

u3a Computing Group

Alan Hopwood, 6 April 2023

Presentation

Using of USB (sticks)

*Everything you ever wanted to know
about USBs*

(And plenty you probably didn't)

Presentation Agenda

The Use of USB sticks

- What is a USB Stick
- What is the USB?
- What can USB be used for?
- Advantages and Limitations
- Evolution
- Connectors
- Power management
- How many connections
- How does your Laptop know what you are plugging in?
- Some interesting uses
- Common Problems

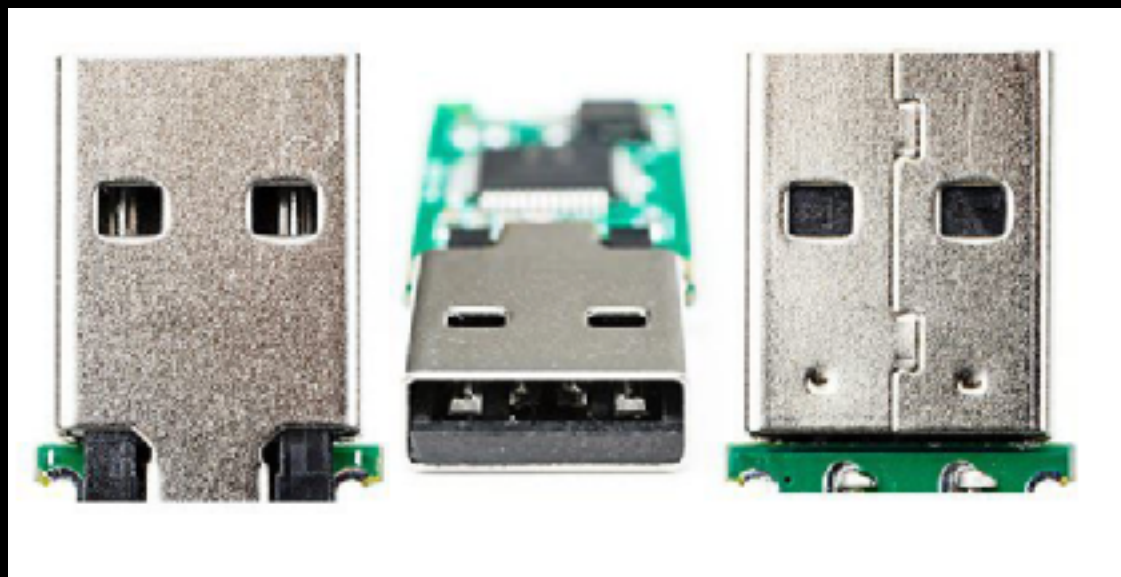
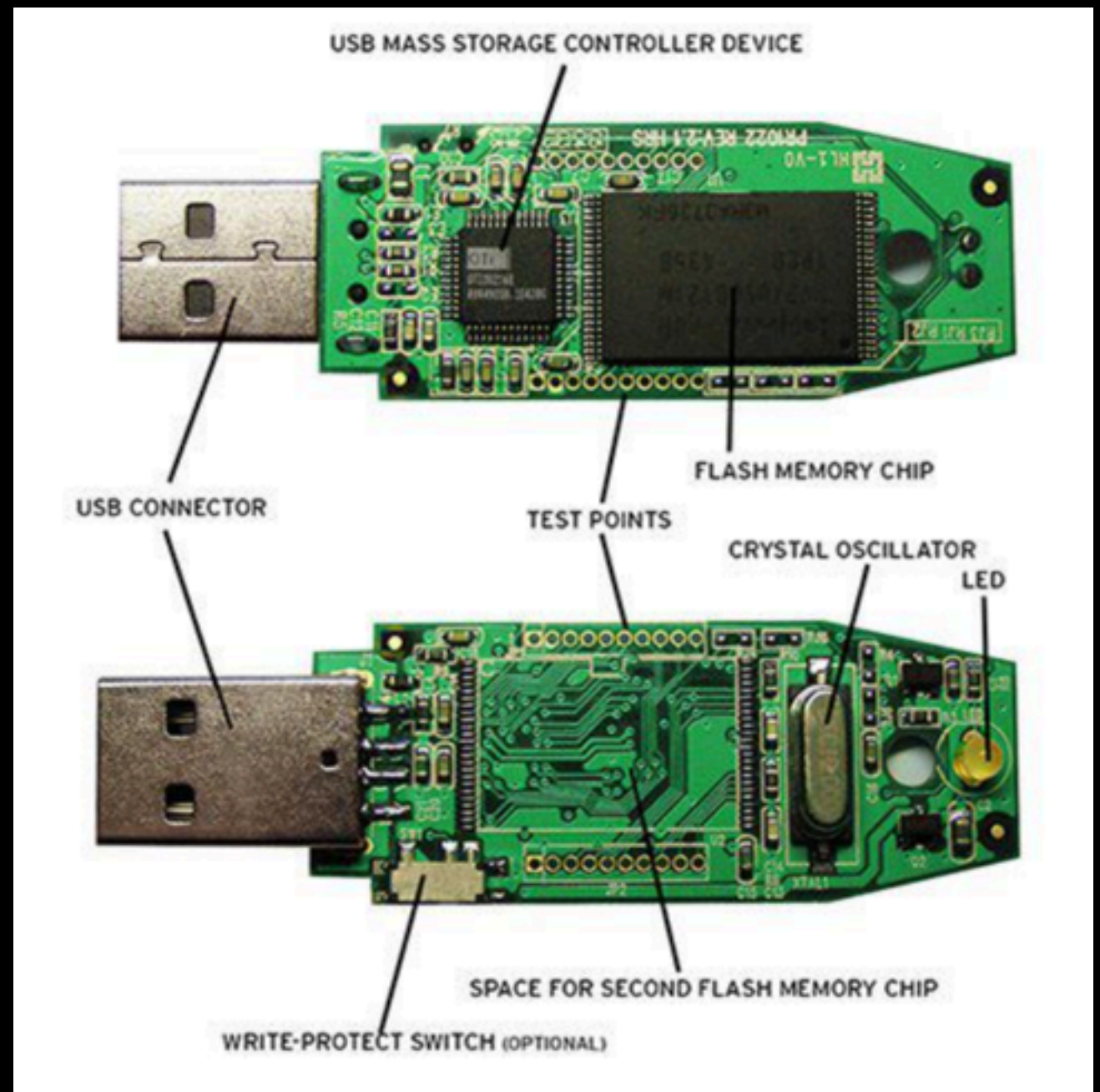
What is a USB Stick?

