-built starting point
- **Setup a development environment**
  - System level development and optimizations
  - Development of a value-add software (applications)
- **Deployed the system on the target via NFS for future development**
  - Transferred images
  - Configured bootloader

Module 1 — Quiz

1. With LinuxLink, what do you need to know before you start your initial design?
2. Are you locked into a kernel version when using LinuxLink?
3. What are the benefits of using LinuxLink? (name at least 1)
4. How soon can you start your application development?

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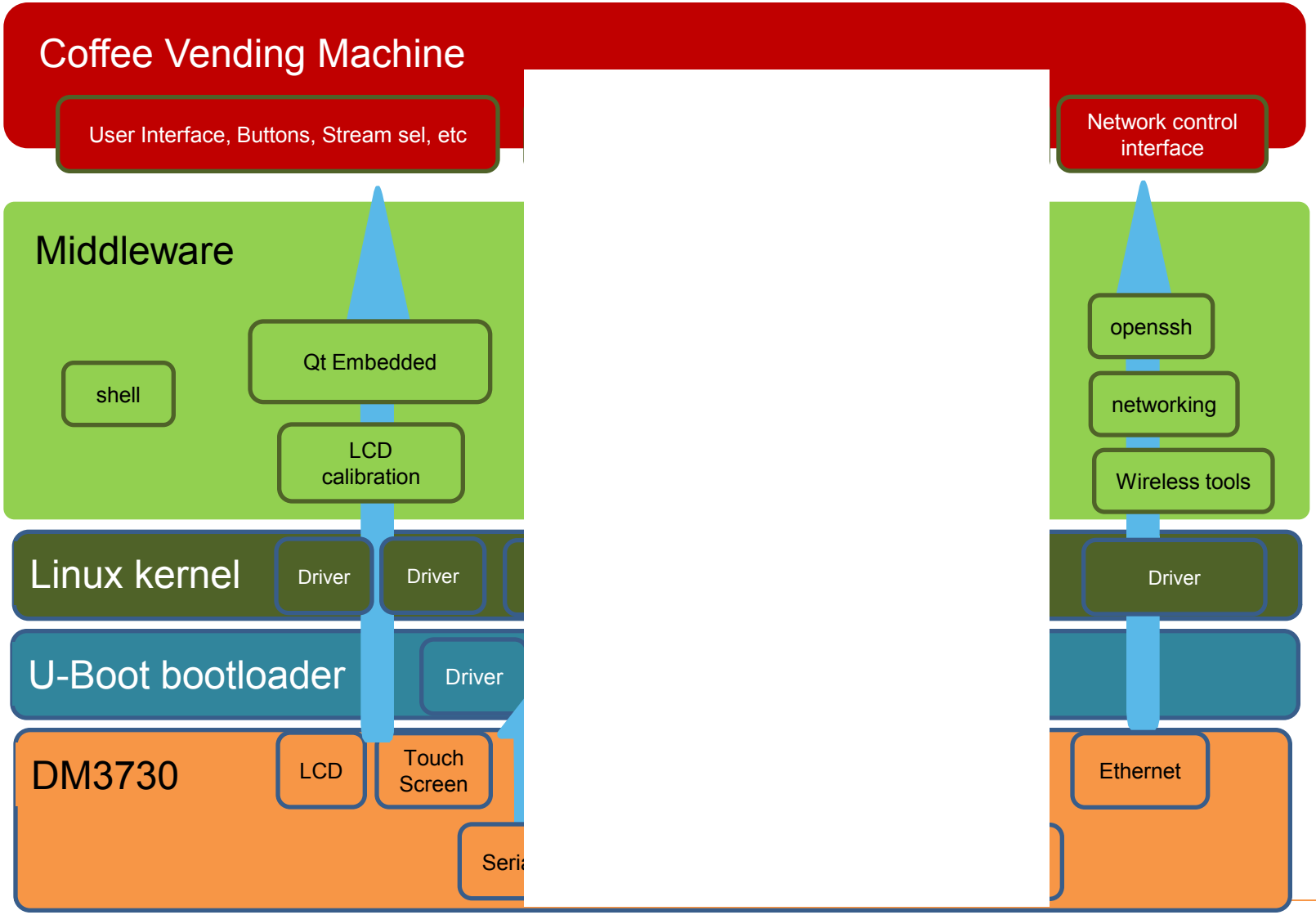
Module 2

- **Modify the underlying Linux image to support Qt**
- **Qt development tools installation/setup**
- **Coffee Vending Machine – GUI development**
  - Create a QMainWindow application
  - Use a number of Qt widgets including
    - QPushButton
    - QLabel
    - Layouts and more
  - Add a custom widget for the clock
  - Create a resource file
  - Test your application locally
  - Cross-compile for the DM3730 target

