Reference Projects

Thesycon commands expertise in several areas surrounding the development of device drivers and firmware. Below, we give a selection of the projects that have benefited from our expertise. Each item listed below refers to development work that Thesycon successfully completed either under contract to a client company or as product development. In many cases we worked together with partner companies responsible for hardware design.

### USB Drivers

**Universal USB Device Driver for Windows**
- Design and implementation of a generic WDM device driver for USB 1.1, USB 2.0 and USB 3.0 devices
- Programming interface for use by C/C++, C# .net or Java applications
- For Windows XP, Vista, 7, 8 and 8.1 (32 and 64 bit): http://www.thesycon.de/usbio
- For Windows CE 5, CE 6, WEC7 and Windows Mobile: http://www.thesycon.de/usbioce

**USB CDC/ACM Class Driver for Windows**
- CDC/ACM (communication device class, subclass abstract control model) device driver
- Virtual COM port emulation
- For Windows XP, Vista, 7 and 8 (32 and 64 bit): http://www.thesycon.de/cdcacm
- For Windows CE 5, CE 6, WEC7 and Windows Mobile: http://www.thesycon.de/cdcacmce

**USB CDC/ECM Class Driver for Windows**
- CDC/ECM (communication device class, subclass Ethernet control model) device driver
- NDIS Ethernet adapter emulation
- For Windows XP, Vista, 7 and 8 (32 and 64 bit): http://www.thesycon.de/cdcecm
- For Windows CE 5, CE 6, WEC 7 and Windows Mobile: http://www.thesycon.de/cdcecmce

**USB CDC/NCM Class Driver for Windows**
- CDC/NCM (communication device class, subclass network control model) device driver
- NDIS Ethernet adapter emulation
- For Windows XP, Vista, 7 and 8 (32 and 64 bit): http://www.thesycon.de/cdcncm
- For Windows CE 5, CE 6, WEC 7 and Windows Mobile: http://www.thesycon.de/cdcncmce

**USB CDC/NCM Class Driver for Mac OS X**
- CDC/NCM (communication device class, subclass network control model) device driver
- For Mac OS X 10.6 and later

**Device Driver for USB Camera Devices**
- Device driver and API for a family of USB cameras

**USB Audio Class 2.0 Driver for Windows**
- Audio class 2.0 compliant high-speed isochronous audio streaming
- Windows WDM audio interface, DirectX
- ASIO 2.2 interface
- For Windows XP, Vista, 7, 8 and 8.1 (32 and 64 bit): see also the Professional Audio section below.

**USB Audio Class 2.0 Driver for Mac OS X**
- Audio class 2.0 compliant high-speed isochronous audio streaming
- Apple Core Audio interface
- For Mac OS 10.6 and later, see also the Professional Audio section below.

**USB Driver Suite for 2G and 3G GSM Phones**
- CDC/ACM and WMC, OBEX drivers with virtual COM port interface
- USB multi-interface (composite) driver
- RNDIS driver for Ethernet emulation
- Support for GSM, GPRS, EDGE, UMTS, HSDPA/HSUPA
- For Windows XP, Windows Vista, Windows 7, Windows 8

**Windows Driver for USB Smart Card Reader**
- WDM-compliant Windows device driver for smart card reader device with high-speed USB interface
- Driver-integrated T0/T1 protocol implementation, compliant to ISO/IEC 7816-3, ISO/IEC 7816-4, ISO/IEC 14443-3, ISO/IEC 14443-4 (Contactless integrated circuit(s) cards, Proximity cards)
- Interoperability Specification for ICs and Personal Computer Systems
- Specification of the SIM - ME interface (GSM 11.11)

**Power Line Modem with USB Interface**
- Windows device driver for a USB-based power line modem

**High-Speed USB Data Capture**
- Device drivers and firmware for various USB-based high-speed data capture applications, e.g. for measuring devices and medical devices
Device Driver for USB-based Touch Screen
- WDM-compliant Windows kernel-mode device driver for touch screen with USB interface

Selective USB Device Filtering
- WDM-compliant Windows filter driver that blocks non-authorized USB devices
- Flexible and configurable filtering based on VID, PID, serial number etc.

