

# USB On-The-Go & Embedded Host Supplement V2.0 Overview



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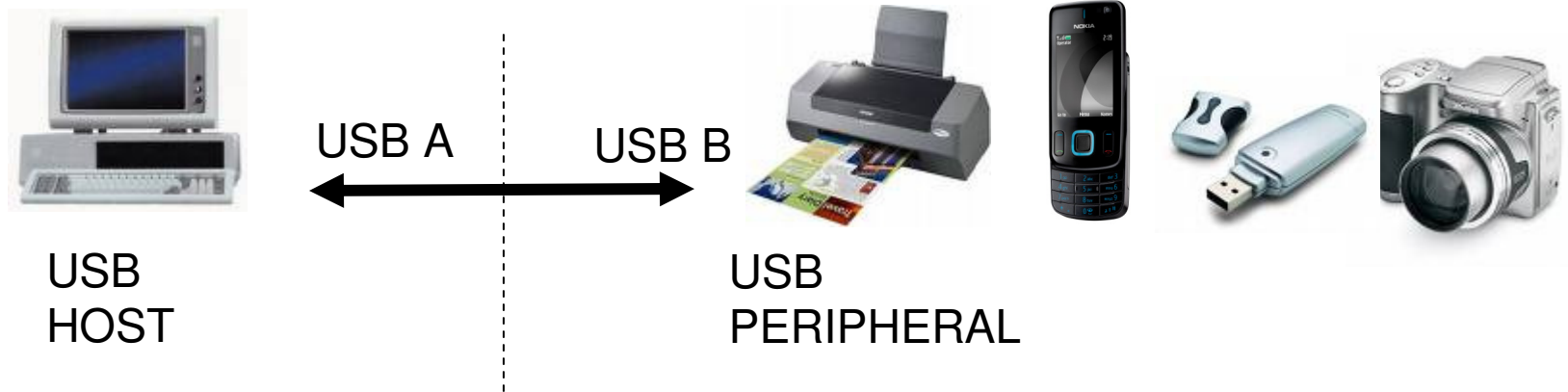
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# Agenda

- Introduction
- Device Definitions
- Operation
- Key Features

# Introduction: PC Hosts

- PC hosts
  - Are general purpose
  - Support a wide range of peripherals and device classes
- USB Specification Revision 2.0 requires:
  - Power to peripherals (0.1A or 0.5A at ~5V)
  - All defined speeds (low, full, high)
  - All defined data types (control, bulk, interrupt, isochronous)



# Introduction: Non-PC Hosts

- Computing resources less expensive
  - Blurred line between PCs/non-PCs
- Connection of non-PC devices:
  - e.g. Printers to cameras
  - e.g. Mobile phones to headsets etc.
- Devices have host capability
- Don't require full range of capabilities:
  - e.g. GPS dongle to a printer makes no sense



# Introduction: USB On-The-Go & Embedded Host Supplement



## ***Revision 2.0***

- Update for *USB On-The-Go Supplement Revision 1.3*
- Referenced by USB 3.0 Specification
- Applies to:
  - On-The-Go (OTG) devices
  - Embedded Hosts (EH)
    - New addition to the supplement
  - SRP and ADP-capable B-devices
    - SRP (Session Request Protocol)
    - ADP (Attach Detection Protocol)

# Introduction: Changes in Revision 2.0

- Clarifications:
  - Operation and user experience
  - TPL and no silent failures requirements
    - TPL (Targeted Peripheral List)
- New features
  - Dynamic role swaps during active connections
  - Power saving protocol
- Updated hardware and software requirements
  - Simplification of SRP
  - Support for USB battery charging
  - Relaxation of protocol timing requirements
  - Optimisation of state behaviour

# Device Definitions: Targeted Host

- Targeted Host = Non-PC Host
- Two categories:
  - ***Embedded Host (EH)***
  - ***OTG device***
- Specific, targeted set of peripherals:
  - ***Targeted Peripheral List (TPL)***
  - Defines supported:
    - power, bus speeds, data flow types, device classes etc.