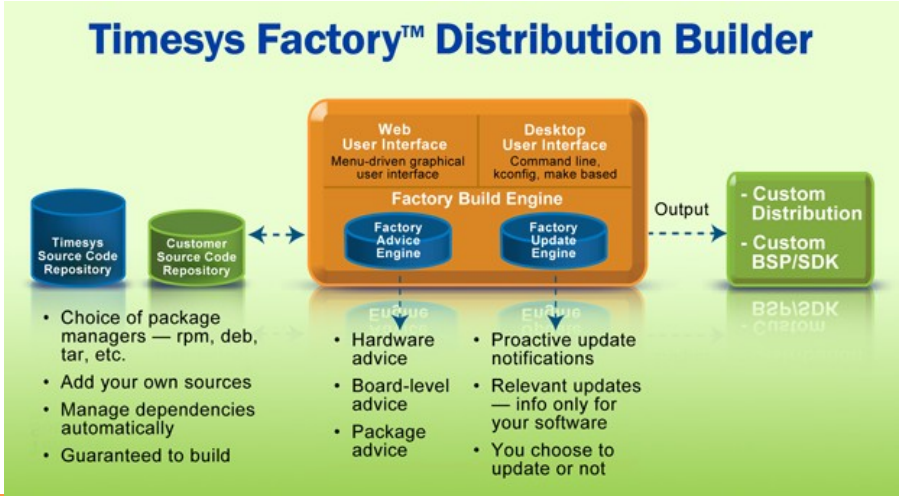
Coffee Vending Machine (Blueprint)



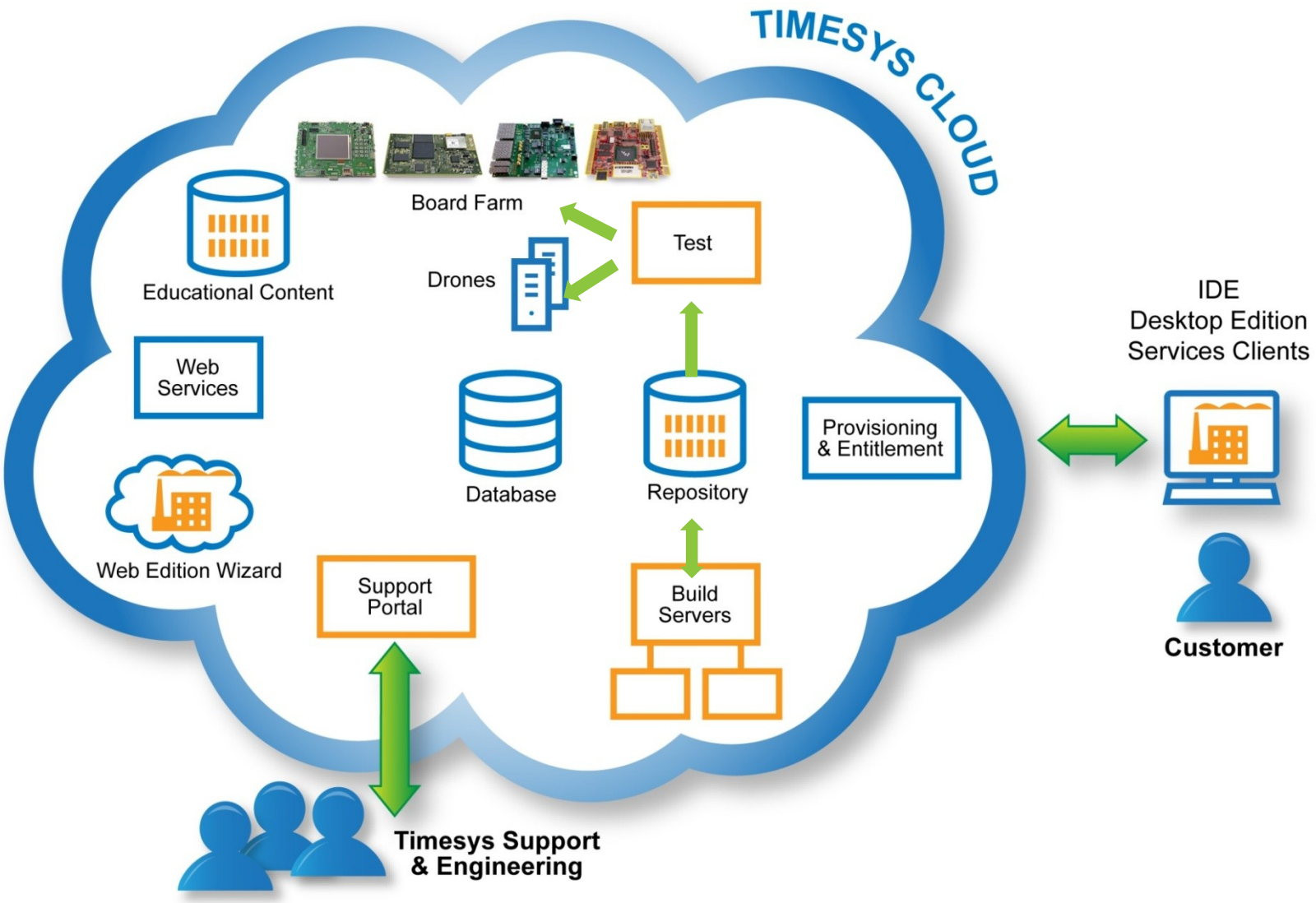
Adding APIs/Libraries Using the LinuxLink Desktop Interface