USB Programming Interface for Java
- Device drivers and JNI libraries for Windows and Linux to create a USB programming interface for Java applications

USB Device Drivers for Linux
- Kernel-mode drivers for various USB devices
- Compatible with Linux kernel 2.4 and 2.6 series
- Various user mode driver libraries

USB Drivers for Apple MacOS-X
- Various USB device drivers for Mac OS 10.5 and later
- USB audio drivers with high-speed isochronous streaming

High-Speed USB Interface for Scanner
- Firmware for Cypress FX-2 microcontroller
- Windows device driver and API

Embedded USB

Embedded USB Device Firmware Stack
- Design and implementation of a modular and portable device firmware stack
- Operating system independent
- USB 2.0 full and high speed support
- Various device classes: CDC/ACM, Mass Storage, CDC/ECM, CDC/NCM, RNDIS, HID, Audio 1.0, Audio 2.0, MIDI 1.0, CCID
- Supported microcontrollers: Atmel, NXP, Infineon, ST Microelectronics, Texas Instruments, Xilinx, Renesas, Spansion
- http://www.thesycon.de/embusbdevice

Embedded USB Host Firmware Stack
- Design and implementation of a modular and portable host firmware stack for OHCI/EHCI
- Operating system independent
- Support for external USB hubs
- Class driver support: Mass Storage, Printer, HID, CDC/ACM
- Supported microcontrollers: Atmel, NXP, Xilinx, Spansion
- http://www.thesycon.de/embushost

Embedded Printer Driver
- Driver for page and label printers with USB interface
- Based on embedded USB host stack
- Printing via PCL3 and ESC/Pos

USB Bootloader for Embedded Systems
- USB-based bootloader, persistent in FLASH
- DFU class compliant protocol
- Windows device driver and API DLL
- Mac OS X firmware downloader
- Convenient integration into applications and scripts

USB Device-to-Device Adapter
- Adds USB device functionality to Linux or Windows system with USB host
- Emulation of various device classes
- Endpoint data transfer via private API

USB Firmware and PC API for Sensor Device
- HID compliant USB interface for sensor chip
- PC API and demo application for data visualization

USB Firmware for Medical Device
- RTOS-based firmware framework for battery-powered data recorder
- Drivers for continuous data sampling
- USB mass storage device functionality

USB Device with Automatic Driver Installation
- USB device with integrated CD-COM emulation
- Automatic driver installation from built-in CD-ROM
- Driver uninstallation via Windows Control Panel
- Supports Windows XP to Windows 8 (32 and 64 bit)
USB to Parallel Port Converter Device
- Design and implementation of an IEEE 1284 parallel port to USB adapter with application-specific protocol implementation in the device
- Firmware for 32-bit ARM-based MCU
- Windows device driver, WHQL certification, driver installer, factory test support tools

USB HID Device with Integrated CD-ROM Emulation
- HID device for Windows installation without administrator privileges
- Integrated CD-ROM emulation for automatic application launch based on Windows autorun
- ISO image stored in device-internal FLASH memory
- ISO image update through HID commands

Firmware for High-end USB Microphone
- USB Audio 1.0 class compliant firmware
- PCM audio streaming via I2S
- HID composite device for private control

IEEE 1394 (FireWire)

IEEE 1394 Bus Driver for Windows
- Design and implementation of an alternative IEEE1394 bus driver for Windows 2000/XP/Vista/7/8
- Compatible with Windows in-box bus driver
- Full IEEE 1394a and IEEE 1394b support
- OHCI 1.0, 1.1 and 1.1+ compliant
- Robust design targeting industrial applications
  http://www.thesycon.de/t1394bus

Universal IEEE 1394 Device Driver for Windows
- Design and implementation of a generic WDM-compliant device driver for IEEE1394 devices
- Programming interface for use by Win32 applications
- Supports Windows XP, Windows Vista, Windows 7, Windows 8:
  http://www.thesycon.de/vhp1394

IP over IEEE 1394 Device Driver for Windows
- Design and implementation of a driver that implements the IPover1394 standard (RFC 2734).
- IP packet transport over IEEE 1394a and IEEE 1394b
- Ethernet adapter emulation

IEEE1394-based Frame Grabber Device
- Design, Documentation and implementation of the 1394-based communication protocol, including isochronous streaming (similar to IEC 61883)
- Firmware on Nexperia processor including PCI device driver for 1394 OHCI controller
- Drivers for various busses: I2C, SPI, JTAG, GPIO
- Windows device driver and application programming interface (API) library

IEEE 1394 Driver Stack for Windows NT 4
- Design and implementation of a 1394 OHCI driver stack for Windows NT 4.0

Programming Interface for IEEE 1394 Cameras
- Design, implementation and documentation of a C++ library that provides a flexible programming interface for various kinds of IEEE 1394-based camera devices

IEEE1394-based Isochronous A/V Streaming
- IEC 61883-6 compliant audio stream transmission via an IEEE 1394 isochronous channel
- Audio streaming server that provides IEC 61883-6 compliant streams to client applications
- IEC 61883-4 compliant transmission of MPEG-2 transport streams via IEEE 1394 isochronous mode