# Device Definitions: Embedded Host



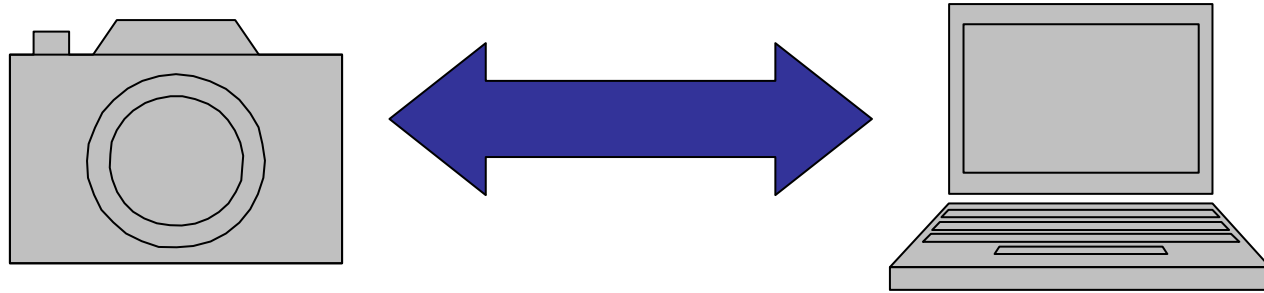
- Provides Targeted Host capability over one or more Standard-A receptacles
- May also provide peripheral capability via one or more Type-B receptacles

# Device Definitions: OTG Device

- Single Micro-AB receptacle
- No other USB receptacles
- Operates as USB host or peripheral
- Standard peripheral when connected to a standard USB host
- Can be connected to other OTG devices
- Can swap dynamically between host and peripheral
  - without turning the cable around

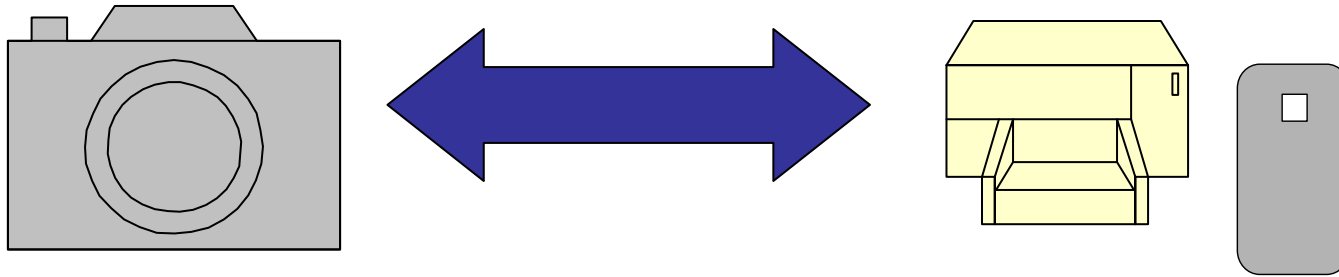


# Operation: OTG Device to PC



- OTG device is attached to a PC
- PC host queries the OTG device
  - Handled as standard USB device

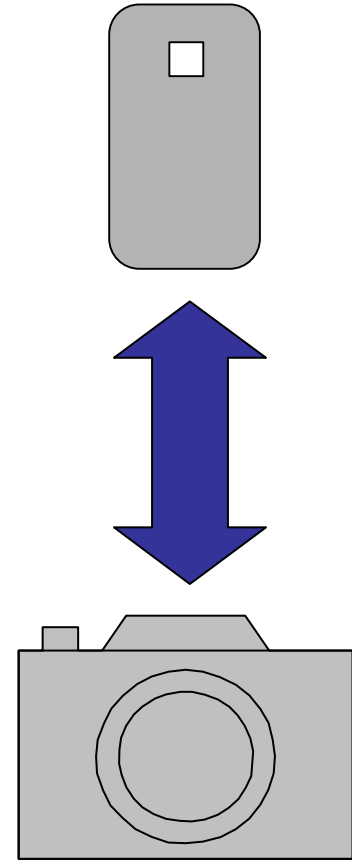
# Operation: OTG Device to Targeted Host



- OTG device is attached to a Targeted Host
- Targeted Host detects attachment
  - If supported
    - Make available to applications running on the host
  - Otherwise
    - Failure message is displayed

