

Supporting USB in a Microkernel Framework

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Bus-System: Introduction

Bus

Bus **B**inary **U**nit **S**ystem

Serial Serial communication

Parallel Parallel communication

Kinds Memorybus, Peripheralbus, Fieldbus, ...

Examples

USB Universal Serial Bus: Peripheralbus

I²C Two-Wire: Peripheralbus

CAN Controller Area Network: Fieldbus

PROFIBUS Process Field Bus: Fieldbus

Universal Serial Bus: Basics

USB Specifications

USB 1.x Published 1996

USB 2.0 Published 2000

USB 3.0 Published 2008

Characteristics

- Master/Slave Mechanism
- Hotplugging Feature
- Different USB-Connectors
- Differential Voltage Connection (*Twisted-Pair*)

Universal Serial Bus: Device

Device

Contains a unique ID

VID Vendor-ID

PID Product-ID

Universal Serial Bus: Device-Classes

Device-Classes

HID Human Interface Device-Class

MSC Mass Storage Device-Class

UVC USB Video Class

Printer Printer Device-Class

... There are more in the USB Specification

Each Device-Class has an generic Interface

Universal Serial Bus: Descriptors

Descriptor-Tables

- Information about a USB-Device
- Placed inside the USB-Device Firmware

Kinds of Descriptors

Device General Information like VID and PID

Configuration Configuration of the Device

Interface Interface for Endpoints

Endpoint Channel for communication

Universal Serial Bus: Transfer-Types

USB Transfer Types

Control Configuration/Status Requests

Bulk Huge payload data

Isochronous Huge payload with guarantee of bandwidth

Interrupt Small Message: Polling

Examples

Control Every USB Device (*Endpoint 0*)

Bulk Mass Storage

Isochronous Video Class

Interrupt Human Interface Devices

Universal Serial Bus: Host-Controller

USB Device Driver

Device specific

USB Stack

USB Software Handling

USB Host Controller

- Electrical Chip
- Offers Interface (*UHCI*)
- Connected to all Devices

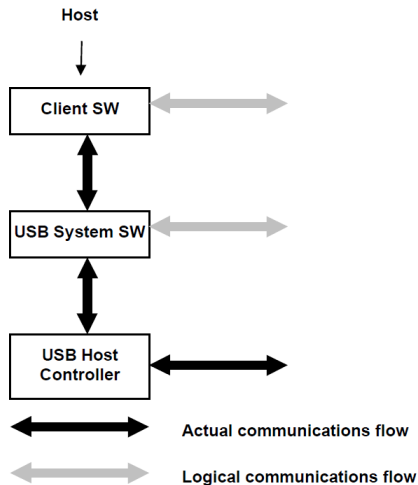


Figure : Host Composition.

HelenOS outline

- 1 Introduction
- 2 Requirements
- 3 Device Driver Framework
- 4 USB drivers
- 5 Devicetree
- 6 Hotplugging Example

Introduction

- microkernel based OS
- compatible with big- and little-endian, 32 and 64 bit
- runs on most common platforms, e.g. AMD64/EM64T, ARM, IA-32, IA-64, MIPS, 32-bit PowerPC, SPARC V9
- offers services: file system, networking, *device drivers* and user interface

important

HelenOS supports USB 1.1 for mice and keyboards.

Requirements

- ① drivers for host controllers
- ② drivers for USB devices
- ③ starting device driver on hotplugging
- ④ interaction with client-applications and drivers
- ⑤ communication between drivers

Device Driver Framework (DDF)

HelenOS' DDF offers solution for requirements 3,4,5

Device Driver Framework (DDF)

- drivers → tasks in userspace
- communication between tasks using IPC (async)
- DDF consists of two parts:
 - ▶ device manager service *devman*
 - ▶ libdrv - used by drivers
- client applications interact through driver interfaces with devices
- interfaces are sets of callback functions the driver must implement

DDF workflow

- 1 bus driver generates match ID for each detected device, e.g. `pci/ven=106b&dev=003f`
- 2 match IDs are sent to the *devman*
- 3 devman iterates a list with all known drivers and chooses the most suitable one
- 4 devman starts the chosen driver, or sends a message if it's already started
- 5 the driver invokes a callback function from *libdrv* defined by author
 - ▶ in this function the device will be initialized
 - ▶ on success the driver informs devman

USB drivers

- important notice: DDF allows splitting drivers in several parts
- UHCI and OHCI are implemented as one Driver split in two tasks
- UHCI and OHCI are strictly coupled
- cooperation of multiple drivers leads to *MID*
 - ▶ MIDs offer several interfaces to access the device, e.g. digital cameras
 - ▶ special vendor driver
 - ▶ fallback driver, e.g. mass storage

Devicetree

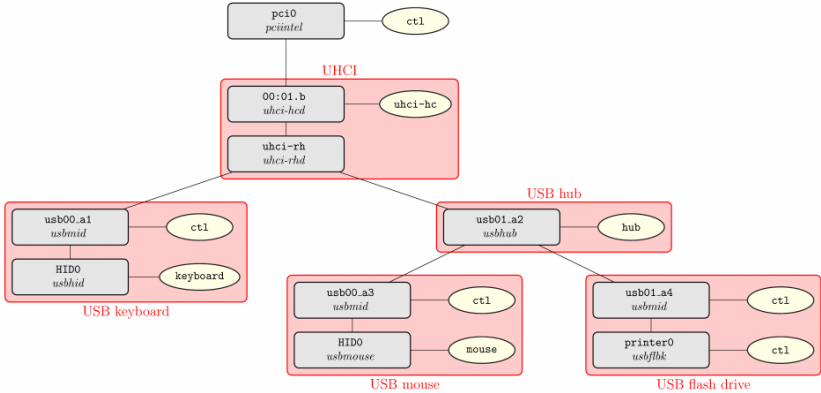


Figure : example of a possible USB devicetree

Hotplugging example

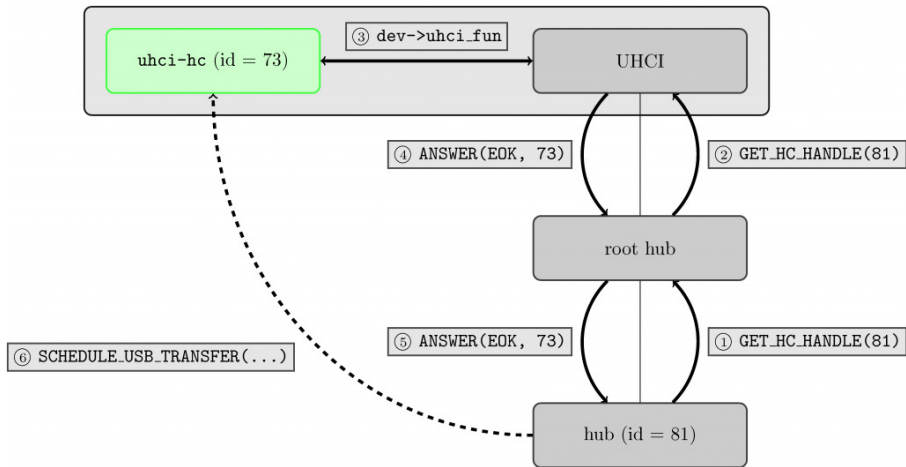


Figure : Hotplugging and registration

Questions

Many Thanks for your attention.

Questions

Any questions?

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