The Use of USB sticks

- The most common USB - USB Flash Drive



- Plug it in.
- Use it.
- tell your PC to disconnect.
- Unplug it.



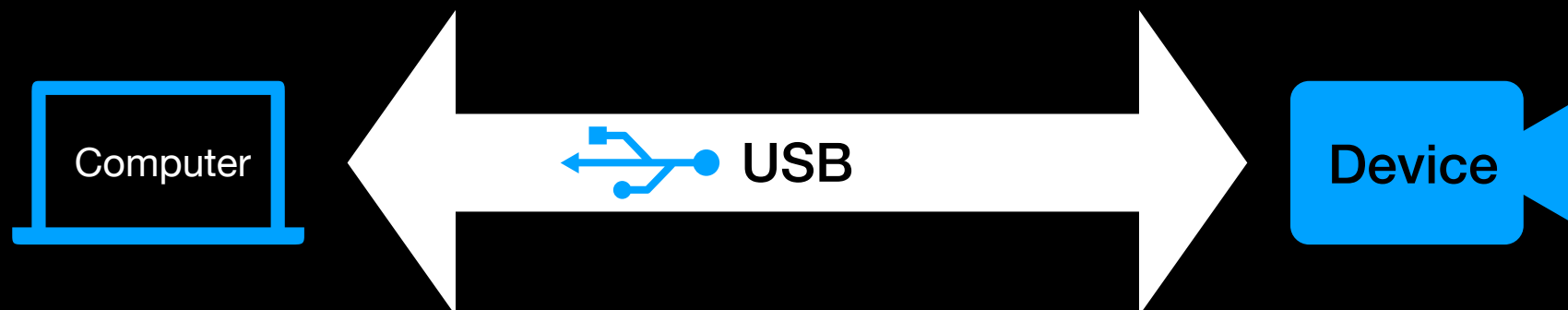
What is the USB?