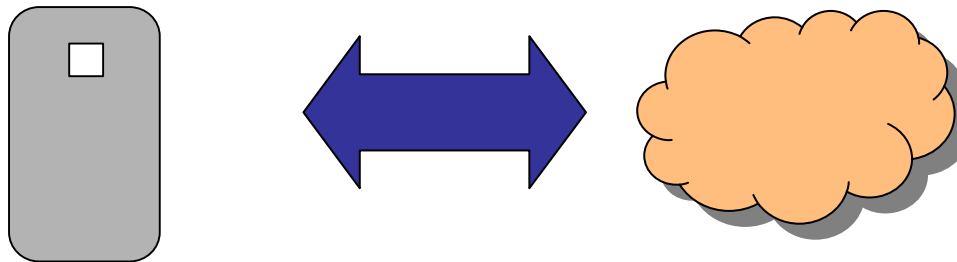
# Operation: Attached OTG Devices

- Two attached OTG devices,
  - User accesses one OTG device from the other
  - 1<sup>st</sup> device is using the bus
  - User uses 2<sup>nd</sup> device
  - 2<sup>nd</sup> device takes control
- Scenario depends on TPL
  - Only if OTG devices on TPL
  - Symmetry requirement is mandatory

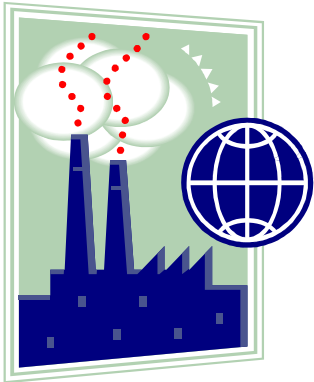


# Operation: Nothing Attached

- Targeted Host is not yet attached to a peripheral.
  - Needs to display/track the attachment status
- Application tries accessing the USB interface
- Application finds nothing is attached either by
  1. Lack of A-plug insertion
  2. No connect in response to VBUS assertion
  3. ADP
- No OTG devices or peripherals listed



# Operation: Powering the USB Port



- Peripherals require power to connect
- Basic cases:
  - Wall-powered EH
    - Powers downstream port at all times
  - OTG device
    - Powers OTG port when A-plug inserted
- Not power efficient
  - Unsuitable for battery powered products

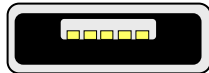
# Operation: Power Efficiency



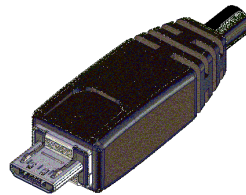
- The following methods can be used to improve power efficiency:
  - Power initiated by user interaction with a host application
  - Power initiated by user interaction with the peripheral (SRP)
  - Track attachment status when powered off (ADP)

# Key Features: OTG Connectors

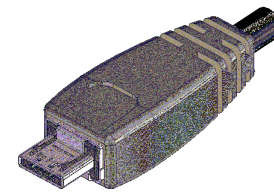
Micro-AB  
receptacle



Micro-B plug

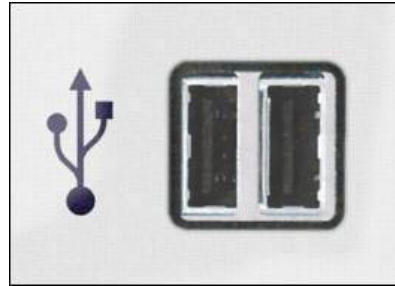


Micro-A plug



- One and only one USB receptacle a Micro-AB accepts
  - Micro-A plug (A-device)
  - or Micro-B plug (B-device)
- A-device powers the USB interface and is default host
- B-device is default peripheral

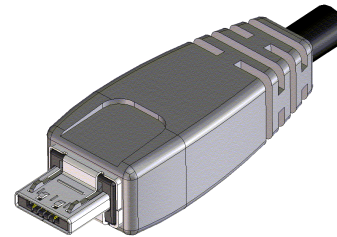
# Key Features: Embedded Host Connectors



- One or more Standard-A receptacles
- Optionally one or more Type-B receptacles
  - Implemented such that the user is unlikely confuse the Embedded Host with a USB hub
- Example:
  - Printer with a Standard-A receptacle on the front
  - Type-B on the back for PC connectivity

