



iWRAP³ Firmware

9.6.2008

Agenda

- **iWRAP³ Overview**
- **Technical Features**
- **Supported *Bluetooth*[®] Profiles**
- **Bluetooth 2.1 + EDR support**
- **Other New Features**
- **Future**



iWRAP³ Overview

iWRAP Overview

- **iWRAP firmware is an embedded software that runs in the internal RISC processor of WT32, WT12 and WT11 modules**
- **iWRAP implements the full *Bluetooth* protocol stack and a set of *Bluetooth* profiles**
 - Serial Port Profile (SPP)
 - Hands Free Profile (HFP)
 - Object Push Profile (OPP)
 - Dial-up Networking Profile (DUN)
 - Human Interface Device (HID)
 - Advanced Audio Distribution Profile (A2DP)
 - A/V Remote Control Profile (AVRCP)
 - Device Identification Profile (DI)
- **iWRAP firmware can be configured to operate autonomously or is controlled by a host processor via ASCII commands (modem like operation)**
 - Supported host communications interfaces: UART, GPIO
 - Other supported interfaces: Analog audio, Digital audio, AIO
- **Bluegiga can easily customize iWRAP for specific application needs**

iWRAP Overview

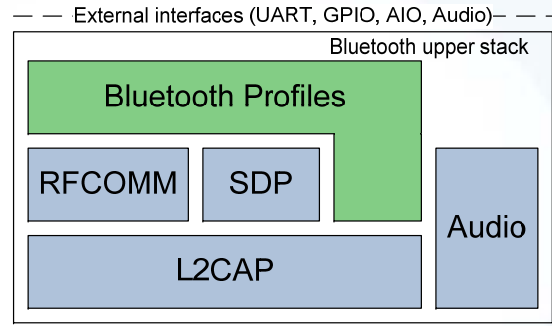
Host processor :

- AVR
- MSP8020
- ARM
- etc.



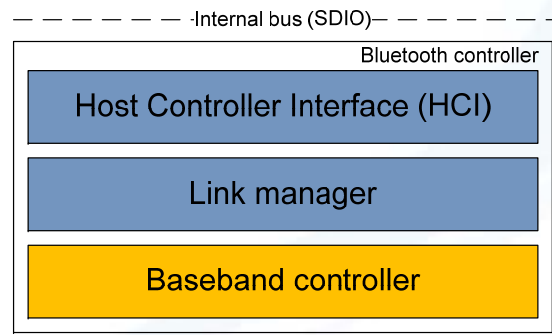
Internal 16-bit RISC:

- WT12
- WT11
- WT32



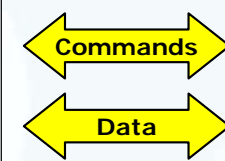
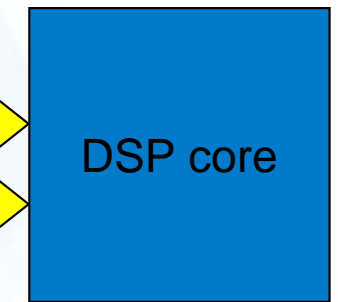
Bluetooth baseband:

- WT12
- WT11
- WT32
- WT21



Internal DSP:

- WT32





Technical Features



Technical Features

Feature:	Value:
MAX simultaneous ACL connections	4
MAX simultaneous SCO connections	1
MAX data rate	600Kbps (WTxx to BT2.0 USB dongle) 500Kbps (WTxx to WTxx) 450Kbps (WTxx to BT1.1-BT1.2 device)
MAX UART baud rate	1000000 bps
Typical data transmission delay	15-20 ms
Minimum data transmission delay	~10ms
PIN code length	Configurable from 0 to 16 characters
Encryption length	Configurable from 0 to 128 bits
MAX simultaneous pairings	16
MAX Friendly name length	Configurable up to 248 characters
RFCOMM Packet size	Configurable from 21 to 1008
Supported Bluetooth profiles	GAP, SPP, HFP (V.1.5), A2DP, AVRCP, HID, DI, OPP* and DUN*
Bluetooth specification version	2.1 + EDR
Supported power saving modes	Sniff and deep sleep



