BlueZ - Plugging the Unpluggable

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Agenda

- BlueZ High-level Architecture
- Audio Architecture
  - With PulseAudio reference design
- Control Architecture
- Telephony Architecture
  - With oFono reference design
- Network Architecture
  - With ConnMann reference design
BlueZ High-level Architecture

User Space
- bluetoothd

Kernel Space
- obexd
- Audio
- Control
- Network
- Telephony
- HCI sockets
- MGMT sockets
- SCO sockets
- RFCOMM sockets
- L2CAP sockets
- BlueZ Core
BlueZ Interfaces

• Application interfaces are D-Bus based
• Use cases based high-level interfaces
• Limited exposure to Bluetooth technical low-level details
• Agent based interfaces
D-Bus agents and BlueZ

- User interface creates unique D-Bus object and registers it
- If required daemon will call into that D-Bus object for extra information
- Agent can reply with information or detailed error codes
Audio Architecture

- **Hands-free Profile (HFP)**
  - Mono voice quality at 8khz
  - Voice commands, navigation and calls
  - Low Latency
  - Bluetooth audio link (SCO)

- **Advanced Audio Distribution Profile (A2DP)**
  - Sink or source role
  - Stereo
  - Medium/High Latency
  - Bluetooth data link (ACL)
Audio Interaction

Application

bluetoothd

PulseAudio

org.bluez.Audio.Connect

org.bluez.Media.RegisterEndpoint

Return empty

org.bluez.MediaEndpoint.SelectConfiguration

Return configuration

org.bluez.MediaEndpoint.SetConfiguration

Return empty

org.bluez.MediaTransport.Acquire

Return file descriptor
PulseAudio Integration

- **module-bluetooth-discover**
  - Detects and loads device modules
- **module-bluetooth-device**
  - Card creation and profile detection
  - Telephony Duplex (HFP)
    - Phone, PC and IVI roles
    - PCM and HCI routing
  - High Fidelity Playback (A2DP)
    - Phone, PC and IVI roles
    - SBC codec
Control Architecture

- Audio and Video Remote Control Profile (AVRCP)
  - Key input
  - Player settings
  - Track metadata
  - Volume control
  - Media Browsing
Control Interaction

- `bluetoothd`
  - `org.bluez.Media.RegisterPlayer`
    - Return empty or error
      - `org.bluez.MediaPlayer.PropertyChanged`
        - `org.bluez.MediaPlayer.TrackChanged`
Telephony Architecture

- **Hands-free Profile**
  - GSM based call states
  - AT commands
  - Volume control
  - Speech control
  - Echo Cancellation and Noise Reduction

- **Dial-up Network Profile (DUN)**

- **Sim Access Profile (SAP)**

![Diagram showing Telephony and Audio connections](bluetoothd)

```
bluetoothd

/org/bluez/[hci0]/hci0
/org.bluez.Telephony

/telephony/path
org.bluez.TelephonyAgent

/org/bluez/[hci0]/hci0/dev...
org.bluez.MediaTransport
```

```
Audio

Telephony
```
Telephony Interaction

PulseAudio

bluetoothd

org.bluez.Telephony.RegisterAgent
Return empty
org.bluez.TelephonyAgent.NewConnection
Return empty
org.bluez.MediaTransport SetProperty
Return empty
org.bluez.MediaTransport.PropertyChanged

oFono

org.bluez.Telephony.RegisterAgent
org.bluez.TelephonyAgent.NewConnection
org.bluez.MediaTransport SetProperty
org.bluez.MediaTransport.PropertyChanged
Network Architecture

- Personal Area Network Profile (PAN)
  - Bluetooth Network Encapsulation Protocol (BNEP)
  - Network Access Point (NAP)
  - Group Ad-hoc Network (GN)
  - PAN user (PANU)
Network Interaction

ConnMan Network

| org.bluez.Network.Connect
<table>
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<tr>
<th>Return empty or error</th>
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bluetoothd

| org.bluez.NetworkServer.Register
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<tr>
<th>Return empty or error</th>
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ConnMan Tethering

<table>
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<th>org.bluez.Network.Disconnect</th>
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<th>Unregister</th>
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Future development

- **Management interface**
  - Kernel based handling of Bluetooth controllers
  - Power efficient with limited wake-ups of user space
  - BlueZ 5.x

- **High-Speed support**
  - Alternate MAC/PHY support
  - Work in progress

- **Low-Energy support**
  - Work in progress
Questions?