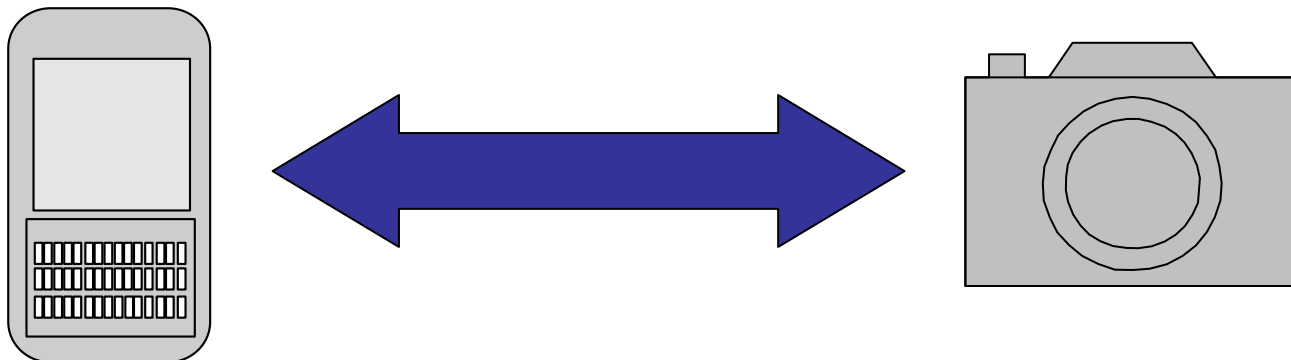
# Key Features: SRP-capable Peripheral-only B-device Connectors

- Compliant B-side connector
- As for standard USB devices e.g.
  - Micro-B receptacle
  - Hardwired captive cable with A-plug (keyboard, mouse...)



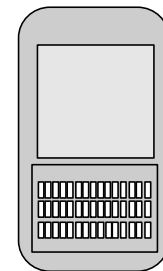
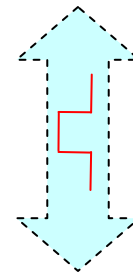
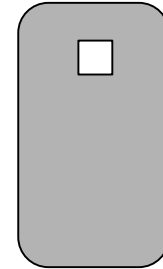
# Key Features: Symmetry

- OTG devices attached to each other:
  - demonstrate the same behavior to the end user...
  - ..whether they are the A-device or the B-device
  - i.e. turn the cable round and it behaves the same
    - A-device always provides VBUS
  - SRP, HNP, HNP polling and ADP all support this capability

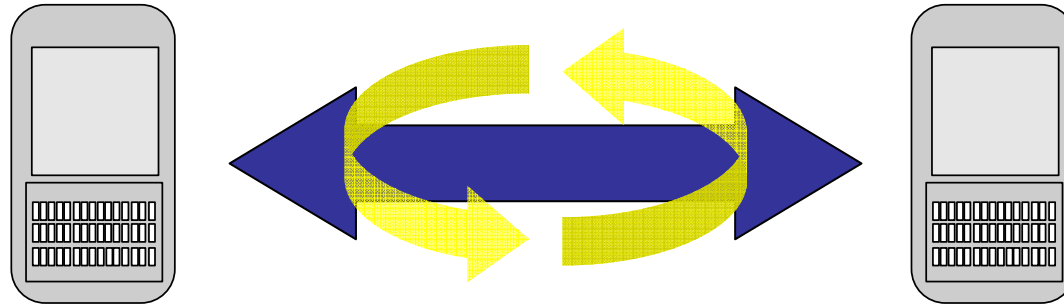


# Key Features: Session Request Protocol (SRP) and Sessions

- Sessions:
  - The period of time that VBUS is powered
  - Ends when VBUS is no longer powered
  - A-device can end the session when no activity
- Session Request Protocol (SRP)
  - B-device requests A-device to start a session
  - Data line pulsing used for signaling
    - VBUS pulsing no longer supported
  - SRP support is indicated in B-device OTG descriptor



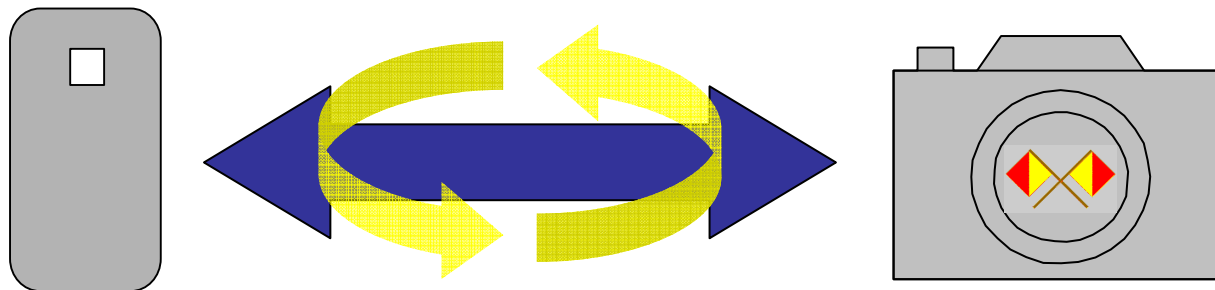
# Key Features: Host Negotiation Protocol (HNP)