The Use of USB sticks

Universal Serial Bus

- Designed to improve on the old style serial and parallel ports on computers.
- It is a specification of an interface between computer and peripheral.
- The Spec Defines:
 - Cables
 - Connectors,
 - Communication protocols
 - Power supply

Every USB device has a (simple) computer to deal with the communications protocols



What can USB be used for?

The Use of USB sticks

1. Connecting almost any peripheral to a computer
2. Extending a computer's capability.
3. Tapping into a computer's power supply
4. Connecting smartphones and tablets to computers (even the latest Apple devices now use USB-C)
5. Attaching devices to Smartphones and tablets

Advantages and Limitations 1/2

The Use of USB sticks

Advantages

- **Self Configuring**: Computer and device sort out speeds, data format, addressing without user intervention
- **Standardised at host**: I.e. Can connect any USB device to any USB socket on your laptop
- **Hot-swappable**: don't need to turn off laptop or reboot when connecting.
- **Self Powering**: small devices can be powered through the USB connection.
- **Socket Sharing**: Multiple devices can be connected to a single laptop USB socket
- **USB compliance assured**: USB logo is only allowed after compliance testing
- **Reliable**: USB protocol has built in error recovery

Advantages and Limitations 2/2

The Use of USB sticks

- **Wide range of Speeds**: Suitable for slow devices like keyboards as well as video streaming devices
- **Caters for different latency needs**: Can cope with time critical functions as well as background transfers (limiting impact on system resources)
- **Standardised Drivers**: Ability to deal with many device types is built in to computers (windows, Mac etc.)

Limitations

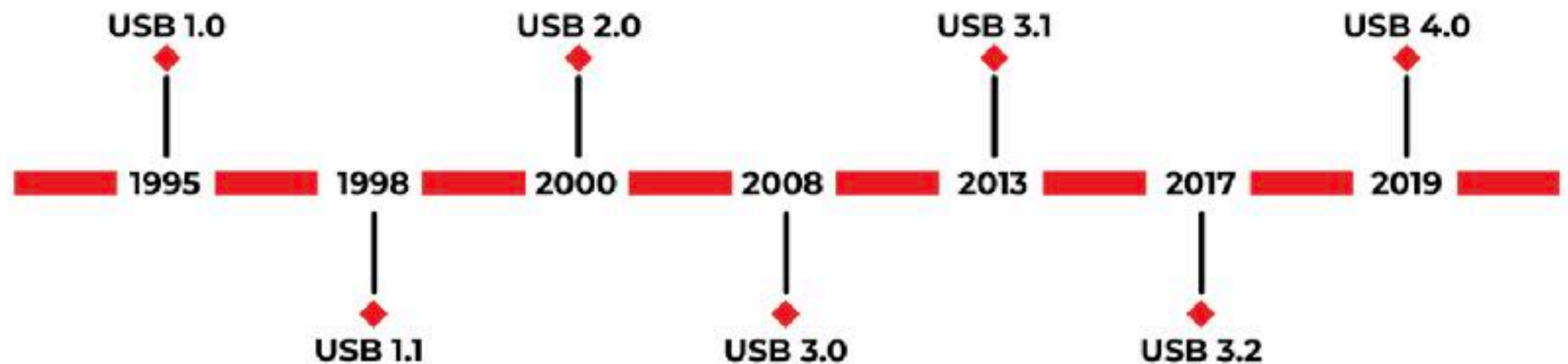
- **Cable length**: Intended for same table, not between rooms.
- **Master Slave**: USB devices cannot intercommunicate except via the host (laptop)
- **Slower** than some interconnects e.g. 100 Gigabit Ethernet

