



LINUX DEVICE DRIVER AND BOARD SUPPORT PACKAGE DEVELOPMENT

COURSE DESCRIPTION

The Linux Device Driver and Board Support Package Development course provides engineers with a fast, cost-effective way to acquire the skills necessary to develop, deploy, and debug their own customized Linux device drivers and BSPs in the Wind River® Linux environment.

After this course, participants will be able to perform the following:

- Develop and manipulate Linux kernel modules
- Develop Linux device drivers for the various types of devices supported in Linux
- Describe the workings of the different kernel subsystems and how they impact the structure of a device driver
- Debug Linux device drivers
- Use the Yocto Project tools to create a new BSP and customize, patch, and validate the BSP
- Port Wind River Linux platform projects to new boards

PRODUCTS SUPPORTED

- Wind River Linux 9
- The following target is available: QEMU simulated target

COURSE FORMAT

- This four-day expert-led course consists of lectures and lab sessions.
- Students gain hands-on experience and receive personal guidance from expert Wind River instructors.
- Specific questions are addressed.

AUDIENCE

- Anyone new to device driver and BSP development in Linux
- Linux application developers who need insight into how the Linux kernel works
- Developers interested in the interface between the Linux kernel and device drivers
- Developers who plan to use Wind River Linux on an unsupported board (hardware architecture is supported)

Course title:	Linux Device Driver and Board Support Package Development
Duration:	Four days
Format:	Instructor-led lectures and hands-on lab sessions; instructor-led Live Remote delivery available
Content:	Day 1: Introduction to Linux Device Drivers; Linux Kernel Source Code; Introduction to Linux Kernel Modules; Character Device Drivers Day 2: Managing Memory in the Linux Device Drivers; Concurrency in Linux Device Drivers; Managing Time in Linux Device Drivers; Handling Interrupts in Linux Device Drivers; Debugging Linux Device Drivers Day 3: Linux PCI Device Drivers; Linux USB Device Drivers; Block Device Drivers; Network Device Drivers Day 4: Wind River Linux BSP Overview; Creating Wind River Linux BSPs; Additional BSP Considerations

PREREQUISITE SKILLS

- Familiarity with the Yocto Project build environment
- Familiarity with makefiles and the GNU toolchain
- Understanding of how to deploy and debug Linux-based applications in a cross-development environment
- C or C++ programming experience on Linux/UNIX

PREREQUISITE COURSES

- Introduction to Linux

RELATED COURSES

- Wind River Linux CLI Essentials

SYLLABUS

Day 1

INTRODUCTION TO LINUX DEVICE DRIVERS

- Linux architecture overview
- Linux device driver overview
- Device driver types
- Linux device model

LINUX KERNEL SOURCE CODE

- Source code organization
- The kernel configurator
- The kernel build system
- Working with kernel patches
- **LAB: Getting Started with the Wind River Linux Lab Environment**
- **LAB: Managing Simulated Targets from the Command Line**

INTRODUCTION TO LINUX KERNEL MODULES

- Overview
- Anatomy of a kernel module
- Module licensing
- Building modules
- Installing modules
- Managing modules
- Module parameters
- **LAB: Managing Kernel Modules**
- **LAB: Developing Kernel Modules**

CHARACTER DEVICE DRIVERS

- Overview
- Driver lifecycle
- Major and minor numbers
- Character driver entry points
- Blocking operations
- Controlling a device
- Querying read/write ability
- Restricting operations
- **LAB: Developing a Character Device Driver**

Day 2

MANAGING MEMORY IN THE LINUX DEVICE DRIVERS

- How Linux manages memory
- Allocating memory with `kmalloc()`
- Page-based memory allocation
- Manipulating memory

- Memory-mapped I/O
- Accessing user space memory
- Implementing the `mmap` operation
- **LAB: Managing Memory in Kernel Code**

CONCURRENCY IN LINUX DEVICE DRIVERS

- Concurrency
- Race conditions
- Locking primitives
- Deadlock
- Atomic variables
- **LAB: Managing Concurrency in Kernel Code**

MANAGING TIME IN LINUX DEVICE DRIVERS

- Measuring time in the kernel
- Delaying execution
- Deferring execution
- **LAB: Managing Execution of Driver Code**

HANDLING INTERRUPTS IN LINUX DEVICE DRIVERS

- How interrupts work
- IRQ threads
- Interrupt handlers
- **LAB: Implementing Interrupt Handlers**

DEBUGGING LINUX DEVICE DRIVERS

- Debugging by printing
- Debugging by querying
- Debugging by observation
- Using a kernel debugger
- **LAB: Implementing Debugging Strategies in Kernel Code**
- **LAB: Configuring KGDB**
- **LAB: Kernel Debugging with GDB**

Day 3

LINUX PCI DEVICE DRIVERS

- PCI configuration space
- Identifying devices
- Matching devices and drivers
- Driver registration
- `probe()` function
- Memory and I/O regions
- DMA
- `remove()` function
- **LAB: Driving Devices over PCI**

LINUX USB DEVICE DRIVERS

- USB architecture
- Matching devices and drivers
- Driver registration
- Probe function
- Communicating with the device
- **LAB: Driving Devices over USB**

BLOCK DEVICE DRIVERS

- Driver lifecycle
- Major and minor numbers
- Block driver entry points
- Processing requests
- Controlling a device
- **LAB: Developing a Block Device Driver**

NETWORK DEVICE DRIVERS

- Overview of network devices
- Driver registration
- Network driver entry points
- Controlling interfaces
- Packet transmission
- Packet reception
- **LAB: Developing a Network Device Driver**

Day 4

WIND RIVER LINUX BSP OVERVIEW

- Role of a Wind River Linux BSP
- Wind River Linux BSP structure
- Setting up the build environment
- Configuring and patching a kernel
- Configuring user space

CREATING WIND RIVER LINUX BSPS

- BSP development overview
- Starting from scratch
- Starting with third-party code
- Enabling supported boards
- Cloning BSPs
- Packaging Wind River Linux BSPs
- **LAB: Managing Kernel Modules**
- **LAB: Developing Kernel Modules**
- **LAB: Creating a BSP**

ADDITIONAL BSP CONSIDERATIONS

- BSP documentation
- Boot loaders
- Legal requirements
- Validating a BSP
- **LAB: Validating the Kernel**

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