- HNP transfers host function between connected OTG devices
- Any number of times during a session
- Eliminates the need for a user to switch the cable connections
- Typically initiated by user input on OTG B-device
- May only be implemented through a Micro-AB receptacle
- A-device is always responsible for powering the USB interface
  - Regardless of whether it is acting in host or peripheral role.
- HNP support is indicated in the OTG descriptor

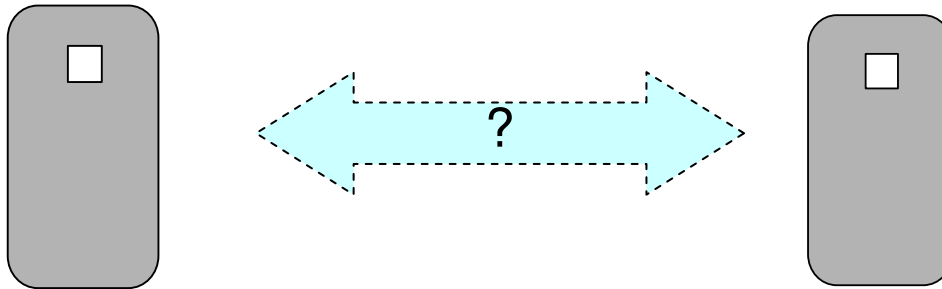
# Key Features: HNP Polling

- Enable role swaps during an active session
- OTG host polls the OTG peripheral regularly during a session
- OTG peripheral indicates it needs host role
  - Triggered by user interaction or automatic application
- OTG host allows the OTG peripheral to become host
  - A-device enables the B-device for HNP
  - B-device suspends



# Key Features: Attach Detection Protocol (ADP)

- Can be supported by any SRP-capable A-device or B-device
- Much lower power than maintaining VBUS
- Detection of attachment/detachment when VBUS not present.
  - UI indication of attached devices
  - Automatic actions triggered by attach/detach
- Embedded Host can also detect cable attachment without VBUS
  - No ID pin in standard A-plug



# Key Features: Targeted Host Requirements

- Targeted Hosts are required:
  - to be fully compliant with USB-IF specifications
- Targeted Hosts are not required:
  - to support the full suite of USB functionality
- Feature selection depends on product design
  - power saving features
  - supported TPL
  - mandatory features must still be supported



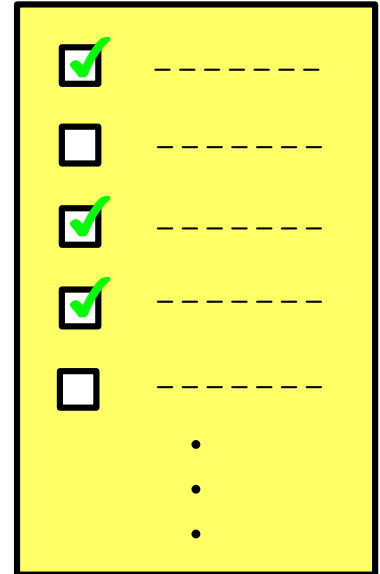
# Key Features: Targeted Peripheral List

- Targeted Peripheral List (TPL):
  - manufacturer declaration of supported peripherals
  - used to define Targeted Host capability
  - accurately represents device class support as host
- Peripherals supported
  - can actually be greater than the TPL
- Supported peripheral, not on the TPL
  - shall not be reported as a failure



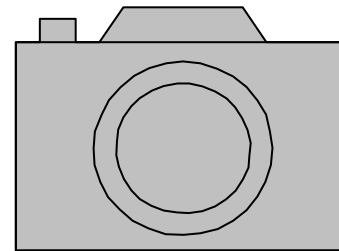
# Key Features: Feature Selection

- Device classes
- Hub support
- Output Power level
  - Power required to operate peripherals on TPL
- HNP
  - Required for OTG B-device with OTG devices on TPL
  - Mandatory for all OTG A-devices because of symmetry
- SRP/Sessions
  - Not required as an A-device if VBUS remains powered
  - Support indicated by B-device as part of OTG descriptor
- ADP
  - Required for applications which automatically detect attachment
- Operating speed (full speed mandatory)
  - Other speeds depend on TPL

