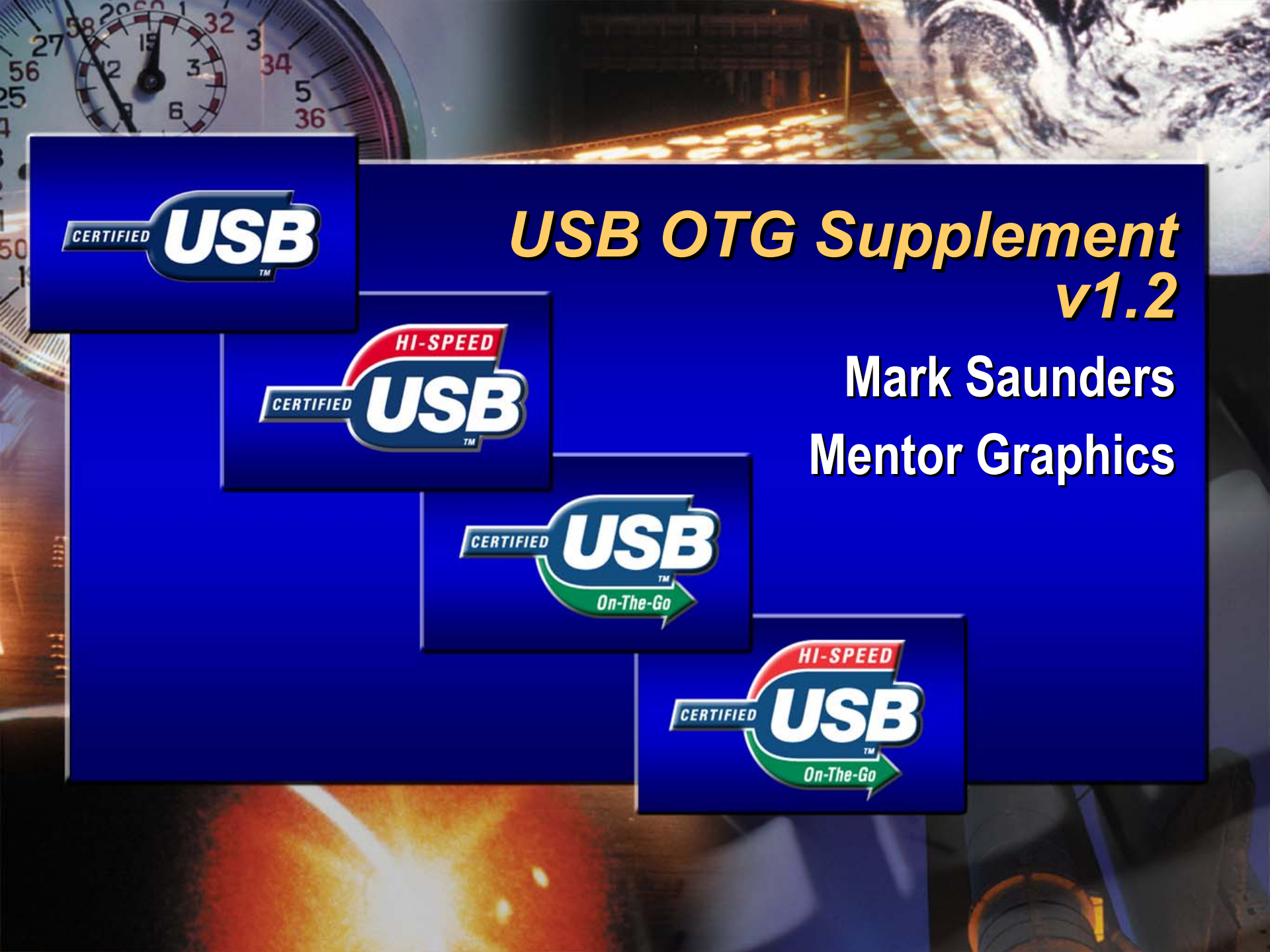


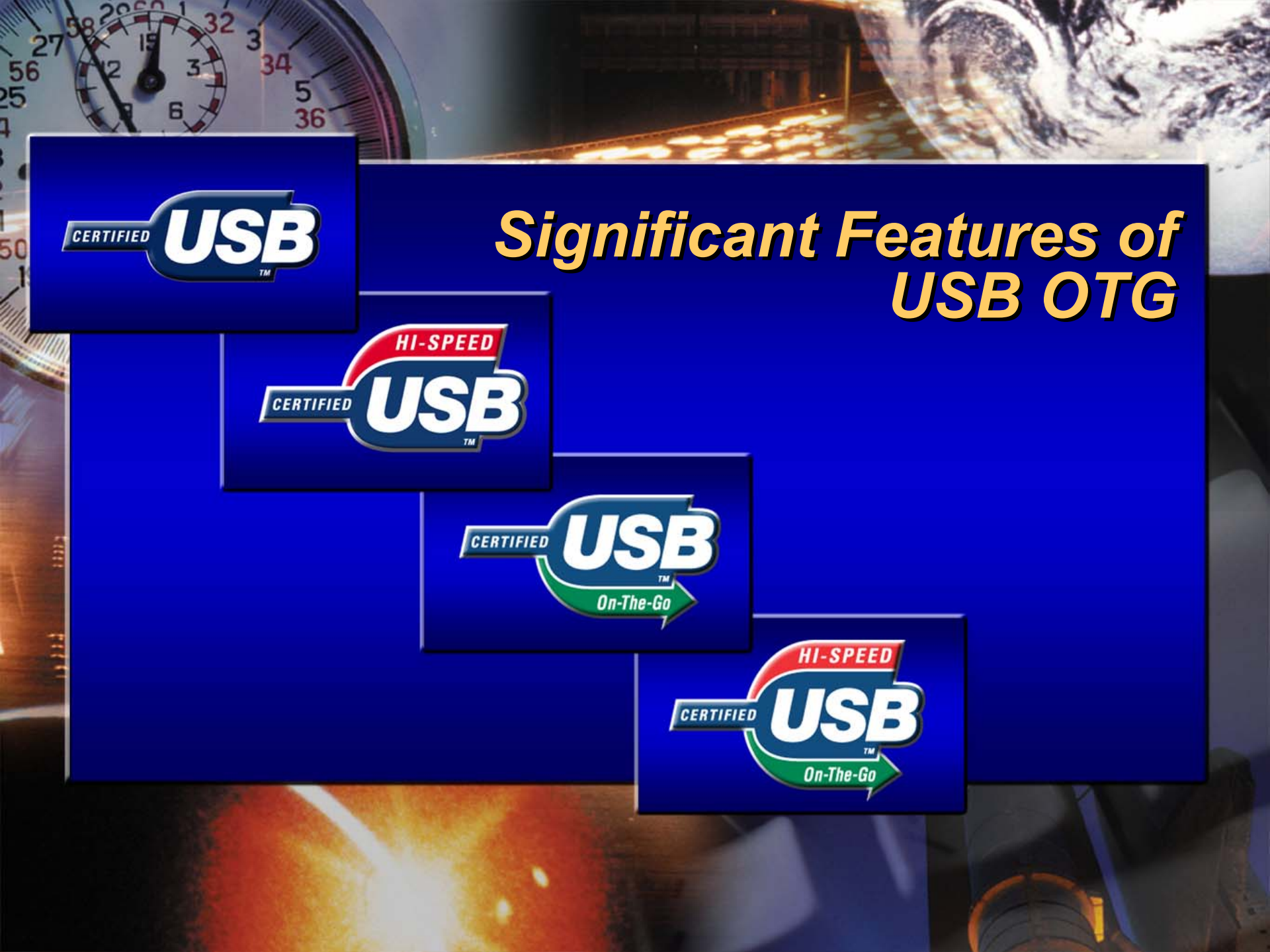
USB OTG Supplement v1.2

Mark Saunders

Mentor Graphics

USB On-The-Go Specification

- Significant features of USB OTG
- Cables and Connectors
- Session Request
- Host Negotiation
- Summary of changes
- Q & A



Significant Features of USB OTG

Minimal Set of Changes

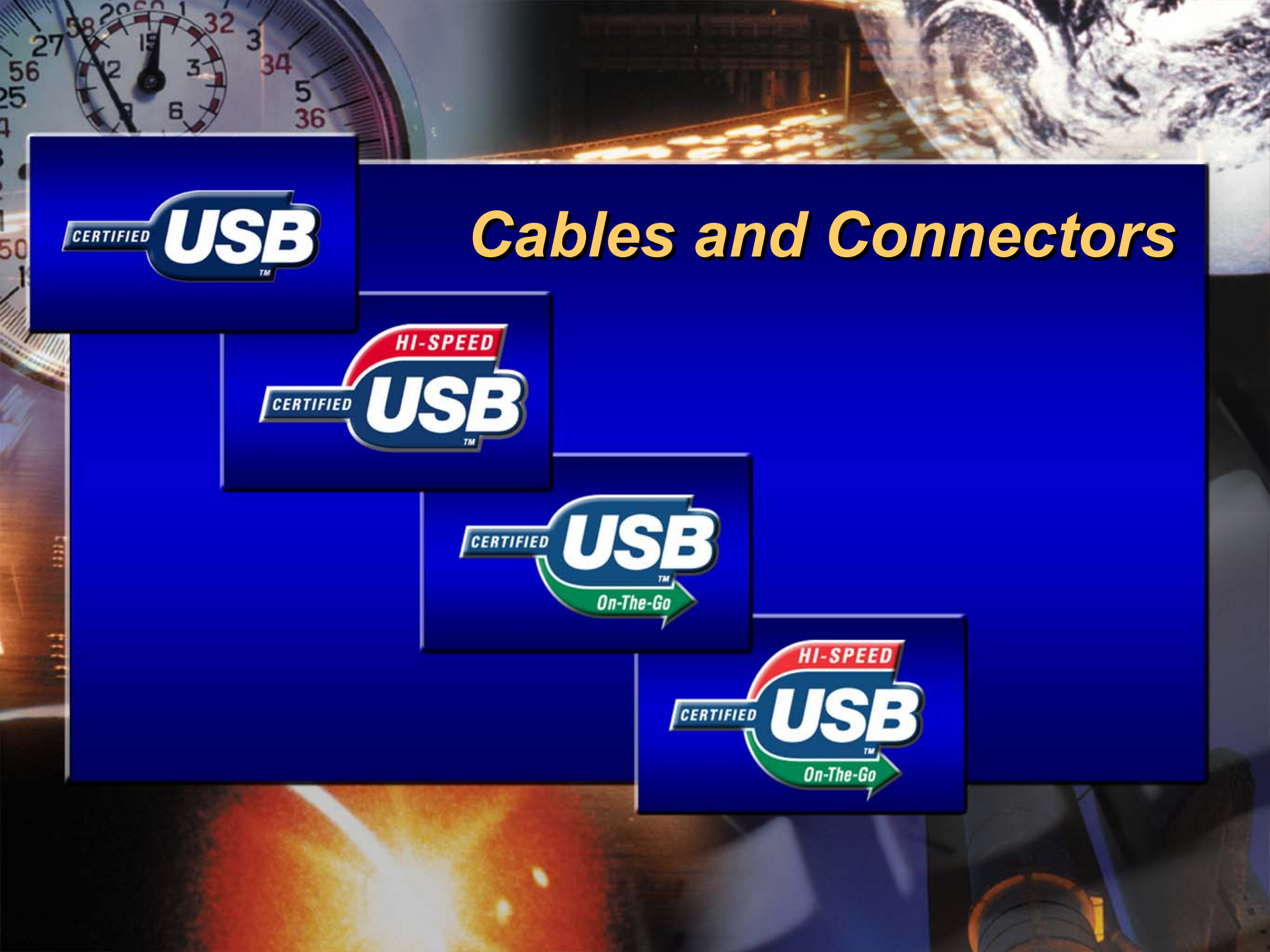
- Targeted Peripheral List (TPL)
- Supply current on V_{BUS}
  - $I_{A\_VBUS\_OUT}$ (8mA)
- Session Request Protocol (SRP)
- Host Negotiation Protocol (HNP)
- Mini Connectors and Cables
- Hub support
  - Device and Host

USB OTG Device

- Fully compliant USB 2.0 Peripheral
- Mandatory Full-Speed Host Support
  - Low- and Hi-Speed Host is optional (per TPL)
    - Hi-Speed Peripherals would only operate at Full-Speed
- Limited Host Capability
- One, and only one, Mini-AB Receptacle
- Means of communicating messages to user
  - No silent failures
- TPL and new protocols

Targeted Peripheral List

- TPL defines supported devices
  - Primitive form lists all tested devices
    - Manufacturer
    - Model
    - Description of device
  - Classes can also be defined in the TPL
    - HID, Mass Storage, etc.
    - List class and specific products tested
  - List composite devices as they enumerate