ASIO/WDM Drivers for Professional Audio Devices with IEEE 1394 Interface
  ⇒ See Professional Audio section below.
Professional Audio

**ASIO/WDM USB Driver for Windows**
- Device driver for a family of professional audio devices with USB 2.0 high-speed interface
- Low-latency isochronous streaming and MIDI
- Supports ASIO 2.0, DirectX/WDM audio, Kernel Streaming (KS) including MIDI and GSIF
- Supports Windows XP 32 bit and Windows Vista, 7, 8 and 8.1 (32-bit and 64-bit)
  - http://www.thesycon.de/usbaudio

**USB Audio Driver for Mac OS X**
- Device driver for a family of professional audio devices with USB 2.0 high-speed interface
- Low-latency isochronous streaming
- Supports Apple Core Audio
- Supports Mac OS X 10.6 and later

**Audio Device Driver for High-end PCIe Card**
- Windows and Mac driver for PCIe plugin card
- Multi-channel, low latency

**USB 2.0 Interface for Pro-Audio Devices**
- Design and implementation of driver and firmware for a universal USB audio interface with up to 16x16 channels I2S, SPDIF and MIDI
- Supports ASIO 2.2, WDM Kernel Streaming (KS)
- Drivers for Windows XP/Vista, XP/Vista x64
- Drivers for Mac OS X 10.4 and 10.5 Core Audio

**Sound Device Emulation on Windows**
- Software-only driver for device emulation
- PCM audio streaming through private driver API
- Dynamic creation/deletion of sound devices
- Supports Windows XP to Windows 8 (32 and 64 bit)

**ASIO/WDM IEEE1394 Driver for Windows**
- Device driver for a large set of professional audio devices with FireWire interface
- Low-latency isochronous streaming according to the following standards: IEC 61883, IEC 61883-6, IEC 60958-1, IEC 60958-3, IEC 61937-5
- Connection management and AV/C controller according to 1394 TA specifications
- Supports ASIO 2.0, WDM/DirectX, GSIF
- Supports multi-device setups and synch management
- Windows XP, Vista and XP, Vista x64 (64 bit)

**ASIO Driver for IEEE1394 Audio Controller**
- Windows ASIO 2.2 driver for 1394 audio device
- IEC 61883-6 compliant audio streaming
- Private MIDI and control protocol

**FireWire-based PC-to-PC Audio Streaming**
- Windows driver with ASIO 2.0 interface
- PC audio streaming network based on standard IEEE 1394 adapters
- Up to 128 channels audio streaming from multiple slave PC systems to one master PC

WLAN-based Audio Streaming
- Windows Kernel Streaming (KS) driver and service to transfer an audio playback stream over Wireless LAN to an external device
- Device control via Universal Plug and Play (UPnP)

Application Development

**Device Status Monitor for Apple iOS**
- Design and implementation of an App for iOS
- Displays current device status
- Communication via WLAN and TCP/IP

**Application for Mobile Data Recording**
- GUI application for Windows CE on handheld PC
- Wireless communication with probe via ANT
- Data recording, viewing, export
- Used in mining and field exploration

Device Driver Installation

**Windows Device Driver Installation**
Thesycon created driver setup wizards for numerous projects. We maintain an internal framework that enables us to create reliable installers very quickly.
http://www.thesycon.de/pnpinstaller

**USB Device Driver Installer for Mobile Phones**
- Complex installer that handles all Windows versions including 64-bit systems and supports a large set of different mobile USB devices and drivers
- Support for silent (non-interactive) mode
- Auto-run support and various user interface options
- External customization
DVB-S and DVB-T

DVB Satellite Receiver PCI Card
- Windows driver for PCI-based DVB-S receiver card with integrated MPEG-2 transport stream Demultiplexer (Demux) and PID-filters
- Satellite tuner control
- DVB SI table parsing and data management
- DirectShow filter for MPEG2 audio and video stream rendering
- DVB teletext parsing and rendering
- Various accompanying Windows applications

Digital Satellite Radio Receiver PCI Card
- Windows driver for PCI-based radio receiver card
- Private API and demo application
- Various tools for supporting mass production

DVB Satellite Receiver with USB Interface
- Design and documentation of the USB-based streaming and control protocol
- WDM compliant Windows device driver
- Device firmware running on a 16 bit microcontroller

Windows Driver for USB DVB Receiver
- Windows XP/Vista/7 driver for USB-based DVB receiver box
- MPEG streaming on USB
- Integration with Windows KS and BDA