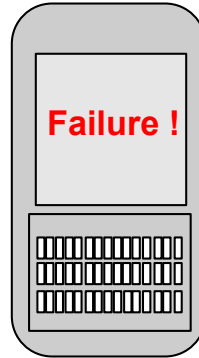


# Key Features: Third Party Support

- OTG device TPL
  - does not define which OTG products will use you as a peripheral
  - product designers have little control over this
- OTG devices must:
  - enable OTG products to support them as a peripheral
- Support for HNP as an A-device is mandatory
  - enables another OTG device to take host role
  - regardless of the direction of cable insertion (symmetry)



# Key Features: No Silent Failures 1



- Targeted Host is required to have a means for communicating failure messages to the user
- Message covers any appropriate mechanism for reporting to the user including:
  - textual messages
  - icons
  - LEDs
  - another means deemed suitable for this purpose

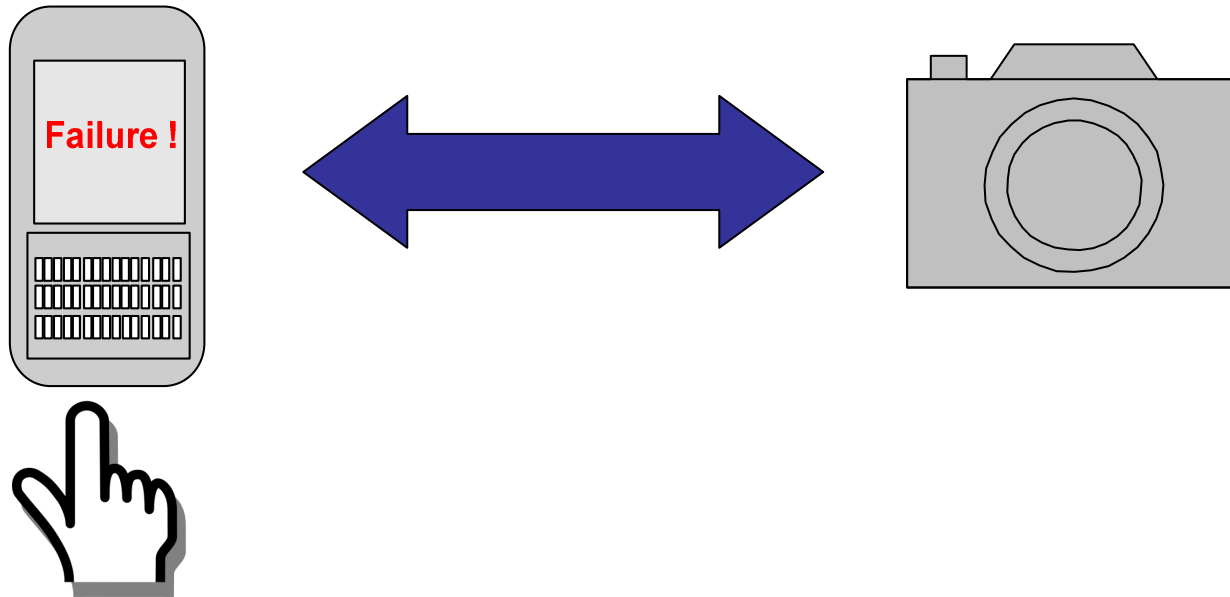
# Key Features: No Silent Failures 2

- Messages shall be self explanatory and not require the user to reference a manual
- Examples of messages are:
  - Device not supported
  - Device not responding
  - Hubs not supported
  - Invalid hub topology



# Key Features: No Silent Failures 3

- When two OTG devices are attached
  - messages displayed on the device the user is currently using;
  - typically the OTG device acting in host role



# Summary

- On-The-Go & Embedded Host Supplement delivers great features
  - for all types of embedded systems needing USB
- All of the benefits of USB hosts and devices
- Scalable according to product needs
- Certifiable at one of USB-IF's compliance workshops or test houses
- Certified products already in the marketplace

# Questions ?



# Abbreviations

<b>ADP</b>	Attach Detection Protocol
<b>EH</b>	Embedded Host
<b>GPS</b>	Global Positioning System
<b>HNP</b>	Host Negotiation Protocol
<b>LED</b>	Light Emitting Diode
<b>OTG</b>	On-The-Go
<b>PC</b>	Personal Computer
<b>SRP</b>	Session Request Protocol
<b>TPL</b>	Targeted Peripheral List
<b>USB</b>	Universal Serial Bus
<b>USB-IF</b>	USB Implementer's Forum