LinuxLink Value Proposition

- **Advanced Customization (all aspects of your Linux platform)**
- **'Factory' – Only easy to use, innovative Build System with:**
  - **Advice engine** — recommends software based on your hardware and application requirements
  - **Update engine** — automatic updates for your custom configuration
- **'Build up' vs. strip down to small distribution**
- **Affordable – costs ~40% less**
- **Build Repeatability Easy Extensibility**



LinuxLink Architecture



Exercise 4:

Enhance Your Design Locally By Adding Required Packages

Exercise Details

- **Find Desktop Factory under:**
  - /home/labuser/LAB/factory
- **Look at the help screen by running make help**
- **Bring up a configuration screen**
  - make menuconfig
- **Familiarize yourself with Desktop Factory data organization**
- **Locate and select two missing packages**

Click the TSU-LAB icon on the desktop

Requirements Helper

Feature	What I need	Where to select
Linux kernel	Latest, 2.6.3x kernel	Linux kernel
Cross-Toolchain	GCC, Binutils, GDB	Toolchains
C Library	glibc	Toolchains
Touch screen	tslib	Packages
Qt	qt-embedded-linux	Packages
Networking	dropbear	Packages
System initialization	busybox	Packages

Qt Development Tools Installation/Setup

Qt Development Tools

Options

- TimeStorm with Qt https://linuxlink.timesys.com
- Qt Creator http://www.qt.nokia.com

Installation

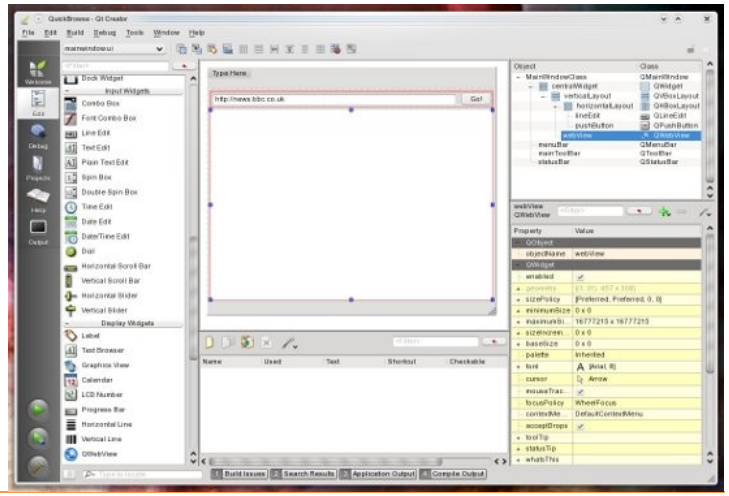
- Downloaded from your LinuxLink account
- Uncompressed with

```
tar xzvf timestorm.tar.gz
```

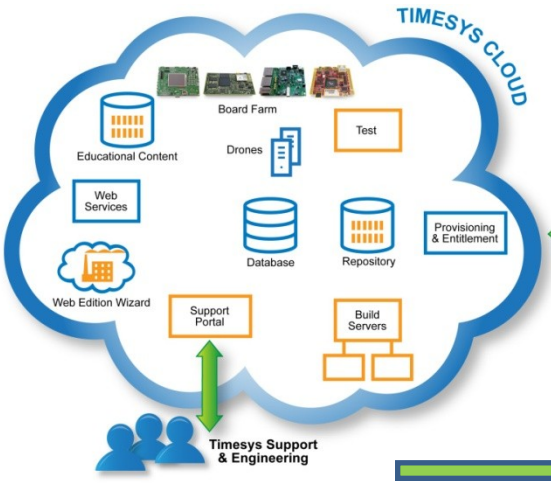
- Preinstalled in your VirtualBox

Run

- Export your QMAKESPEC variable and point it to linux-timesys-g++ in the SDK
- Execute TimeStorm binary
- Done in a script



IDE and Cross-Environment



Host PC/Linux

TimeStorm

Recognizes Automatically

LinuxLink
Desktop Interface

Coffee Vending Machine – GUI Development

The Qt Story

- **The Qt toolkit is a multi-platform C++ GUI toolkit (class library)**
- **Developed by Troll Tech AS, later acquired by Nokia**
- **Qt is licensed under dual license:**
  - LGPL
  - Commercial (mostly if you plan to extend Qt and sell it)
- **Around 1997, Qt was chosen as the code basis for the KDE Linux desktop environment**
- **Latest version — Qt 4.7.4 is available for Windows, Unix, Linux, Embedded Linux, Mac OS X libraries and Symbian OS**
- **Recent additions include:**
  - Qt Quick (programming with QML)
  - Target form factor simulator (cell phones)

