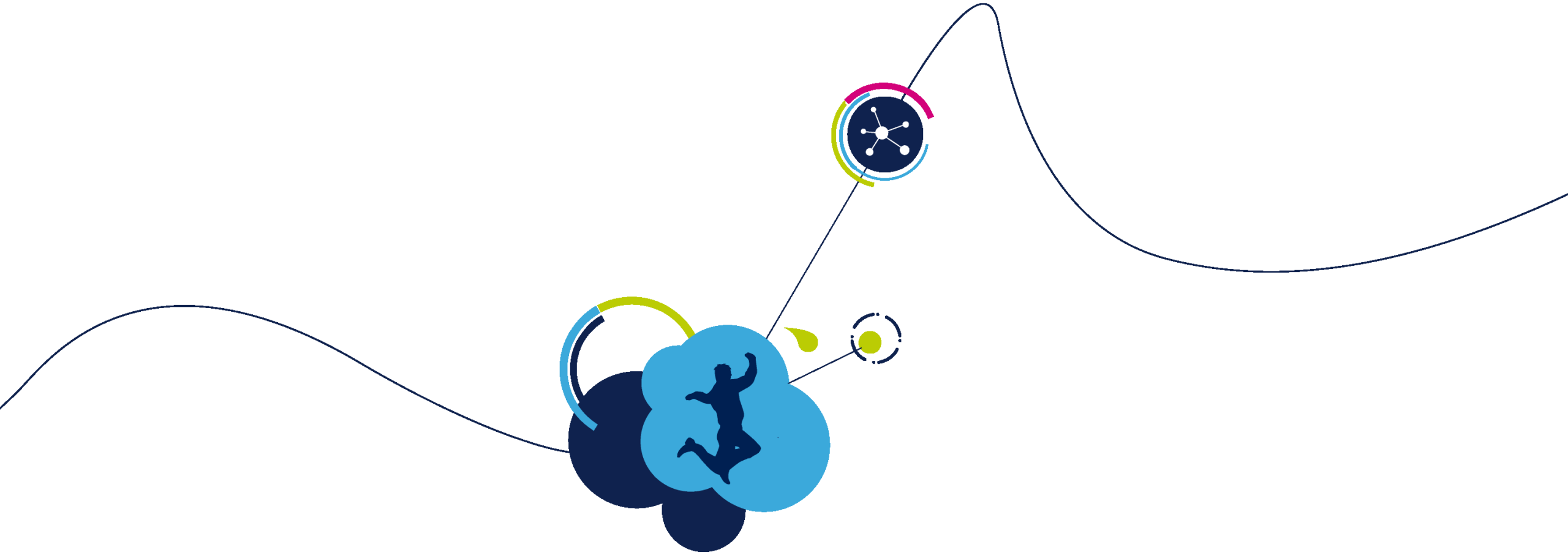


USB standard class overview

What are USB standard classes?

- Defined by USB-IF
- Classes (usually) supported by OS system drivers
  - No need to write your own drivers
- Compatibility between different USB hosts/devices
  - Some incompatibilities or unusual behavior introduced by Microsoft
- Wide range of different applications
- Not all standard classes are mentioned here