Supported *Bluetooth*® Profiles

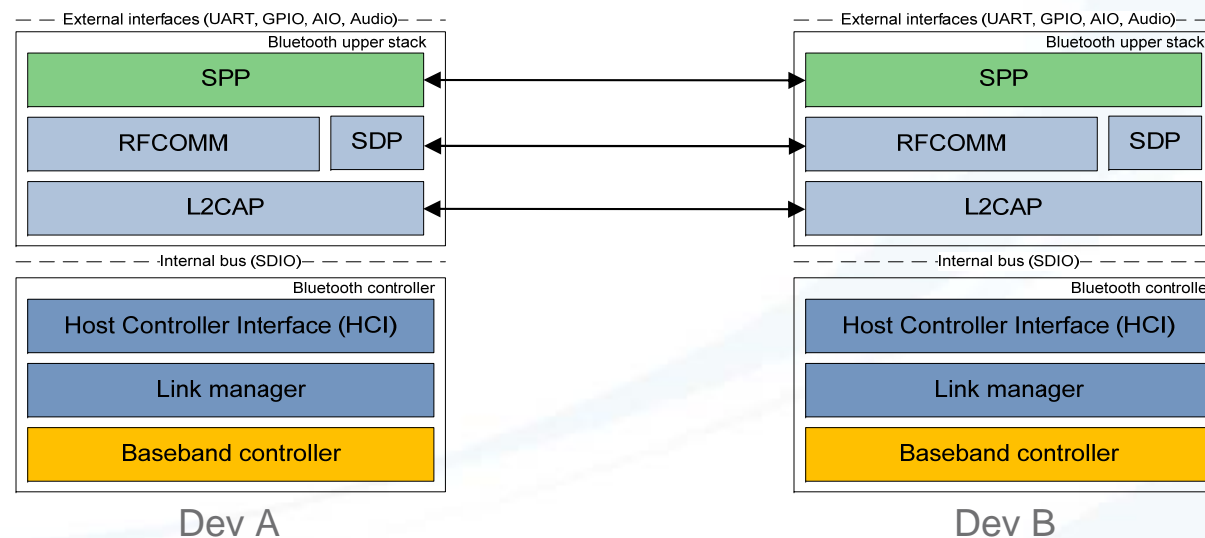


Supported *Bluetooth* Profiles

- Serial Port Profile (SPP) - DevA and DevB
- Hands Free Profile (HFP) v.1.5 - HPF and HFP-AG modes
- Object Push Profile (OPP) - OPP server
- Dial-up Networking Profile (DUN) - Terminal emulation
- Human Interface Device (HID) - HID device
- Advanced Audio Distribution Profile (A2DP) - Sink and source modes
- A/V Remote Control Profile (AVRCP) - AVRCP controller
- Device Identification Profile (DI)

Serial Port Profile

- SPP defines how to set up virtual serial ports and connect two *Bluetooth* enabled devices
 - Device A** – This is the device that takes initiative to form a connection to another device (initiator).
 - Device B** – This is the device that waits for another device to take initiative to connect (acceptor).
- RFCOMM is the *Bluetooth* adaptation of GSM TS 07.10, providing a transport protocol for serial port emulation.