CERTIFIED USB
Cables and Connectors
HI-SPEED
CERTIFIED USB
CERTIFIED USB
On-The-Go
HI-SPEED
CERTIFIED USB
On-The-Go

The USB OTG Cable

- Mini-A to Mini-B is *the* USB OTG Cable
- Mini-AB Receptacle
  - Cable plugs either way around
  - Mini-A and Mini-B Receptacles are keyed to prevent incorrect insertion
- Extra pin: ID
  - B: ground (<10Ω)
  - A: resistance (>100kΩ)

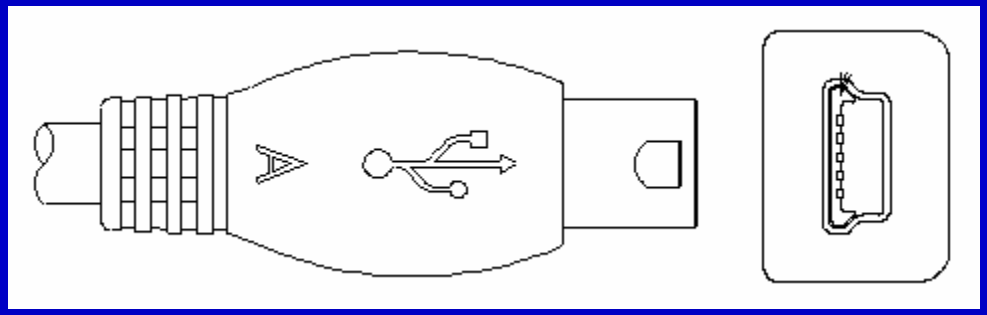
- Pin Assignments

Contact	Signal	Wiring
1	V_{BUS}	Red
2	D-	White
3	D+	Green
4	ID	*A* < $R_{A\_PLUG\_ID}$ *B* > $R_{B\_PLUG\_ID}$
5	GND	Black
Shield	Shield	Drain Wire

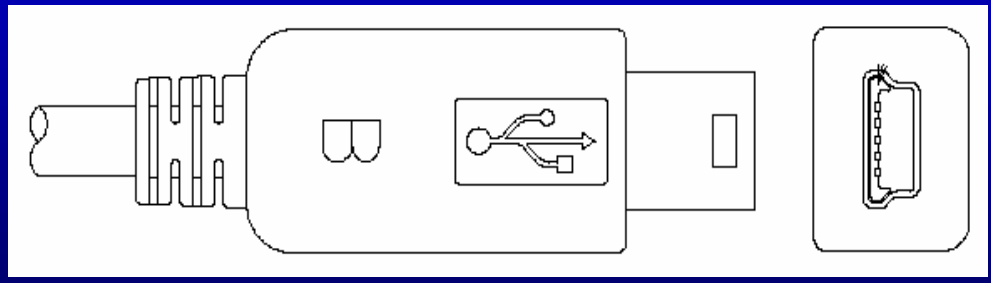
Identifying USB OTG Connectors

- Color-coded plastic
  - Mini-A Plug and Receptacle must be white
  - Mini-B Plug and Receptacle must be black
  - Mini-AB Receptacle must be gray

- Overmolds
  - Mini-A is oval



  - Mini-B is square




Session Request
CERTIFIED USB
HI-SPEED
CERTIFIED USB
CERTIFIED USB
On-The-Go
HI-SPEED
CERTIFIED USB
On-The-Go

Session Request

- SRP Peripherals allow A-devices to conserve power
  - Any A-device may respond to SRP
  - Any B-device may initiate SRP
  - All USB OTG devices must initiate and respond
    - Insertion-based A-devices never use SRP
- Request the A-device to power V_{BUS}
  - V_{BUS} out of $V_{A\_SESS\_VLD}$ or $V_{B\_SESS\_VLD}$ range
    - $V_{A\_SESS\_VLD}$ is 0.8V to 4.0V
    - $V_{B\_SESS\_VLD}$ is 0.8V to 2.0V

SRP Signaling

- B-device waits for initial condition
  - Low V_{BUS}
  - SE0 for $T_{B\_SE0\_SRP}$ min
    - SE0 is D+ and D- low
- Data-line pulsing
  - Pull up D+ for Full Speed SRP
- V_{BUS} pulsing
- B-devices must support both methods
  - Try data-line pulsing before V_{BUS} method
- A-devices only need to support one method

Host Negotiation

Host Negotiation Protocol

PDA

Cell phone

A-host ●⋯⋯⋯⋯⋯⋯→ B-peripheral

Browse web

Drop bus

HNP (automatic)

A-peripheral ←⋯⋯⋯⋯⋯⋯● B-host

Upload addresses

USB OTG Descriptor

- A-device issues GetDescriptor(Configuration)
- B-device responds
  - srp_support
    - Only used during compliance testing to automatically detect the capabilities of the B-device
  - hnp_support
    - If hnp_support is TRUE, then srp_support must also be TRUE