Widgets

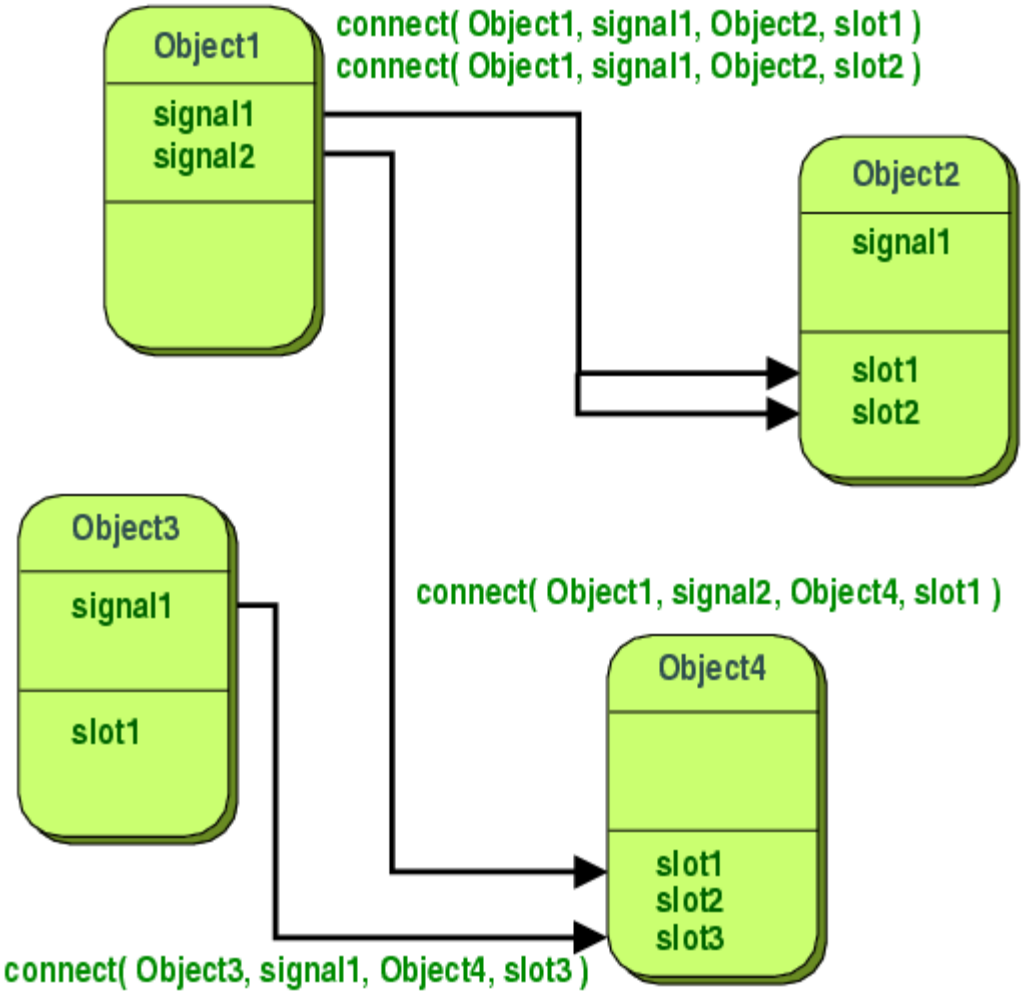
- **Base class for all UI widgets**
  - QPushButton, QLineEdit, QTabView, …
- **Properties**
  - width, height, backgroundColor, font, mouseTracking, backgroundPixmap, etc.
- **Slots**
  - repaint, show, hide, move, setGeometry, setMainWidget, etc.
- **Signals**
  - mouseMoveEvent, keyPressEvent, resizeEvent, paintEvent, enterEvent, leaveEvent, etc.

Event Handling

- **Qt's approach to IPC: signals and slots**
  - A widget sends out various signals
  - Object methods can be declared as slots
  - Compatible signals and slots can be connected or plugged together (parameter types must match!!!)

- **Clear UI/Logic separation**
  - This separation between UI components and program elements lends itself to component-based programming

Signals and Slots



http://doc.qt.nokia.com/latest/signalsandslots.html

Signals and Slots (cont.)

```
#include <QObject>

class Counter : public QObject {
        Q_OBJECT

public:
        Counter() { m_value = 0; }
        int value() const { return m_value; }

public slots:
        void setValue(int value);

signals:
        void valueChanged(int newValue);

private: int m_value;

};
```

qmake

- **The qmake utility is typically invoked with the following commands:**
  - qmake – project
  - qmake
- **IDE tools invoke qmake automatically**
- **Rules:**
  - Be sure to place code in its own directory.
  - qmake scans all subdirectories for dependencies.
  - Looks at the .pro file and generates Makefile structure

Events – Triggered by Signals

- **Signals: emit events**
  - declare as signals
  - You don't implement them, you send them with the keyword “emit”
    - e.g. emit(counterAtZero(100))
- **Slots: receive and handle events**
  - Normal member functions declared as slots
- **Connect: must connect signals to slots**
  - QObject::connect(Object 1, SIGNAL(activated(int)), Object 2, SLOT(handlingMethod(int)));

Other Qt features

QtCore	Core non-graphical classes used by other modules
QtGui	Graphical user interface (GUI) components
QtMultimedia	Classes for low-level multimedia functionality
QtNetwork	Classes for network programming
QtOpenGL	OpenGL support classes
QtOpenVG	OpenVG support classes
QtScript	Classes for evaluating Qt Scripts
QtScriptTools	Additional Qt Script components
QtSql	Classes for database integration using SQL
QtSvg	Classes for displaying the contents of SVG files
QtWebKit	Classes for displaying and editing Web content
QtXml	Classes for handling XML
QtXmlPatterns	An XQuery & XPath engine for XML and custom data models
QtDeclarative	An engine for declaratively building fluid user interfaces.
Phonon	Multimedia framework classes
Qt3Support	Qt 3 compatibility classes