Serial Port Profile

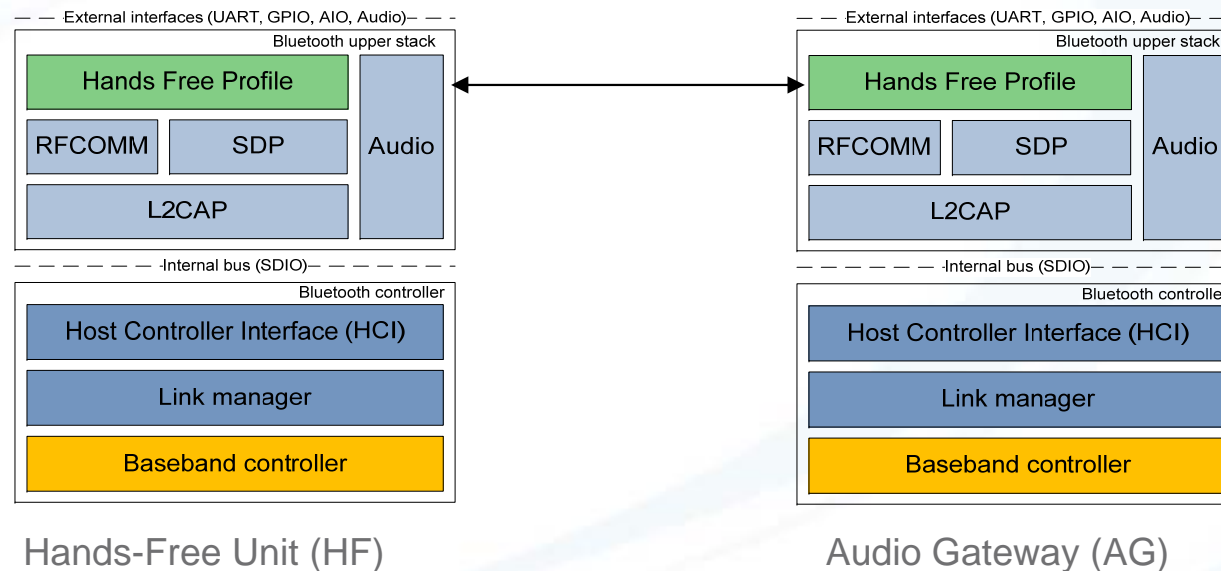


Summary:

- 4 simultaneous SPP connections can be achieved
- Data rate split among the connections
- MUX mode can be used to send/receive data "simultaneously"

Hands Free Profile

- HFP describes how a gateway device can be used to place and receive calls for a hand-free device.
 - Audio Gateway (AG)** – This is the device that is the gateway of the audio, both for input and output, typically a mobile phone.
 - Hands-Free Unit (HF)** – This is the device acting as the Audio Gateway’s remote audio input and output mechanism. It also provides some remote control means.
- iWRAP will act as Hands-Free control entity responsible for Hands-Free unit specific control signaling; this signaling is AT command based.**



Hands Free Profile

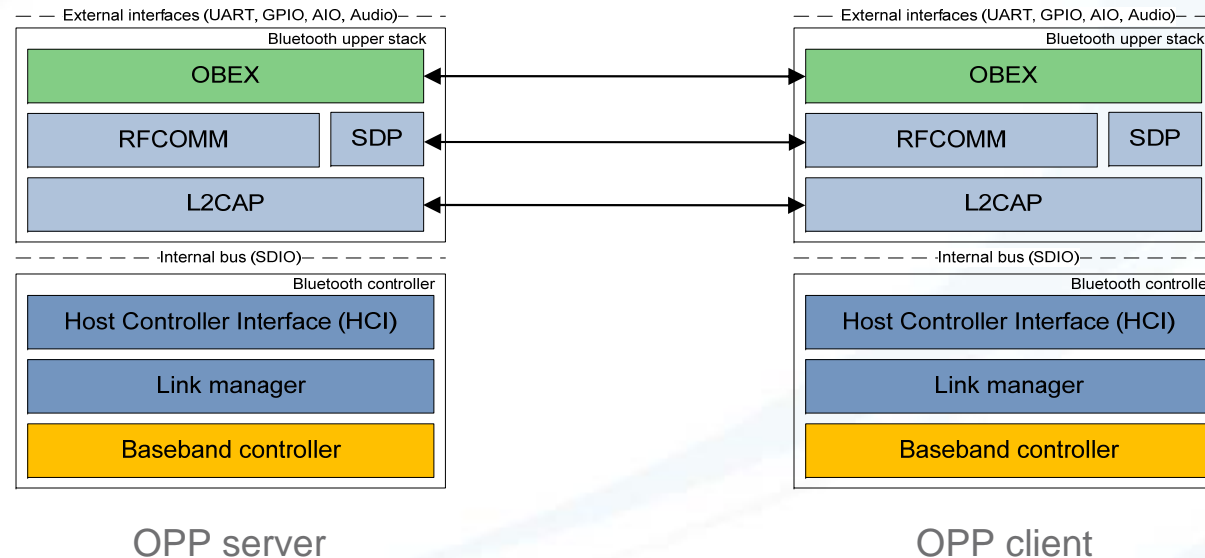


Summary:

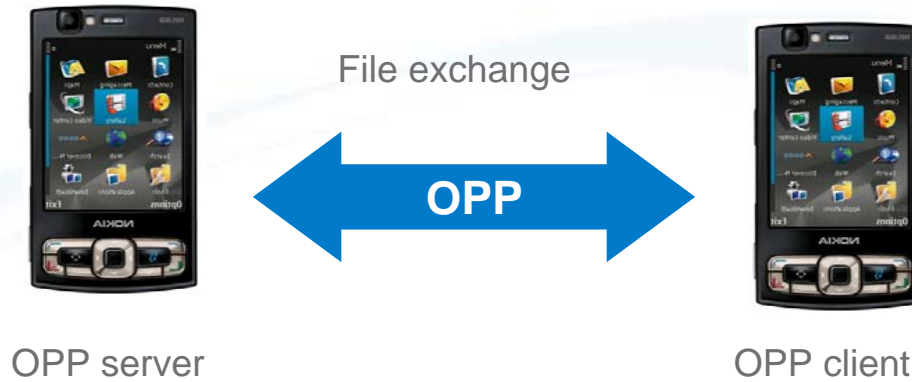
- AT control channel is based on SPP
- Audio uses eSCO/SCO link (eSCO does not use all bandwidth unlike SCO)
- Audio quality: full-duplex, mono, 8kHz, 8bits -> 64kbps

Object Push Profile

- OPP defines the roles of push server and push client. These roles are analogous to and must interoperate with the server and client device roles that GOEP defines.
 - **Push Server** – This is the device that provides an object exchange server.
 - **Push Client** – This is the device that pushes and pulls objects to and from the Push Server. (NOT supported by iWRAP)
- OBEX is the *Bluetooth* adaptation of IrOBEX.



Object Push Profile

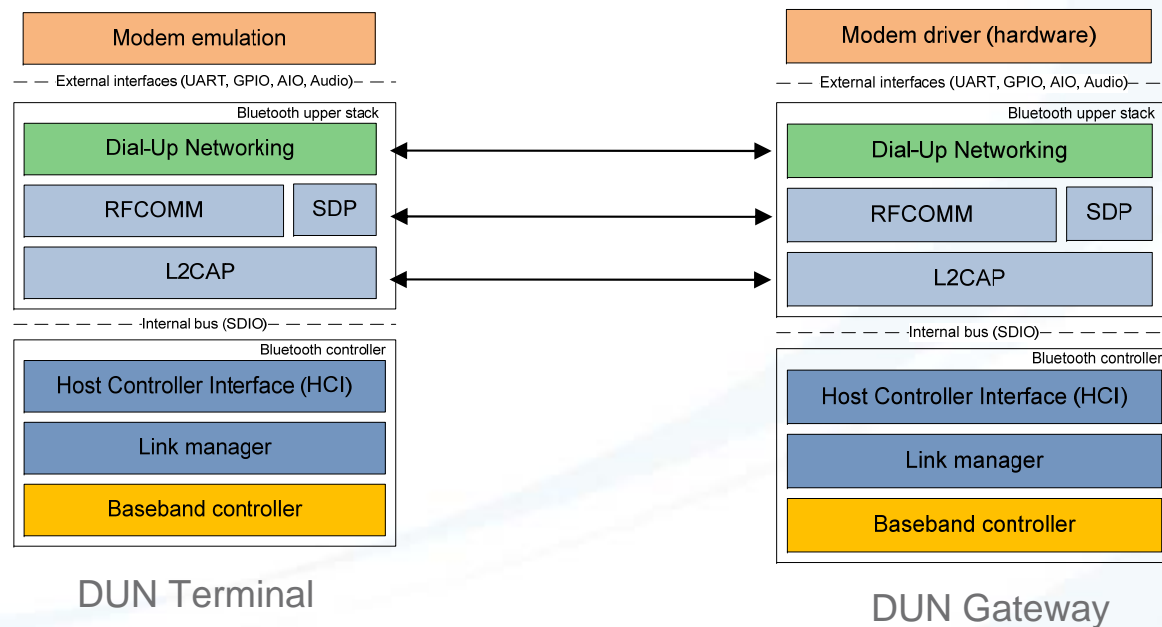


Summary:

- . Only server side (receiving files) is supported
- . OPP is based on SPP, so host side implementation on top of SPP is trivial

Dial-Up Networking Profile

- DUN provides a standard to access the Internet and other dial-up services over *Bluetooth* technology.
 - Gateway (GW)** – This is the device that provides access to the public network. (NOT supported by iWRAP)
 - Data Terminal (DT)** – This is the device that uses the dial-up services of the gateway.
- The most common scenario is accessing the Internet from a laptop by using your mobile phone as a wireless dial-up modem.



Dial-Up Networking

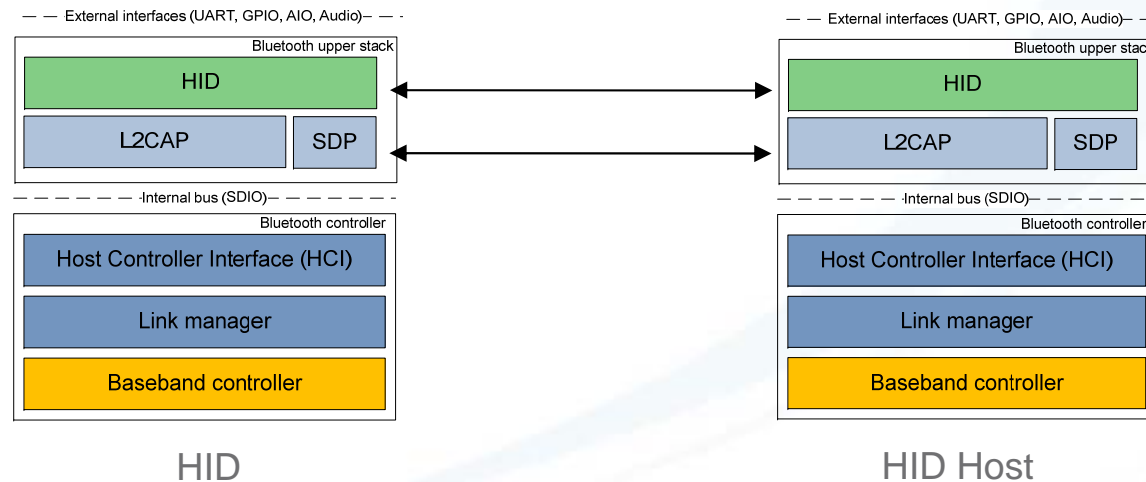


Summary:

- DUN profile allows you to control the modem hardware (SMS, Phone calls, TCP/IP)
- Control is done with AT commands
- iWRAP only support DUN terminal (DUN gateway requires modem hardware)
- iWRAP does not run PPP not TCP/IP stacks, so host must implement one of them (free implementations exists)

Human Interface Device Profile

- The HID profile defines the protocols, procedures and features to be used by *Bluetooth* HID such as keyboards, pointing devices, gaming devices and remote monitoring devices.
 - Human Interface Device (HID)** – The device providing the service of human data input and output to and from the host.
 - Host** – The device using or requesting the services of a Human Interface Device. (NOT supported by iWRAP)
- The HID profile uses the universal serial bus (USB) definition of a HID device in order to leverage the existing class drivers for USB HID devices.