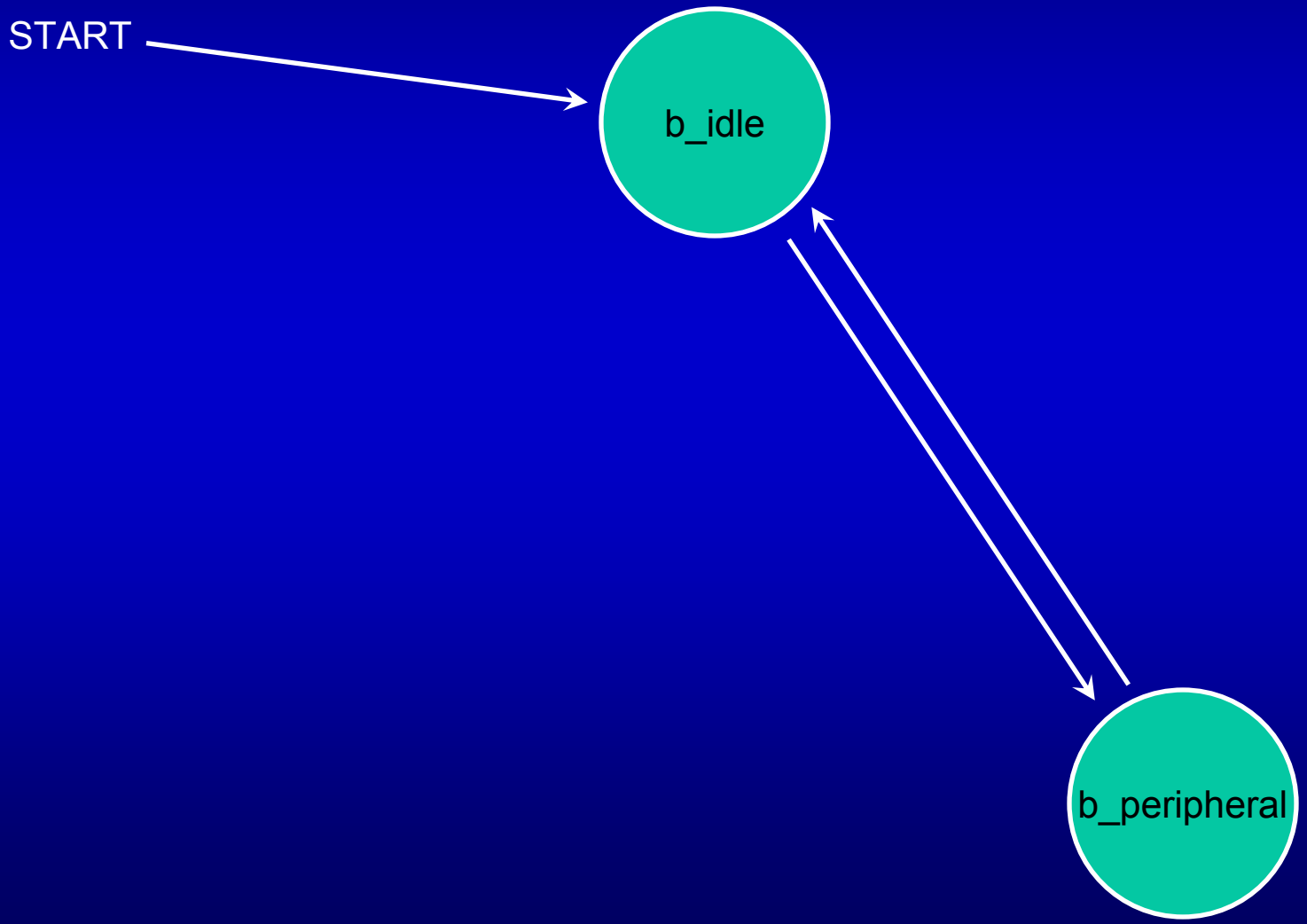
Offset	Field	Size	Value	Description
0	bLength	1	3	Size of Descriptor (constant)
1	bDescriptorType	1	9	OTG Type (constant)
2	bmAttributes	1	Bitmap	D7..D2: Reserved (0) D1: HNP D0: SRP

Using SetFeature()

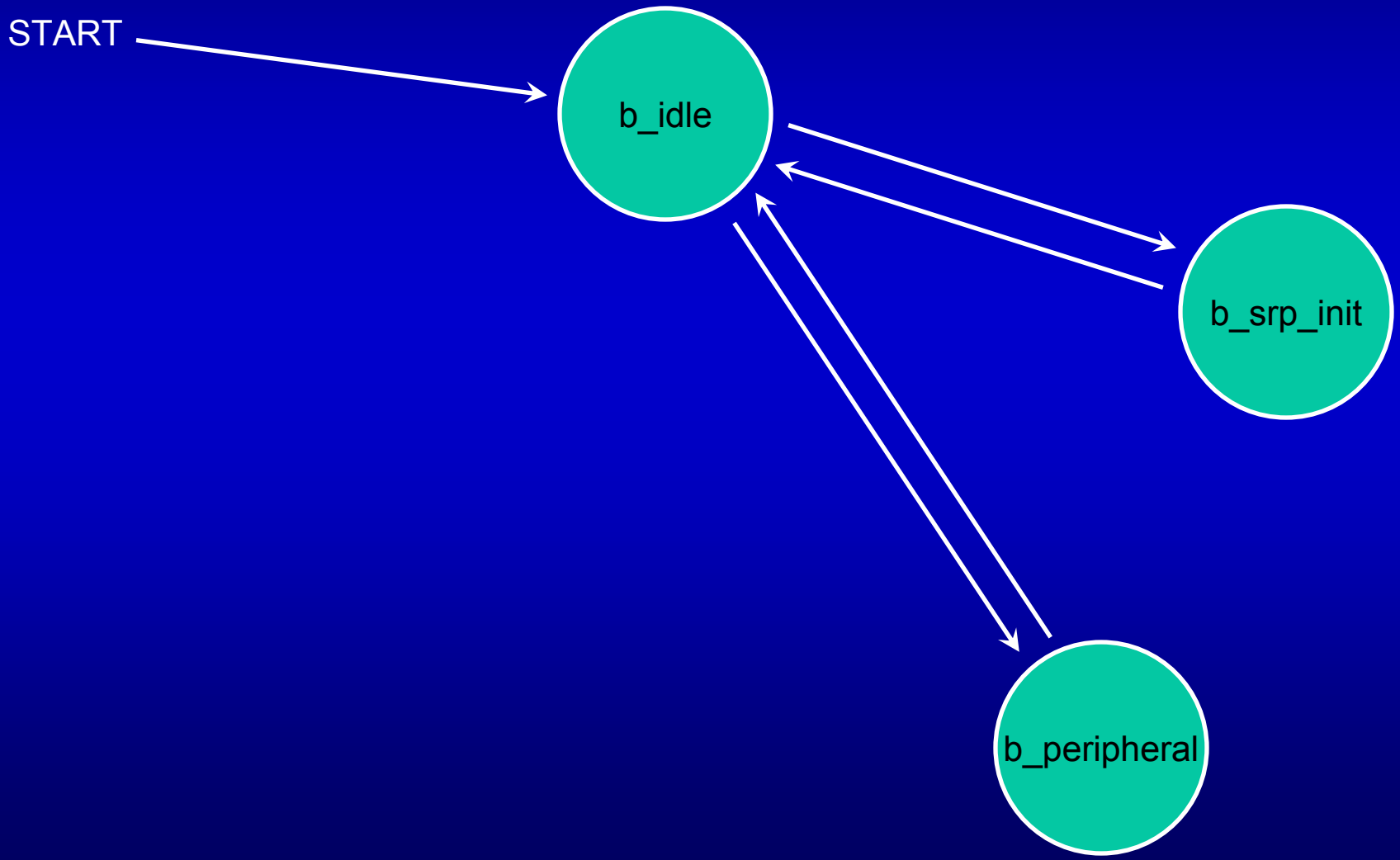
- b_hnp_enable
  - Allows the B-device to initiate HNP
  - Highest priority feature (over-rides the following)
- a_hnp_support
  - Tells the B-Device that HNP is supported
    - HNP is not allowed until b_hnp_enable is set
- a_hnp_alt_support
  - Indicates an alternative port that does support HNP