Evolution

The Use of USB sticks

- Speed and power have developed
- Connectors miniaturised

USB Standards Timeline



USB version	USB 1.0	USB 1.1	USB 2.0	USB 3.0	USB 3.2 Gen1	USB 3.2 Gen2	USB 3.2 Gen 2x2	USB 4.0
Connector Type	Type A or B	Type A or B	Type A or B	Type A or B	Type A or B	Type C	Type C	Type C
Max. Speed	1.5 Mbps	12 Mbps	480 Mbps	5Gbps	5Gbps	10Gbps	20Gbps	40Gbps
Charging Power	N/A	N/A	2.5 W	4.5 W	100 W	100 W	100 W	240 W

Variations - Connectors

The Use of USB sticks

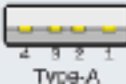

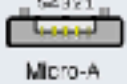



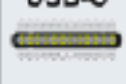
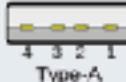

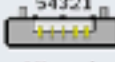





- Standards - lots of them



Variations - Connectors

The Use of USB sticks

- Only USB-C cables can have the same connector at each end.
- Do not connect PC to PC - it will damage the PC

Plugs, each end	USB A  Type-A	USB Mini-A  Mini-A	USB Micro-A  Micro-A	USB B  Type-B	USB Mini-B  Mini-B	USB Micro-B  Micro-B	USB 3.0 Micro-B  Micro-B SuperSpeed	USB-C 
USB A  Type-A	Proprietary, hazardous	Proprietary, hazardous	Proprietary, hazardous	Yes	Yes	Yes	Yes	Yes
USB Mini-A  Mini-A	Proprietary, hazardous	No	No	Deprecated	Deprecated	Non-standard	No	No
USB Micro-A  Micro-A	Proprietary, hazardous	No	No	Non-standard	Non-standard	Yes	No	No
USB B  Type-B	Yes	Deprecated	Non-standard	No	No	No	No	Yes
USB Mini-B  Mini-B	Yes	Deprecated	Non-standard	No	OTG non-standard	OTG non-standard	No	Yes
USB Micro-B  Micro-B	Yes	Non-standard	Yes	No	OTG non-standard	OTG non-standard	No	Yes
USB 3.0 Micro-B  Micro-B SuperSpeed	Yes	No	No	No	No	No	OTG non-standard	Yes
USB-C 	Yes	No	No	Yes	Yes	Yes	Yes	Yes

Power Management

The Use of USB sticks

- USB allows for a range of device power needs
- All devices startup in lower power mode.
- The USB device then defines its power need - which your computer may reject.

USB power standards			
Specification	Current	Voltage	Power (max.)
Low-power device	100 mA	5 V ^[a]	0.50 W
Low-power SuperSpeed (USB 3.0) device	150 mA	5 V ^[a]	0.75 W
High-power device	500 mA ^[b]	5 V	2.5 W
High-power SuperSpeed (USB 3.0) device	900 mA ^[c]	5 V	4.5 W
Multi-lane SuperSpeed (USB 3.2 Gen 2) device	1.5 A ^[d]	5 V	7.5 W
Battery Charging (BC) 1.1	1.5 A	5 V	7.5 W
Battery Charging (BC) 1.2	1.5 A	5 V	7.5 W
USB-C	1.5 A	5 V	7.5 W
	3 A	5 V	15 W
Power Delivery 1.0/2.0/3.0 Type-C	5 A ^[e]	20 V	100 W
Power Delivery 3.1 Type-C	5 A ^[e]	48 V ^[f]	240 W