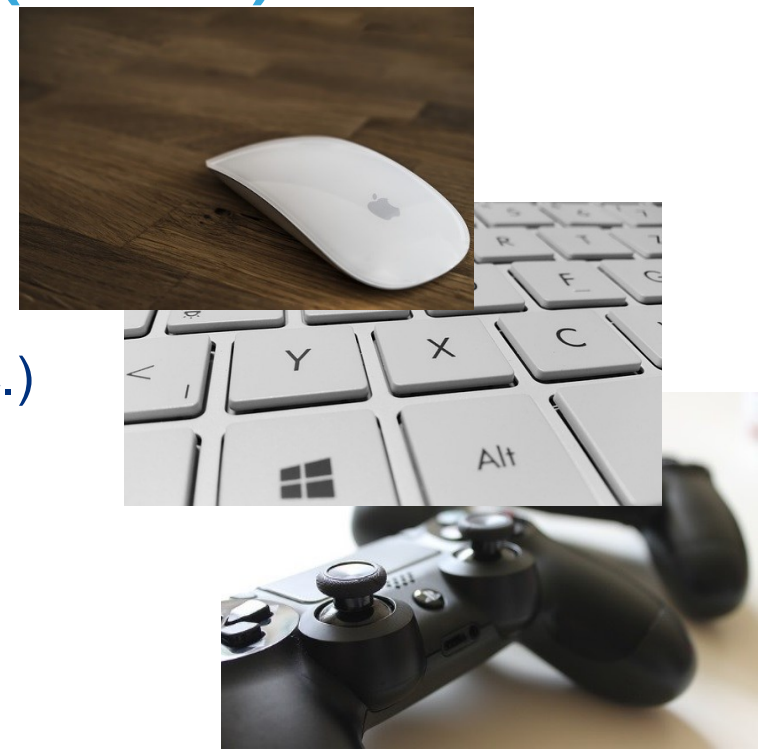
Storage classes

- MSC – Mass-Storage Class
  - Transfer based on raw data
  - Filesystem managed by the USB host
  - Used by USB drives
- MTP – Multimedia transfer protocc
  - Filesystem managed by the USB device
  - Transfer is based on files
  - Enables shared access to the filesystem
  - Used mainly by smart phones, audio pla
  - Some incompatibilities to the USB stand
    - Most of the devices tested against Wind
    - Proprietary MTP recognition
    - More info: http://events.linuxfoundation.org/sites/events/files/slides/Media%20Transfer%20Protocol.pdf

CDC class (Virtual COM port)

- Used as USB-to-serial bridge
- Often used for data acquisition systems
  - Custom protocol over the serial line
- Requires driver for Windows 7/8.1
  - There is system driver in Windows, but it needs to be linked to PID/VID
    - Signed INF file is required
  - ST provides VCOM port driver for specific VID and PID
- Windows 10 don’t require driver (system driver is used)
  - CDC class needs to be specified in device descriptor
  - No driver provided by ST (since it is not required)
- Usually bulk transfer (isochronous also possible)
  - Transfer is finished when packet smaller than maximum packet size is received
    - Otherwise the OS will not propagate the data to application (more in the Hands-On)

Human interface device (HID) class



- HID devices:
  - Mouse
  - Keyboard
  - Gaming controllers (gamepads, joysticks, steering wheels etc.)
- Interrupt oriented communication
- HID specific descriptors
  - Describes the format and meaning of the data
- Custom HID
  - Custom communication with USB device without the need for vendor specific drivers
  - Low bandwidth

Device firmware update (DFU) class

- DfuSe extension
  - Enables to update parts of the memory
- Downloads new firmware to the device
- Can upload the firmware from the device

- Supported as a part of the system bootloader on selected devices
- Demo application & drivers for Windows
  - Unofficial application (dfu-util) for Linux and MacOS
  - Third party Android app for OTG enabled tablets/smartphones

Audio class

- Used for speakers and microphones
- Real-time audio transfer
  - Uses isochronous transfers – clock synchronization might be required
- Supports various data formats, sampling frequencies
- USB uses unaligned / packed format
  - This can be issue for 24-bit formats
  - STM32 peripherals expect 32-bit aligned data – Single 32-bit write to data register via DMA
  - Additional unpacking required by software
- ST library can not cover all features and data formats

Audio class

- Version 1.0 supports only full-speed (max. 1023 bytes per ms)
  - Stereo 24-bit at 96kHz supported (2 x 3 x 96 bytes = 576 < 1023)
  - Stereo 32-bit at 96kHz supported (2 x 4 x 96 bytes = 768 < 1023)
  - Stereo 16-bit at 192kHz supported (2 x 2 x 192 bytes = 768 < 1023)
  - Lower sample rates also supported

- Version 2.0 supports high-speed
  - Not straightforward porting from 1.0 (descriptors are different)
  - Useful for higher number of channels (5.1 or 7.1 audio)
  - Lower latency (data sent every 125µs instead of 1ms)
  - Higher sample rate (high frequency measurement)
  - Not supported natively by Windows OS (only new version of Windows 10)
    - Custom drivers required for older Windows

Composite device

- Contains multiple interfaces for different USB classes
  - All classes can operate at the same time
  - Possible to use OS system drivers for standard interfaces
- Example ST-Link V2.1 contains
  - ST-Link debug interface (vendor specific)
  - Mass-storage for downloading the firmware
  - CDC class for communicating with the device through UART

USB class support in STM32 library

USB Class	Device support	Host support	Windows driver support
MSC	Yes	Yes	Yes
MTP	No	Yes	Yes
CDC	Yes	Yes	From Windows 10 / with ST drivers
HID	Yes	Yes	Yes
AUDIO	Yes	Yes	Yes
DFU	Yes	No	With ST drivers