Feature Selector	Value
b_hnp_enable	3
a_hnp_support	4
a_hnp_alt_support	5

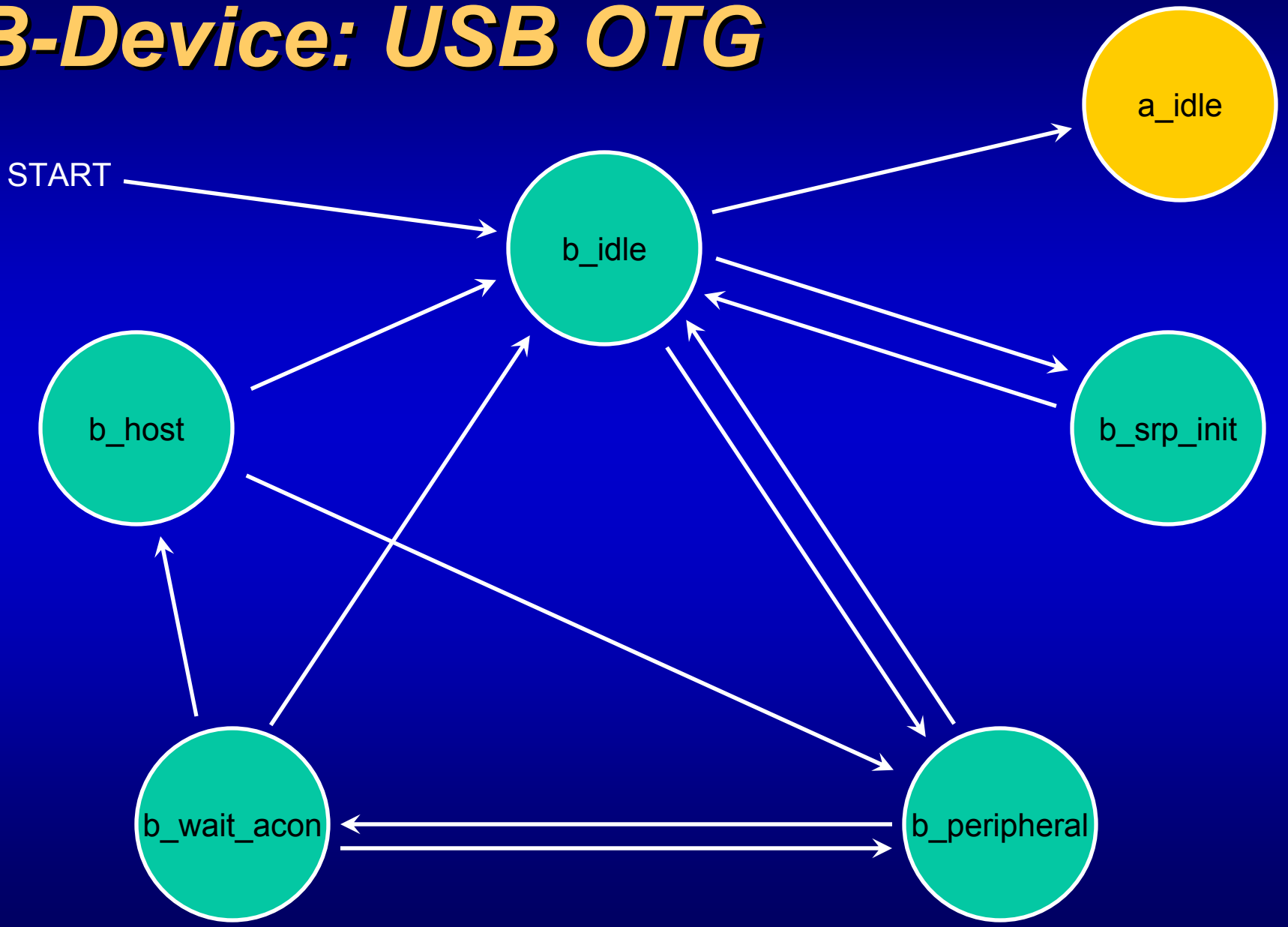
B-Device: Peripheral Only



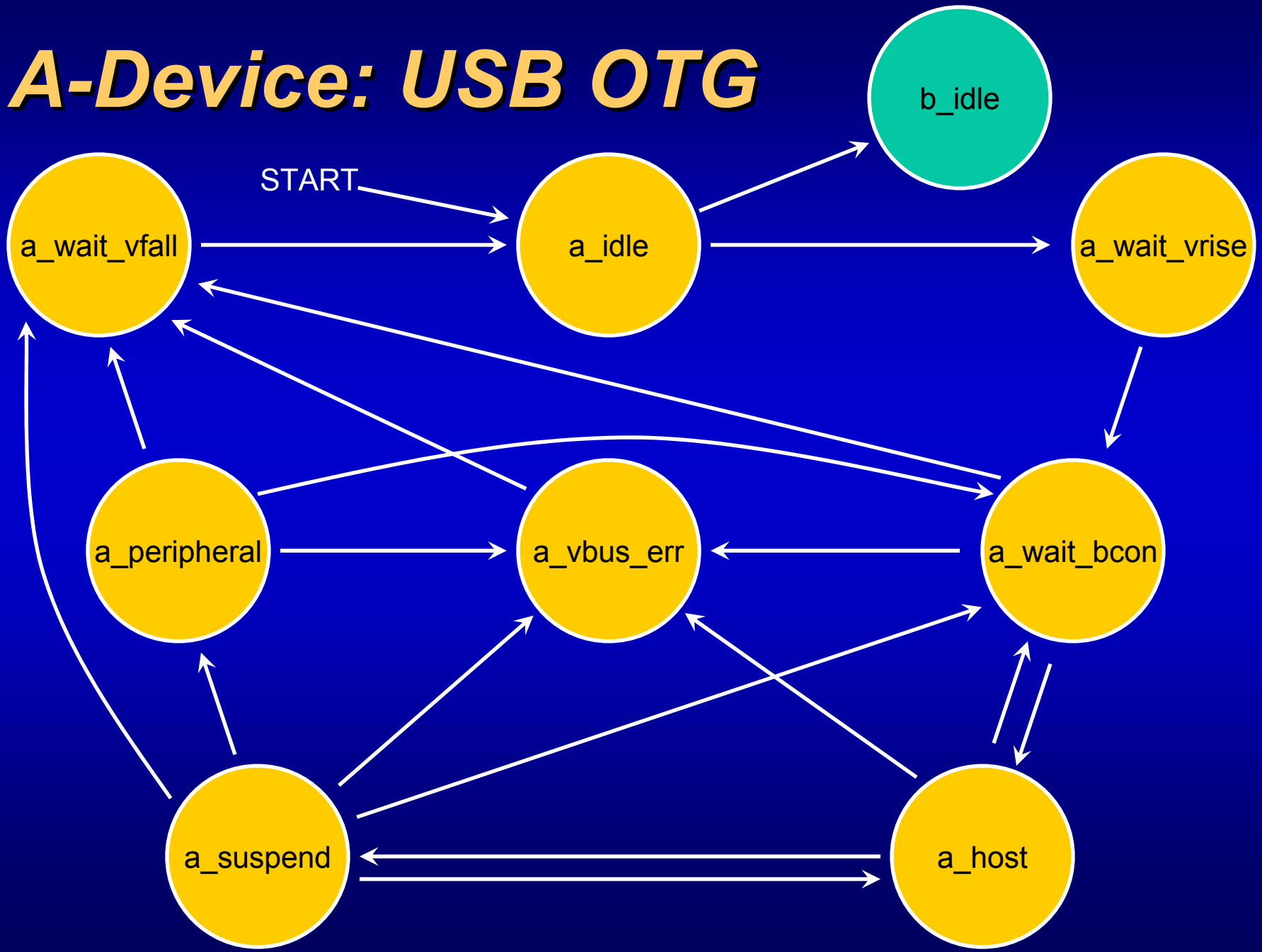
B-Device: SRP-Capable



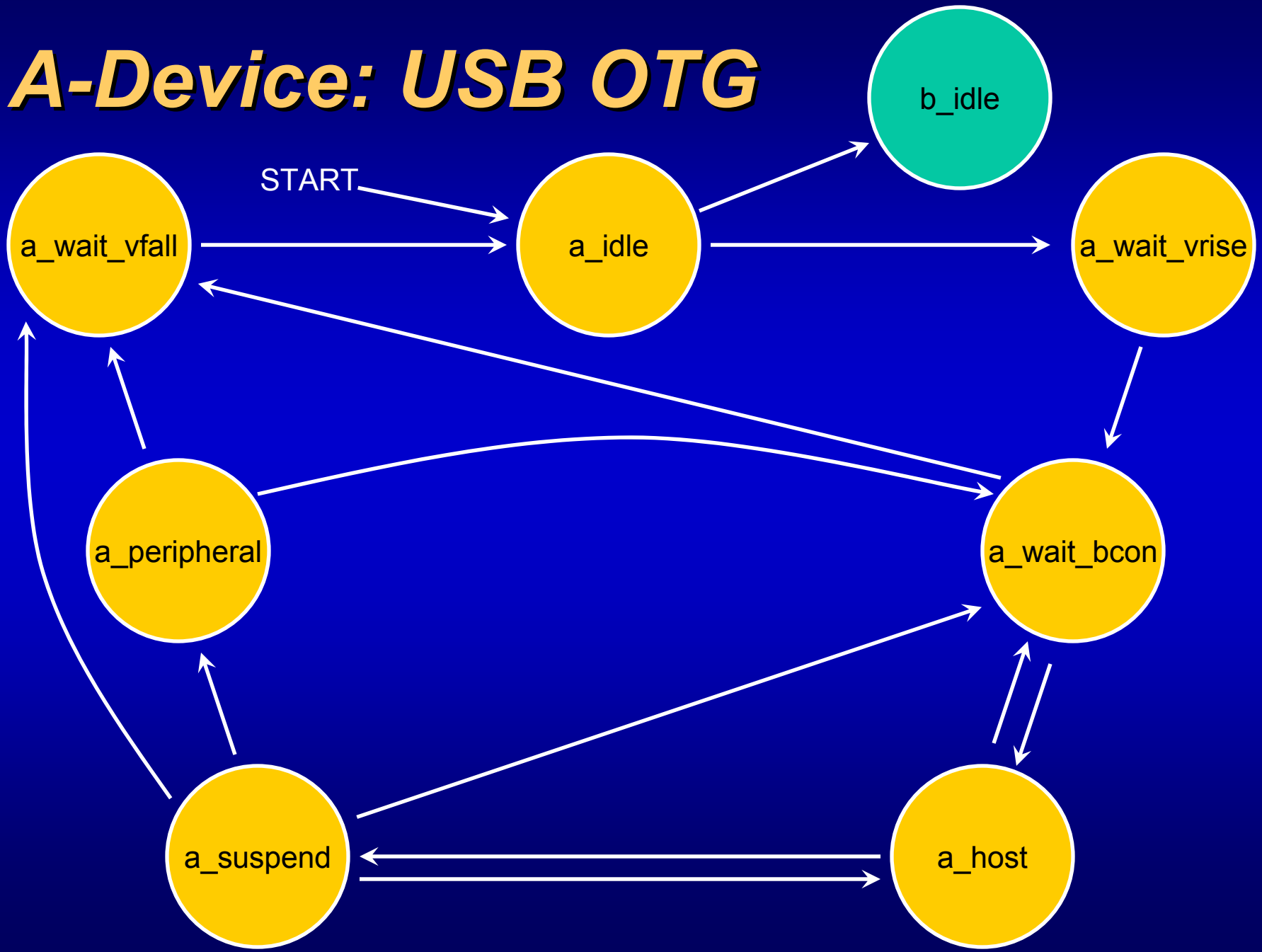
B-Device: USB OTG



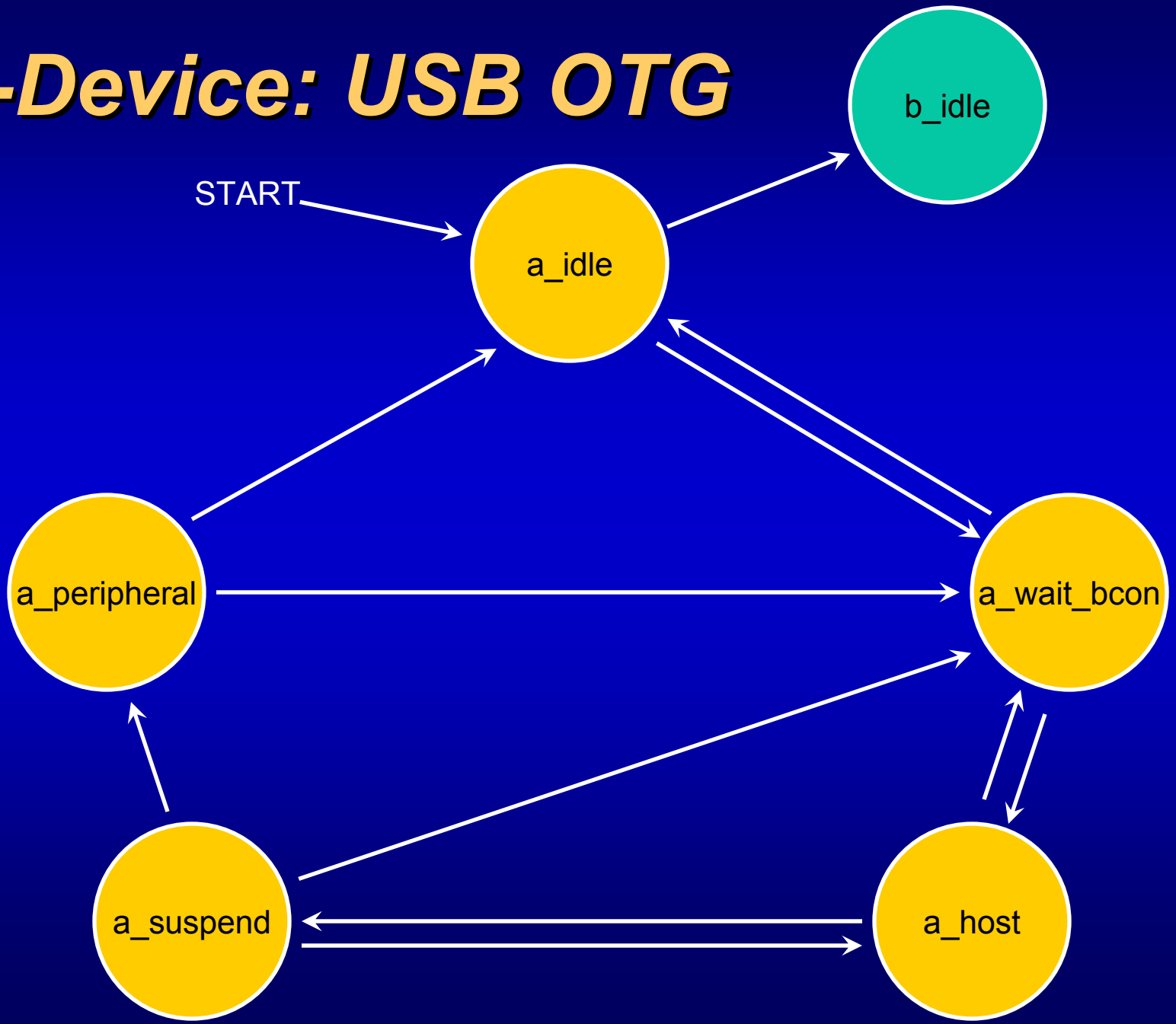
A-Device: USB OTG

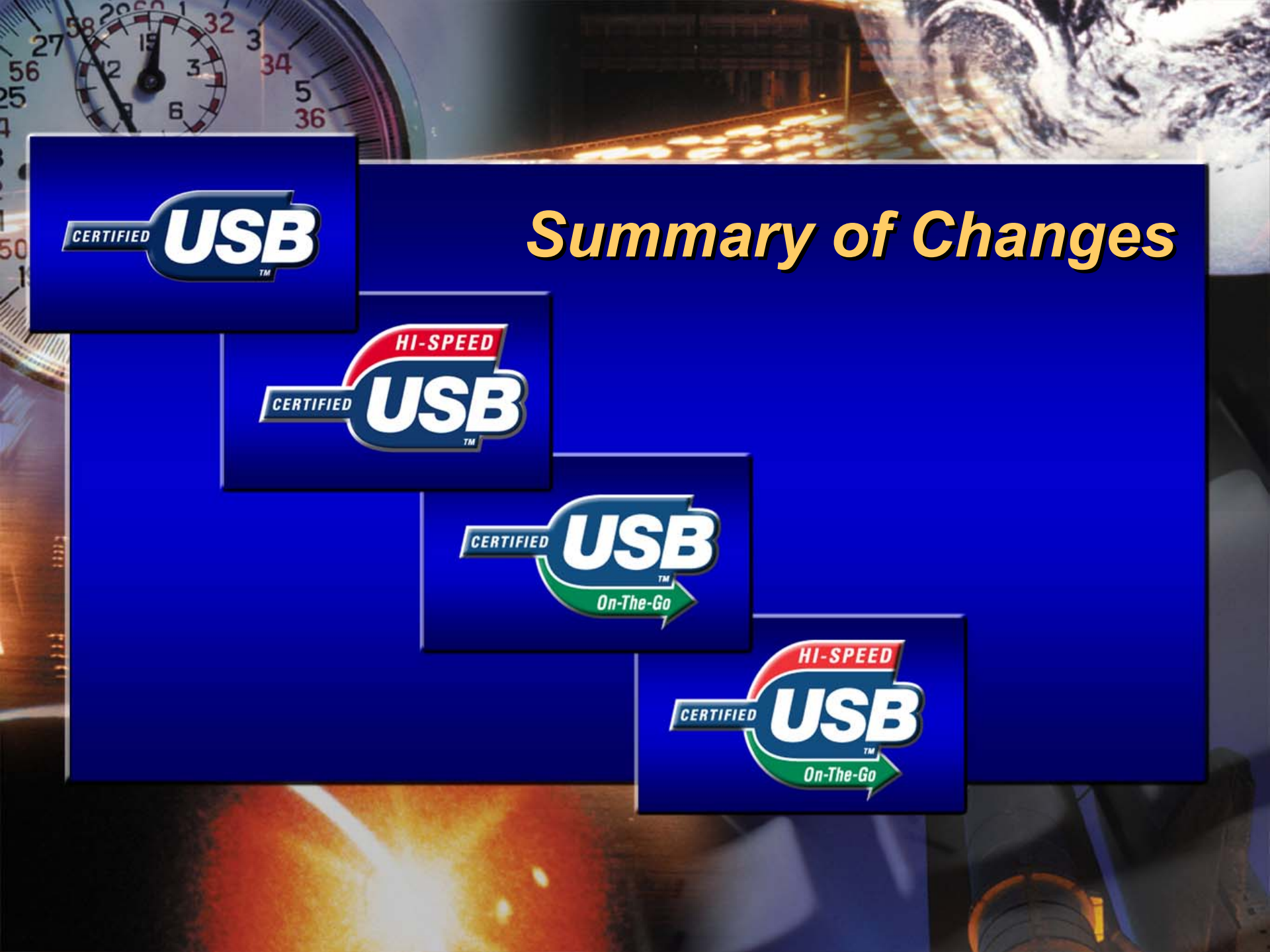


A-Device: USB OTG