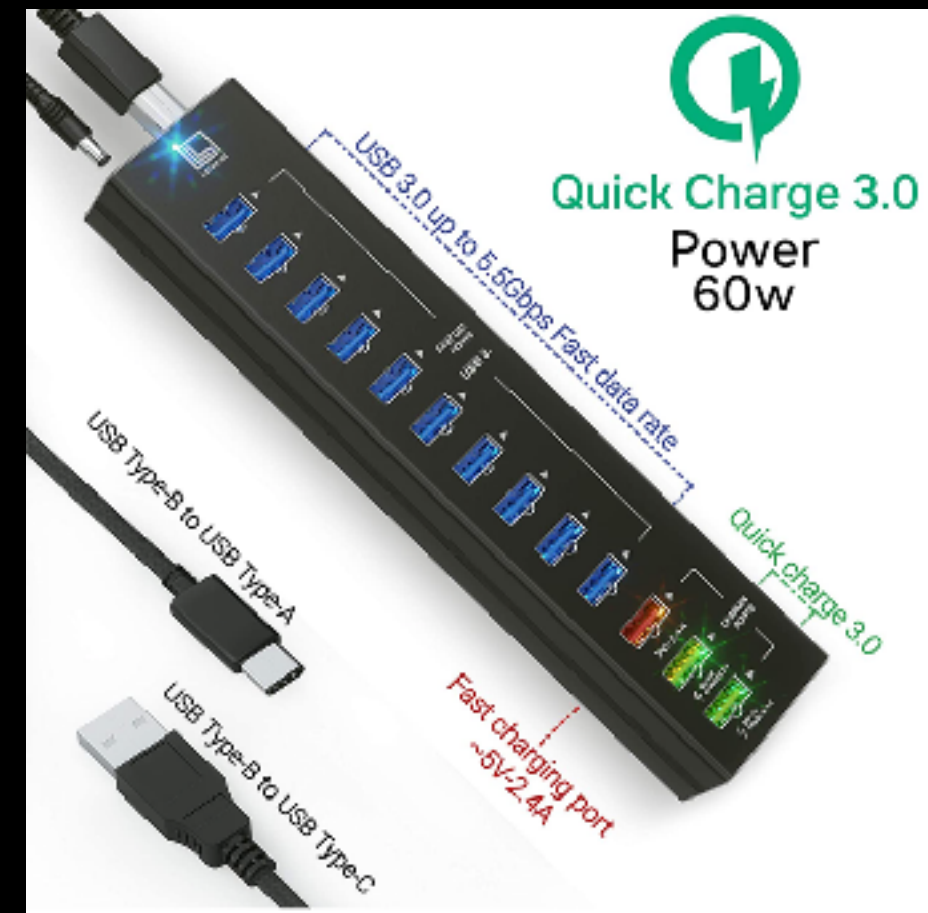
How many USBs can you connect?

The Use of USB sticks

- More than most people need.
- The practical limit is probably about 10.
- The simplistic answer is that a Controller can handle 127 devices.

However:

- PCs may have 1 Controller for multiple USB sockets or 1 each.
- A USB Controller addresses “Endpoints”
- A USB device can have (use) up to 32 endpoints.
- The power required by devices may be the limiting factor.
- Can use powered USB hubs to overcome power limitation.
- Think about bandwidth required.



How Does Your Laptop Know what is being connected?

The Use of USB sticks

- USB link is really computer to computer communications
- Devices are connected in a tree configuration
- Devices stay “silent” until polled by the host
- A newly connected device is addressed as “type 0, unspecified”
- The host (PC) reads specific memory of USB device which specifies the device type.
- The host allocates an address to the device and uses the correct device driver to deal with the device appropriately

How Does Your Laptop Know what is being connected?