Human Interface Device Profile

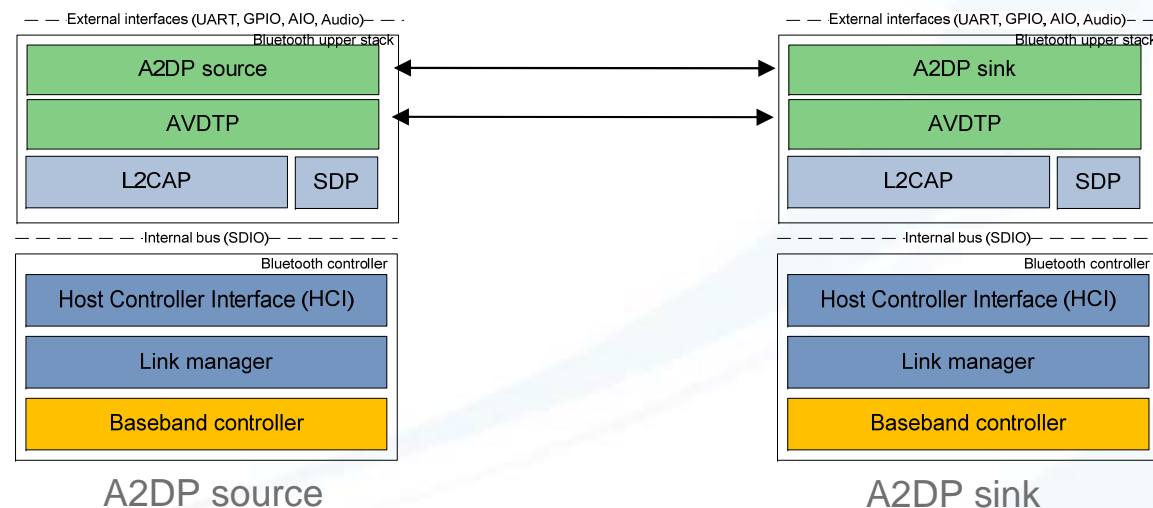


Summary:

- iWRAP supports HID mouse and keyboard simultaneously
- Keyboard data sent as ASCII commands (ASCII codes 32-126) + special keys
- 3 button, 2-axis mouse
- Raw mode for sending any HID reports

Advanced Audio Distribution Profile (A2DP)

- A2DP describes how stereo-quality audio can be streamed from a media source to a sink.**
 - Source (SRC)** – A device is the SRC when it acts as a source of a digital audio stream that is delivered to the SNK of the piconet.
 - Sink (SNK)** – A device is the SNK when it acts as a sink of a digital audio stream delivered from the SRC on the same piconet.
- A2DP defines the protocols and procedures that realize distribution of audio content of high-quality in mono or stereo on ACL channels. The term “advanced audio,” therefore, should be distinguished from “Bluetooth audio,” which indicates distribution of narrow band voice on SCO channels as defined in the baseband specification.**



Advanced Audio Distribution Profile (A2DP)



A2DP source



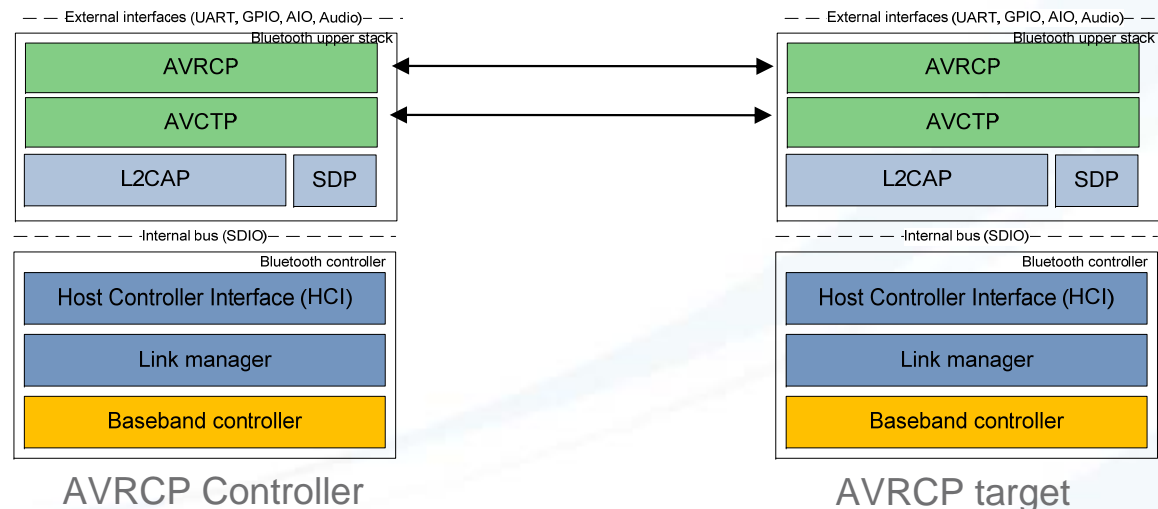
A2DP sink

Summary:

- A2DP includes mandatory support for low complexity subband codec (SBC) and supports optionally MPEG-1,2 Audio, MPEG-2,4 AAC and ATRAC.
- A2DP is only half-duplex
- Surround sound distribution is not included in the scope of A2DP

Audio/Video Remote Control Profile

- VRCP is designed to provide a standard interface to control TVs, hi-fi equipment, or others to allow a single remote control (or other device) to control all the A/V equipment to which a user has access. It may be used in concert with A2DP or VDP.
 - Controller** – The controller is typically considered the remote control device.
 - Target** – The target device is the one whose characteristics are being altered.
 - In a “walkman” type media player scenario, the **control** device may be a headset that allows tracks to be skipped and the **target** device would be the actual medial player.
- This protocol specifies the scope of the AV/C Digital Interface Command Set to be applied, realizing simple implementation and easy operability. This protocol adopts the AV/C device model and command format for control messages and those messages are transported by the Audio/Video Control Transport Protocol (AVCTP).



Audio/Video Remote Control Profile



AVRCP controller



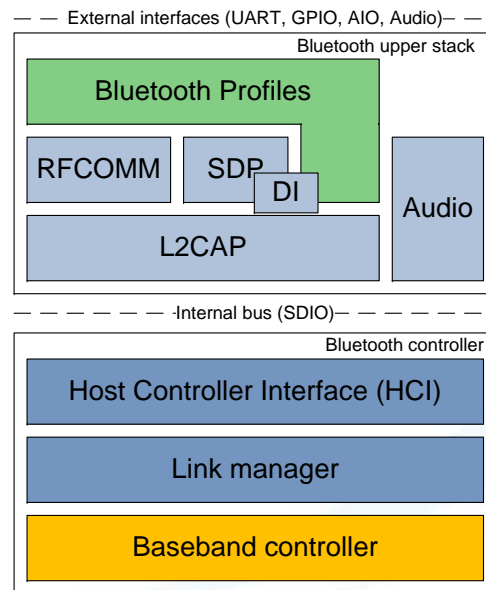
AVRCP target

Summary:

- iWRAP implements AVRCP controller
- AV commands are sent as simple ASCII strings, like "AV PLAY" and "AV PAUSE"

Device Identification Profile

- Device ID profile can be used to identify the manufacturer and model of Bluetooth devices by transmitting the Device ID Service Record or so called *PNP* Information over Bluetooth link.
- DI profile is part of Bluetooth SDP profile.





Bluetooth 2.1 + EDR support

Bluetooth 2.1 + EDR

Several new commands for handling audio configuration and audio hardware.

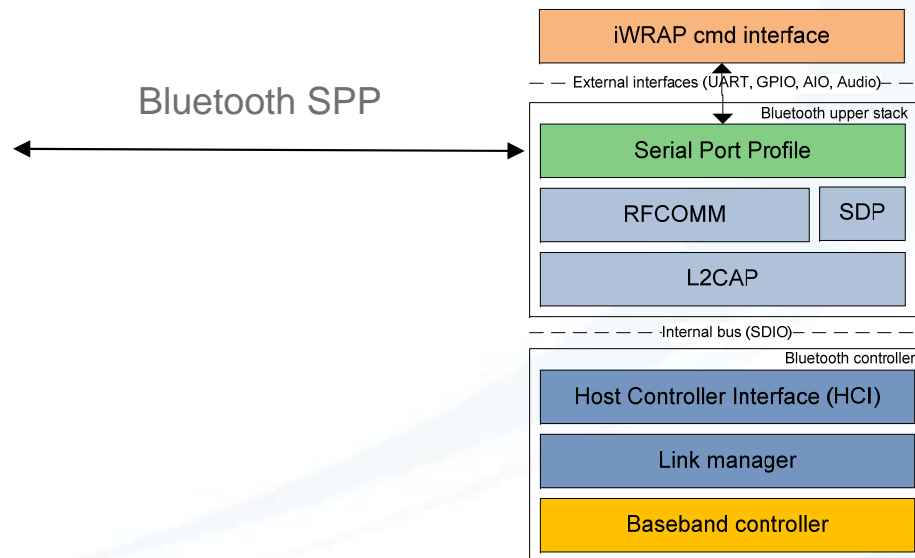
- **Enhanced Inquiry Response**
 - iWRAP displays EIR reports during inquiry
 - EIR reports can be enabled or disabled
- **Sniff subrating**
 - Supported if other end requests for it
 - Can not be activated from iWRAP yet
- **Park mode was removed from Bluetooth 2.1**