Qt Application Structure

- **.pro file**
  - Holds information on all files that will be used to build a predefined executable(s)
  - Used by qmake to generate Makefiles for your project
- **.ui file**
  - User Interface file
  - Can open in a designer view
  - Has canvas on which you can drag and drop widgets
  - Its XML format is translated into C file (moc_) at compile time
- **.qrc file**
  - Holds information on all resources (non C++ code) used
  - Referenced throughout the project e.g. QPushButton icons
- **.qss file**
  - Used to define a style sheet for a custom look and feel
  - Loaded at runtime by your application

Exercise 5:

Create a GUI application with TimeStorm and Qt

Coffee Vending Machine Application

- **Start TimeStorm**
  - Native configuration (select this option – desktop icon)
  - Cross configuration
- **Create a new Workspace**
  - Save it to your USB key /media/<USB key number>
- **Create a new Qt GUI Project**
  - UI Type – QMainWindow
  - Don't need to select any additional Qt frameworks
- **Create the following components**
  - Remove menu bar and status bar
  - Use layouts
  - Add 3 additional GUI Qt classes
    - Preset the size of all UIs to 480x272 (will help you see actual design)
    - Design UIs on all three screens

Solution can be found in Exercise 5 folder

Exercise 6:

Develop Logic Behind the GUI

Coffee Vending Machine Application

- **Define/Connect signals (Button)**
  - Add code for an Espresso Coffee Button
  - Capture the signal in a service class
  - Implement the service routine (copy/paste from Coffee routine)

- **Define/Connect signals (Inter-Object)**
  - Manually connect 2 separate objects

In CoffeeBrewing class constructor

```
ACDisplay* disp = (ACDisplay*)(ui->brewingWidget);
connect(disp->returnDisplayItem(), SIGNAL(counterAtZero()), this, SLOT(counterDone()));
```

  - Emit the signal

In CountdownDisplayItem::updateTime() function, append at the end

```
if(secs >0 & secs < 2)        //when the countdown timer reaches 1 sec, emit a signal
{
    emit counterAtZero();
}
```

  - Service routine is already implemented

If we have time …

- **Add an icon on the Espresso button**
  - Image already added to your resource file
- **Look under exercise 6 solutions for full implementation**
- **Cross compile by launching TimeStorm cross and by using the solution code**
- **The design also includes the following:**
  - Custom Style Sheet
  - Third-party classes for the clock and the countdown timer

Module 2 — Summary

- **Used LinuxLink Desktop Edition interface**
  - Added needed packages and rebuilt the runtime BSP and SDK images
- **Used an IDE to design/develop Qt based UI**
- **Developed a GUI with the following:**
  - Layers, Several Widgets and Labels
  - Implemented signals and handlers
- **Cross-compiled for DM3730 target**

Module 2 — Quiz

1. What is Qt?
2. What tools can you use to develop with Qt?
3. How do you trigger cooperation between objects in Qt?
4. What is the purpose behind using Layers?

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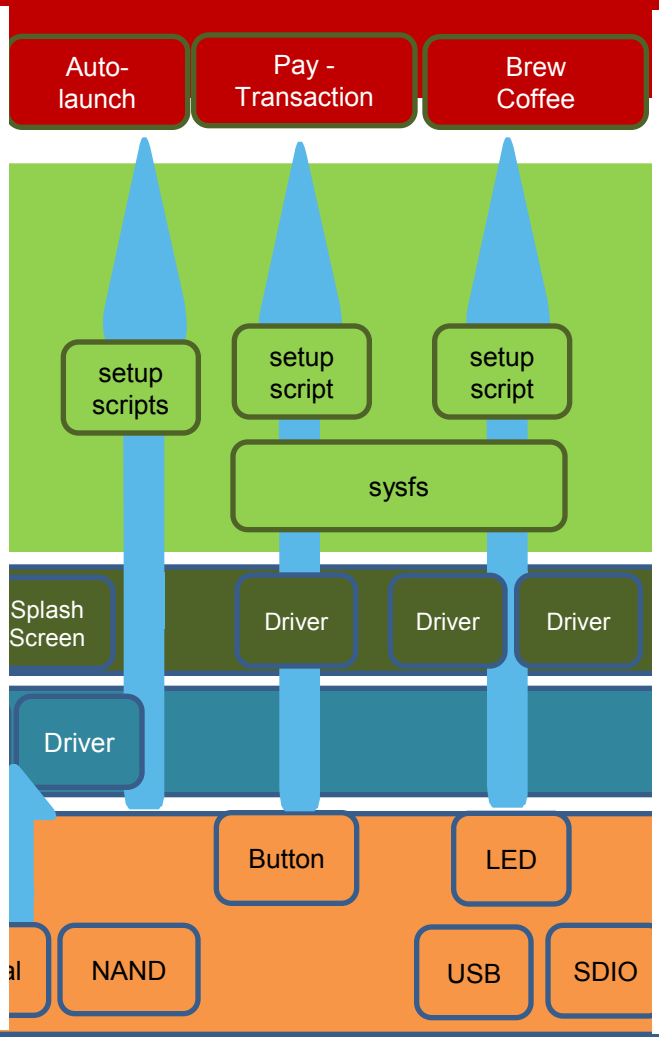
Module 3

- **GPIO Primer**
- **Setup GPIO lines to:**
  - Dispense coffee — LED
- **Add appropriate code to the UI application**
- **Add a splash screen to a booting Linux kernel**
- **Create auto startup scripts for the complete system**

Coffee Vending Machine (Blueprint)

Coffee Vending Machine



GPIO primer

General Purpose IO

- **Lines are controlled by a device driver**
- **Enable in a Linux kernel**
  - Use Linux configuration screen
    make menuconfig
  - Enable GPIO under
    device drivers -> GPIO

SYSFS and GPIO – What Are They?