Windows Driver for DVB Descrambling Device
- Windows XP/Vista/7 driver for USB-based DVB CAM
- Protocol implementation according to EN 50221 (Common Interface Specification for Conditional Access)
- Kernel streaming and DirectShow integration

Networking

Windows Driver for W-LAN Network Interface Card (PCI and CardBus)
- NDIS 5.1 miniport driver for PCI/Cardbus W-LAN adapter with integrated software protocol module
- Windows 98, ME, 2000 and XP

USB RNDIS Driver
- USB Remote NDIS device driver for Windows as a replacement for the in-box driver

USB CDC/ECM Class Driver
- USB CDC/ECM class driver for Windows XP, Windows Vista, Windows 7, Windows 8: http://www.thesycon.de/cdcecm
- For Windows CE 5, CE 6, WEC7 and Windows Mobile: http://www.thesycon.de/cdcecmce

USB CDC/NCM Class Driver
- USB CDC/ECM class driver for Windows XP, Windows Vista, Windows 7, Windows 8: http://www.thesycon.de/cdcncm
- For Windows CE 5, CE 6, WEC7 and Windows Mobile: http://www.thesycon.de/cdcncmce

Virtual NDIS Network Adapter Driver
- NDIS 5.0 miniport driver that provides a virtual network adapter with direct access to Ethernet packets via private API

NDIS Multiplexer Intermediate Driver
- Controls two physical NICs
- Exposes one virtual NIC

PXE Boot Driver for UEFI BIOS
- UEFI network driver (UNDI) for USB device

Automatic W-LAN Configuration Wizard
- Windows tool for automatic configuration of an external WLAN-based device
- Automatic Windows firewall configuration

ATM Network Adapter Drivers
- Various device drivers for ATM-155 and ATM-25 network interface controllers
**Other**

**Audio/Video Processing and Streaming**
- Design and implementation of a library of DirectShow modules for real-time processing and transmission of audio and video data streams
- The functionality includes audio/video capturing, encoding, real-time network transmission, decoding.

**Various PCI Drivers**
Thesycon has implemented many PCI device drivers for Windows 2000/XP/Vista/7/8, Windows CE/Mobile and Linux. Most devices use PCI bus mastering. Device types include:
- PCI video capture board (frame grabber)
- PCI multi-function card with serial and parallel ports
- DMA-based high-speed measuring data capture
- Network interface card
- PCI-based USB device controller PLX NET2282

**Serial Multiplexer Driver**
- WDM-compliant device driver for Windows that implements the serial multiplexing protocol defined by the ETSI TS 101 369 (GSM 7.10) standard

**Persistent USB Disk Drive Letter Assignment**
- Windows kernel-mode driver that guarantees a fixed and persistent mapping of drive letters to USB disks

**Serial Port Emulator (Virtual COM)**
- WDM-compliant bus driver that provides virtual COM port devices
- Private API to create/destroy virtual ports and to transfer data
- Can be used to create various virtual COM port solutions, for example: COM over TCP/IP tunneling, COM port emulation on top of arbitrary devices.

**Virtual CD-ROM and Disk Driver**
- Windows kernel-mode driver that emulates a CD-ROM or hard disk drive and implements special data processing such as decryption

**WHQL Certification of Windows Device Drivers**
Thesycon has executed WHQL certification procedures and submissions on behalf of many customers. We have huge experience in running WHQL test benches on Windows XP, Windows Vista, Windows 7 and Windows 8. Thesycon offers WHQL driver certification as a service to customers.

**Consulting**

**USB Problem Analysis**
For many customers, Thesycon has analyzed USB-related hardware, firmware or driver problems and provided methods of resolution, or implemented fixes.

**USB Protocol Design**
Thesycon has designed and optimized the USB-based device communication protocol for numerous applications. Thesycon has huge experience in designing reliable and efficient protocols as required by many industrial-scale solutions.

**Driver Problem Analysis and Optimization**
Thesycon has helped various customers to solve issues in existing PCI and other device drivers and to improve efficiency of the driver code.

**Programming Interface Design**
Thesycon has many years experience in application programming interface (API) design and other software interface design tasks. Main design principles are: efficiency, robustness, simplicity and scalability.

**EHCI USB Host Controller Verification**
Thesycon has supported a major silicon manufacturer in verifying an EHCI host controller design. Thesycon provided various USB test benches and supported the designers in Windows kernel-mode debugging.

**FireWire Problem Analysis**
Thesycon has supported customers in the analysis and solving of IEEE1394-related hardware, firmware or driver problems. We worked out solution strategies for various application scenarios, e.g. very large topology configurations.

**Feasibility and Technology Studies**
- USB 3.0 security aspects
- USB device based security exploits