A-Device: USB OTG





Summary of Changes

Revision History

- USB OTG Supplement v1.0 in December 2001
- Version 1.0a changes
  - Definition of “USB OTG Device”
  - Clarified short and long de-bounce
  - Updated contributor list
- Version 1.1 changes
  - Clarification of various sections
  - Clarified nomenclature
    - No longer using DRD or Dual Role Device
  - Renamed to v1.2 to avoid confusion with USB 1.1

Errata A: HNP Parameters

- Hi-Speed HNP timing anomaly
- Constituent parts of $T_{B\_AIDL\_BDIS}$ out of range
- Desired values:
  - $T_{B\_AIDL\_BDIS}$ min = 4ms
  - $T_{B\_AIDL\_BDIS}$ max = 150ms
- Change $T_{B\_FS\_BDIS}$ max from 147.0ms to 146.875ms
- Change $T_{B\_AIDL\_BDIS}$ min from 5.0ms to 4.0ms

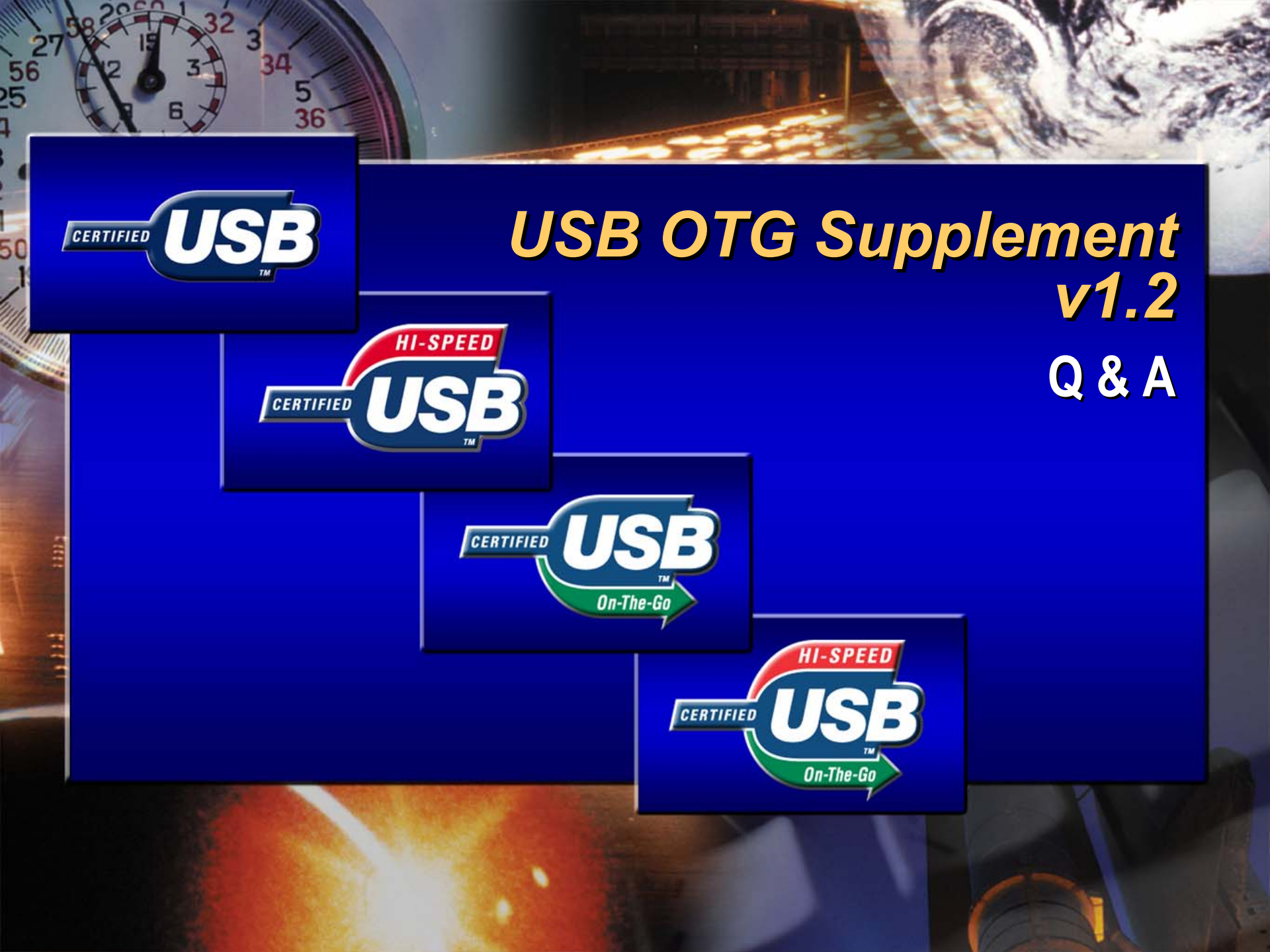
Errata B: SRP Parameters

- SRP race condition
  - B-device can fail before A-device responds
- A-device has $T_{A\_SRP\_RSPNS}$ max = 30s
- B-device must wait $T_{B\_SRP\_FAIL}$ min = 5s
- Change $T_{A\_SRP\_RSPNS}$ max to 4.9s

- Now B-device can wait too long
  - Improve user experience
  - Change $T_{B\_SRP\_FAIL}$ max value from 30s to 6s

Errata C: Remote Wakeup

- USB OTG Hosts must support remote wakeup



USB OTG Supplement v1.2

Q & A