- **What is SYSFS**
  - Virtual in-memory file system
  - Exports information about devices and drivers from the kernel device model to userspace
  - Used for configuration of **GPIO**
- **GPIO-SYSFS**
  - User interface to the in kernel gpio framework
  - Same interface no matter what platform you're developing for
  - Deals with pins strictly one at a time
  - Available in all mainline kernels from 2.6.27 onwards

Exercise 7:

Enabling GPIO

Enabling GPIO

- **Lines are controlled by a device driver**
- **Enable in a Linux kernel**
  - Navigate to [TSU-LAB]/factory
  - Use Linux configuration screen
    make menuconfig
  - Enable GPIO under
    device drivers -> GPIO
    device drivers -> GPIO -> SYSFS

You can reconfigure all aspects of the Linux kernel — frequently used when moving to a custom hardware

GPIO Lines Setup

How to Control GPIO with SYSFS

Procedure

- Find the correct GPIO lines for the onboard LED
  - Use hardware reference manuals
- Request the GPIO number from the kernel (73 and 74)

  # echo 74 > /sys/class/gpio/export
- Once you've done this you'll see a folder
  /sys/class/gpio/gpio74

  In this folder you'll see the attributes needed to control the gpio.
  We will use attribute value.

How to Control GPIO with SYSFS (Cont'd)

Procedure

- Set the direction for each GPIO by writing one of "in", "out", "high" or "low" to your gpio's direction attribute. "low" and "out" have the same effect, to change the pin to an output which is initially low. "high" changes the pin to an output which is initially high. "in" changes the pin to an input.

```
# echo out > /sys/class/gpio/gpio74/direction
# cat /sys/class/gpio/gpio74/direction
```

- Control the GPIO state (LED on/off) by writing "0" or "1" to the value file

```
# echo 1 > /sys/class/gpio/gpio74/value
```

- Set links for your application

Exercise 8:

GPIO Setup

Controlling GPIO lines

- **Setup a GPIO line for the onboard LED**
- **Also available in sysfs as:**

  /sys/class/led

  - Control by passing a value 0 or 1 to

    /sys/class/leds/led2/brightness

  Setup a custom access file

```
mkdir /leds
ln –s /leds/led2 /sys/class/leds/led2/brightness
```

Exercise 9:

Linux Kernel Patching

Custom Splash Screen

- **Can be any image that matches resolution of framebuffer**
- **An image file e.g. jpg needs to be turned into a format understood by a Linux kernel**
  - Limit number of colors to 223

```
ppmquant 224 logo.ppm > logo_224.ppm
```

Full procedure documented on LinuxLink (search term “boot logo”)

- **Ways to modify a Linux kernel**
  - Direct file alterations in a kernel source tree
  - Patching (better for maintenance)

Custom Splash Screen (Cont'd)

- **A Linux kernel patch has been created for you already (see exercise 9 folder)**
- **Apply the patch manually**
  - Navigate to your Linux kernel directory and execute the following command:

    patch p0 < <full path to the patch>
- **Can be automated via LinixLink Desktop Edition**
  - Copy your patch to the Desktop Factory src directory for the kernel
  - Using factory configuration screen, add your custom patch at the end of the patches field

Autoboot

- **Create a custom SXX startup script in /etc/init.d/**
  - Export QWS and TSLIB variables
  - Start the Coffee Vending application
- **Create an overlay that includes the following:**
  - Custom startup script
  - Coffee Vending Machine application
  - GPIO setup scripts
  - Create a tar file with overlay directory structure
- **Using desktop factory merge the overlay into the system's RFS**
  - Using Desktop Factory Interface navigate to:
  - Target Configuration->Build RFS->RFS Content Tarball
    file:///<fully qualified path to the overlay tarball

Checkout the overlay under Extra Exercises

Module 3 — Quiz

1. What is GPIO?
2. How do you enable GPIO?
3. What is SYSFS?
4. Can I use SYSFS to pass data to/from Linux kernel?

Building a Coffee Vending Machine with LinuxLink — Agenda

- **Module 1**
  How to assemble and deploy an initial BSP and setup development environment with the matching SDK
- **Module 2**
  How to build a modern User Interface for a Vending Machine using Qt Embedded for Linux
- **Module 3**
  How to enhance your Vending Machine application to control external devices via GPIO lines
- **Module 4**
  How to optimize, test and integrate the solution for fast boot and quick deployment

Module 4

- **How to measure boot time in our dev environment**
- **Fast boot optimizations**
  - Boot process overview
  - Bootloader optimizations
  - Kernel level optimizations
  - Filesystem optimizations
  - Other options
- **Deployment**
  - SD card preparations