The Use of USB sticks

- USB Device Classes: categories of devices with similar characteristics
- The standard USB-IF defines these classes
- Windows (for example) includes drivers for some classes as a standard operating system component
- A supplier may provide a device specific driver

Device Classes

The Use of USB sticks

- Standard Device Classes

Device Type	Examples
Device 0	Unspecified
Audio	Speaker, microphone, sound card, MIDI
Communications and CDC control	Modem, Wifi adapter, Ethernet adapter
Human Interface	keyboard, Mouse, joystick
Physical	Force feedback joystick
Still Imaging	Scanner, Cameral
Printer	Laser Printer, Inkjet, CNC Machine
USB Mass Storage	USB flash drive, memory card reader, digital audio player, digital camera

Device Classes

The Use of USB sticks

- Standard Device Classes

Device Type	Examples
USB Hub	High Speed USB Hub
Smart Card	USB Smart Card reader
Content Security	fingerprint reader
Video	Webcam
Personal Healthcare Device	Pulse Monitor
Audio/Video	Webcam / TV
Wireless Controller	Bluetooth adapter

Some Interesting Uses

The Use of USB sticks

- Use a USB Flash Drive to Lock/Unlock Your PC
- Run Portable Apps Anywhere With a USB Flash Drive
- Increase Performance With “ReadyBoost” (it acts as a hard drive cache, caching frequently used files.)
- Store Vital Travel Documents to take on holiday
- Install Almost Any Operating System With a USB Stick
- Rescue Your PC From Hardware Failure and Viruses

<https://www.makeuseof.com/tag/five-uses-for-a-usb-stick-you-didnt-know-about/>

Recovering a corrupted PC

The Use of USB sticks

If your PC has crashed and you need to recover it, or retrieve data from your hard disk, a USB disk is perfect. Flash drives are ideal for this, able to store and boot recovery tools to help you fix your computer.

These tools include:

- Hiren's BootCD
- SystemRescue
- Knoppix
- Ultimate Boot CD
- Bootable Rescue Disk
- Trinity Rescue Disk

All these tools will run from USB. Simply download the preferred tool, write to USB, and boot your prone computer from the USB stick.

<https://www.makeuseof.com/tag/5-best-rescue-disks-windows-system-restore/>

<https://lifehacker.com/five-best-system-rescue-discs-5984707>

USB On-The-Go

The Use of USB sticks

- Is a smart phone a USB host or peripheral?
- USB On-the-Go (OTG) allows two USB devices to talk to each other without requiring the services of a personal computer (PC).
- It allows USB devices, such as tablets or smartphones, to act as a host, allowing other USB devices, such as USB flash drives, digital cameras, mouse or keyboards, to be attached to them.
- You can use a keyboard, mouse, flash drive or printer with your tablet (or phone)
- Available on Android - but may need to be enabled
- Apple IOS has equivalent

Run Software from a USB flash drive

The Use of USB sticks

- You can't install Microsoft Office or Photoshop on a USB drive (or cloud drive)
- But there are open-source equivalents to almost everything that can be run entirely from a USB drive
- PortableApps.com allows you to have everything you need on the USB. Work on any Windows PC. Leave nothing on the PC.
- 450 apps available on <https://portableapps.com/>
- All categories from Office tools to utilities to graphics, games and music.
- Also look at <http://www.portablefreeware.com/>

Interesting Devices

The Use of USB sticks



USB Extension



Robot USB hub



Dancing Groot figure

ThinkGeek USB Pet Rock



And the Winner Is

The Use of USB sticks

The Mouse Jiggler



USB gadget can be programmed to "jiggle" the mouse every so often to keep the screen awake

Common USB Problems

The Use of USB sticks

- USB Device Not Recognised
 - Glitch in hardware - power off / disconnect /restart
 - Driver not present - if unusual device, may have device specific driver
 - Driver corrupted - Uninstall device driver and let Windows reload it.
 - Driver needs an update.
- Plugging in a device causes a glitch on pc
 - Try a different socket to check device vs socket problem
- Other potential issues:
 - Length of cable (<5m for USB 2, 1m for USB 3, 40m using hubs)
 - Too many devices hit power limitation.

Questions & Clarifications

The Use of USB sticks

- Any Questions?