Other New Features

Over-the-Air configuration

- A 2nd Serial Port Service (SPP) that gives access to the iWRAP command interface
- 2 level protection:
 - Bluetooth pin code
 - Password protection
- Can be used for production line or "on the field" configuration.
- Also for remote GPIO reading/writing



Audio Configuration

Several new commands for handling audio configuration and audio hardware.

- **SET CONTROL GAIN {in} {out}** - Controls ADC and DAC gain (WT32 only)
- **SET CONTROL PCM {config} {data}** - Configures PCM codec and data format
- **SET CONTROL MICBIAS {vol} {current}** - Configures MIC bias voltage and current (WT32 only)
- **"VOLUME [value] | UP | DOWN"** - Increases or decreases volume level (WT32 only) (alias for SET CONTROL GAIN)

GPIO Handlers

iWRAP3 has commands to read and write the direction and status of GPIO pins:

- "PIO GETDIR" - Reads the contents of the PIO data direction register
- "PIO GET" - Reads the contents of the PIO data input register
- "PIO SET {mask} {bits}" - Sets the contents of the PIO data output register
- "PIO SETDIR {mask} {bits}" - Sets the contents of the PIO data direction register
- "PIO GETBIAS" - Reads the contents of the bias register
- "PIO SETBIAS {mask} {bits}" - Sets the contents of the bias register
- "PIO RESET" - Restores iWRAP default PIO registers

Adaptive Sniff mode

iWRAP3 can automatically change the power saving state of Bluetooth connections.

- "SET BT SNIFF {mode} {min} {max} {attempt} {timeout} {duration}"

Example:

"SET BT SNIFF 1 40 20 1 8 60"

iWRAP will use ACTIVE mode until link has been 60 seconds idle and then moves then to sniff equivalent to SET BT SNIFF 40 20 1 8.

L2CAP connections

iWRAP3 supports setting up raw L2CAP connections.

Is useful if one wants to implement L2CAP based profiles over iWRAP.

- **L2CAP {psm}** - Registers L2CAP psm
- **CALL {bd_addr} {psm} L2CAP** - Opens L2CAP connection

Bluetooth Clock

- Clock command and event can be used to read Bluetooth piconet clock value.
- This is useful in sensing applications where one needs to time synhronize slaves
- **CLOCK {link_id}** - Reads Bluetooth piconet clock value
Accuracy 625us

Connection Repeater

iWRAP3 can act as a repeater / range extender for RFCOMM connections

- **CONNECT {link_id} {link_id}** - Connects two {link_id}:s together as a transparent connection

blue giga

Future

Future: iWRAP 4

- Rest of Bluetooth 2.1 + EDR
 - Secure simple pairing
 - Full support for sniff subrating
 - etc.
- Health Device Profile (HDP)
 - Dedicated profile for Medical / Health devices
- AVRCP v.1.4
 - File browsing, transmission of song titles etc.
- Digital audio support
 - A2DP over digital interfaces I²S and SPDIF
- Multiple SCOs
 - Capability to handle 2 simultaneous SCO links (HFP)
(Only for WT32)
- Phone Book Access Profile
 - Read / Write phone book entries to mobile phones
- USB
 - iWRAP over USB interface
- More DSP extensions
 - Extra encryption, etc. for WT32



Thank You