Boot time Measurement

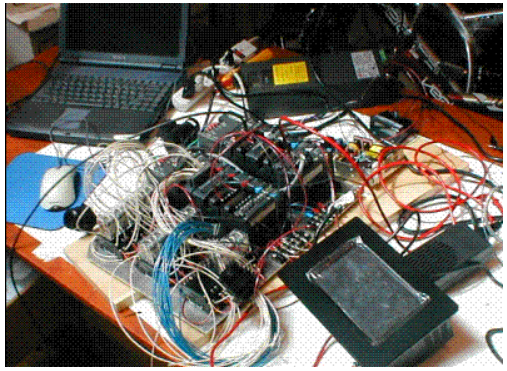
Measuring the boot time

- **Each embedded design is different**
- **Instrumentation is available**
  - Helps measure boot time at all stages
  - Most are open source based
  - Can be easily removed when you are done

The trick behind boot time optimization is to know where your system is spending time.
You may end up loosing a lot of time with little results!!!

Available Instrumentation

- **Bootloader**
  - Logic analyzer (using GPIO pins)
- **Kernel Measurement**
  - Printk
    - Compile kernel with: CONFIG_PRINTK_TIMES=y
    - Switch on dynamically: “echo Y >/sys/module/printk/parameters/time”
  - initcall_debug
    - On boot command line, use: initcall_debug=1
- **User space measurement**
  - Bootchart (www.bootchart.org)
  - Strace
    - Run strace –cT 2>/tmp/strace.log bluetoothd
  - Linux Trace Toolkit
- **System**
  - uptime
    - Add (echo -n "uptime:" ; cat /proc/uptime) to an RC script



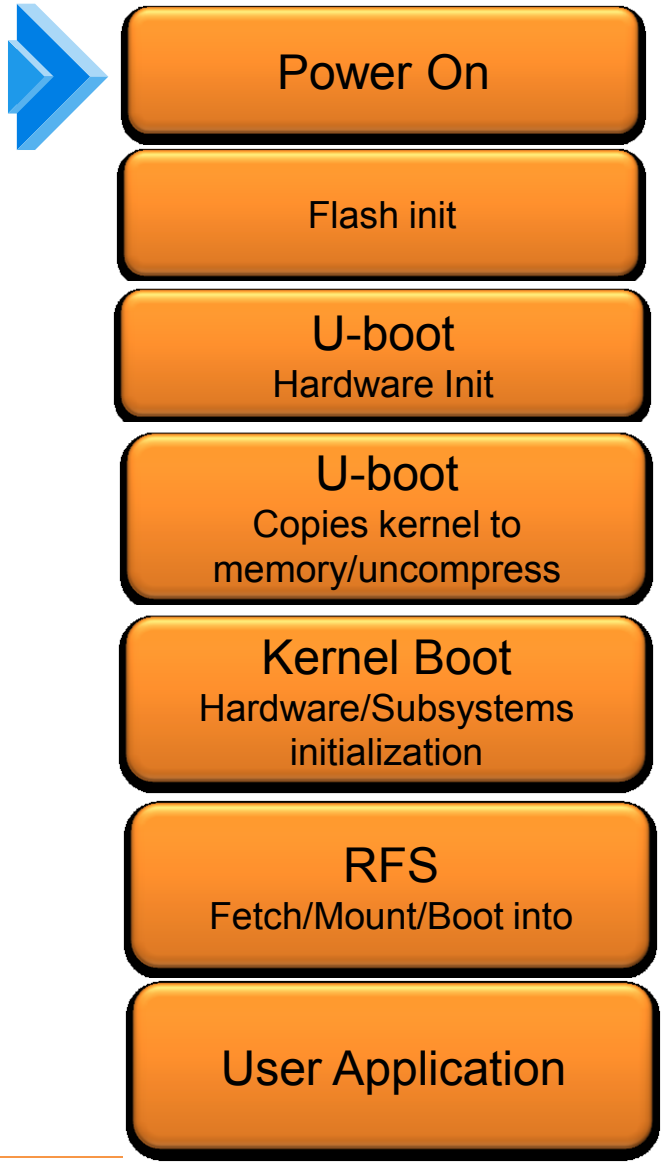
Fast boot Optimizations

Boot Process Overview

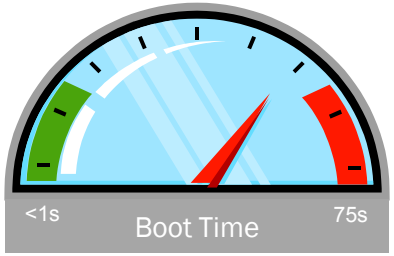
TIME

- **U-Boot**
  - Reset, copy U-Boot to SDRAM and jump to start address
  - Basic System Init. (IMPORTANT)
  - Copy the Linux kernel Image to SDRAM from SD
  - Decompress the kernel if needed
  - Jump to upload address and start the kernel
- **Kernel**
  - Run Kernel Init code
  - Init kernel subsystems (device drivers)
  - Init SD card
  - Mount SD card partition with RFS
  - Execute init script
- **Application**
  - Depends on your specific requirements

Boot Process Sequence



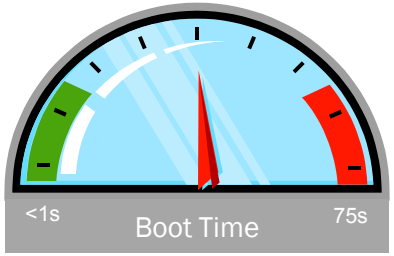
Bootloader Optimizations



- **Low hanging fruit**
  - Set the bootdelay variable to 0 (time savings 4s)
  - Preset the bootcmd; do not use setenv (time savings 0.5s)
  - Disable console (time savings 2s)
    - CFG_CONSOLE_INFO_QUIET
    - CONFIG_SILENT_CONSOLE
    - In our case- silent=yes
  - Disable other tests (time savings 2-6s)

- **Additional modification/enhancements**
  - If possible, use uncompressed Linux kernel
  - Optimize the NAND read operation, to shorten image copy time
  - Rewrite/disable CRC32 checksum code
  - Load the image directly to Entry point
    - Set CONFIG_LOADADDR
  - If NOR Flash is used, leverage XIP
  - For large kernel image, use different compression algorithms

Linux Kernel Optimizations



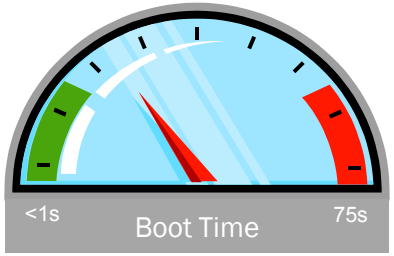
- **Low hanging fruit (time savings: 2-15+s)**
  - Use uncompressed kernel
    - Uncompressing takes time
  - Remove unused kernel options
    - Not used networking i.e. IPV6, multiple file systems
    - Debug features and symbols (for final deployment)
  - Build not initially used device drivers as Loadable Kernel Modules
    - Keep the features needed at boot time built into the kernel
    - Remaining drivers built as LKMs will make kernel smaller
  - Consider various approaches for your RFS deployment
    - JFFS2 with appended journal summary (skip flash scan)
    - CRAMFS, UBIFS
  - Suppress the console output
    - Use “quiet” with your kernel command line

Making Linux Kernel Small and Fast

Linux kernel options we will look at today

Kernel Option	Comment
CONFIG_EMBEDDED	Disables or tweaks a number of kernel options and settings. Think uClinux
CONFIG_IKCONFIG	Saves complete kernel configuration in the kernel
CONFIG_KALLSYMS	Prints our symbolic crash information and backtraces
CONFIG_BUG	Disables BUG and WARN functions
CONFIG_HOTPLUG	Can be disabled if no external devices will be attached and if you use static device files
CONFIG_DNOTIFY	File change notification to user space
CONFIG_EXT2	Disable if using jffs2 file system
CONFIG_PRINTK	Makes kernel silent when disabled
CONFIG_PRINTK_TIME	A way to track where time is spent at boot time
CONFIG_CC_OPTIMIZE_FOR_SIZE	Will select –Os instead of –O2 resulting in a smaller kernel

Userspace Optimizations



- **Filesystem modifications**
  - Optimize the RC Scripts (remove the ones you don't use)
  - If possible replace RC scripts with a single init
  - Pre-link
  - Link applications statically
  - Avoid udev – create needed device nodes ahead of time
  - Use static IP address
- **Filesystem modifications**
  - Staged booting
  - Code level modifications
  - Add a splash screen

Fast Boot Offering from Timesys

- **If your requirements include fast booting, Timesys can help you save time**
- **Implement added levels of optimizations with open source techniques**
  - Some of the deep-level optimizations techniques, described earlier
- **Use non open source technologies available to Timesys to further speed up the boot-time**
  - Typically needed when many services have to be up and running asap
- **This engineering experience is available as a service**

Deployment:

SD Card

SD Card Deployment

Card Preparations

- Use a card of appropriate size
- Format the card as follows:
  - Partition 1: VFAT – size: 20MB
  - Partition 2: ext3 – size: 48MB+
- Copy the images
  - Partition 1: uImage kernel, uboot, uboot.cfg, MLO, lolo
  - Partition 2: uncompress the file system created with the factory Desktop interface
- Insert the card in the target's SD Card slot
- Change the bootcmd variable to boot from SD Card

  setenv bootcmd "mmc init 0; fatload mmc 0 0x80000000 uImage-DM3730;bootm;"

  setenv bootargs "console=ttyS0,115200n8 root=/dev/mmcblk0p2 rw rootfstype=ext2 rootwait"
- Reset the system

Checkout the SD card content under Extra Exercises

Module 4 — Quiz

1. Why is fast boot useful?
2. What knowledge is required to get under 10s?
3. Can one get to sub 2s boot time?

How to Reach Us

- **Maciej Halasz — for questions related to this workshop**
  - +1-412-325-6313
  - maciej.halasz@timesys.com
- **Al Feczko — for questions related to LinuxLink subscriptions**
  - +1-412-325-6390 (o)
  - +1-412-897-2416 (m)
  - al.feczko@timesys.com
- **If you have a LinuxLink userid and password, you can work with our technical support engineers by submitting support requests directly**
  - https://linuxlink.timesys.com/support

Q&A