Next Generation BlueZ & Bluetooth Smart Devices

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Bluetooth – Short Introduction

- **Short range wireless technology operating at 2.4 GHz**
- **Originally announced in 1998 as a replacement for RS-232**
  - but has evolved way beyond that
- **1.1 in 2001 fixed many issues in the initial version**
- **2.0 in 2004 with increased data rate from 1 to 3 Mbit/s**
- **3.0 in 2009 with High Speed support together with WiFi**
- **4.0 in 2010 with Low Energy (aka Bluetooth Smart)**
  - Bringing Bluetooth into many new kinds of devices

Bluetooth – Common Uses

- File transfer
- Contacts & Message access
- High quality audio streaming
- Media playback control
- Phone call control & audio
- Health care devices
- Human Input Devices
- Networking
- ...and many more

Bluetooth Low Energy

- **A new 2.4 GHz technology reusing many features of Bluetooth**
- **Went through several names in its evolution**
  - Wibree, Ultra Low Power, Low Energy
- **Now official branding**
  - Bluetooth Smart – For single-mode (LE-only) devices
  - Bluetooth Smart Ready – For dual-mode (LE + traditional Bluetooth)
- **Much lower power consumption – coin-cell battery is enough**
  - ...with the drawback of having less bandwidth than traditional Bluetooth
- **Much faster connection creation**
  - Smaller penalty for being more often disconnected – saves more power

Bluetooth Smart Devices

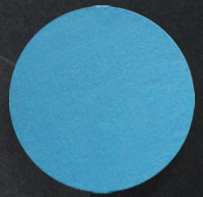
Differences to traditional Bluetooth

- **Connection model**
  - Scanning and Advertising
- **All profiles based on the Attribute Protocol**
  - ATT = Attribute Protocol
  - GATT = Generic Attribute Profile
- **Device roles in matching pairs**
  - Central & Peripheral
  - Observer & Broadcaster
- **Security algorithms on the host side instead of the controller**
- **Privacy**
  - Random device addresses in addition to public ones

ATT & GATT

- **A basis for all LE profiles**
- **Smallest logical unit – the attribute**
  - Type
  - Value
  - Permissions
- **Hierarchy**
  - Profile
  - Service
  - Characteristic
- **Read/write operations, indications & notifications**

BlueZ



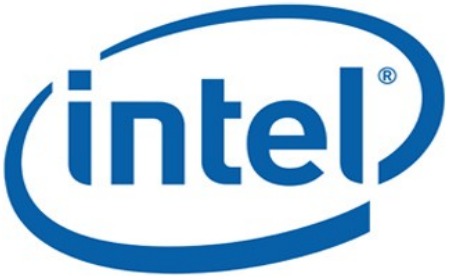
BlueZ - History

- **Standard Linux Bluetooth stack since 2.4.6 (2001)**
- **BlueZ 2 in 2002**
- **BlueZ 3 in 2006**
  - First D-Bus release
- **BlueZ 4 in 2008**
  - Refined D-Bus
  - Bluetooth 2.1 support
- **BlueZ 5 end of 2012**
  - Refined D-Bus
  - Bluetooth 4.0 support

BlueZ – Maintainers & Contributors

- **Maintainers**
  - Marcel Holtmann (Intel, Kernel & User Space)
  - Johan Hedberg (Intel, Kernel & User Space)
  - Luiz Von Dentz (Intel, User Space)
  - Gustavo Padovan (Collabora, Kernel)
- **Contributors**
  - 82 AUTHORS entries (people with > 10 commits or bigger patches)
  - Intel, IndT, ProFUSION, TI, Qualcomm, Google, CSR, Atheros, etc.

BlueZ Contributor Companies



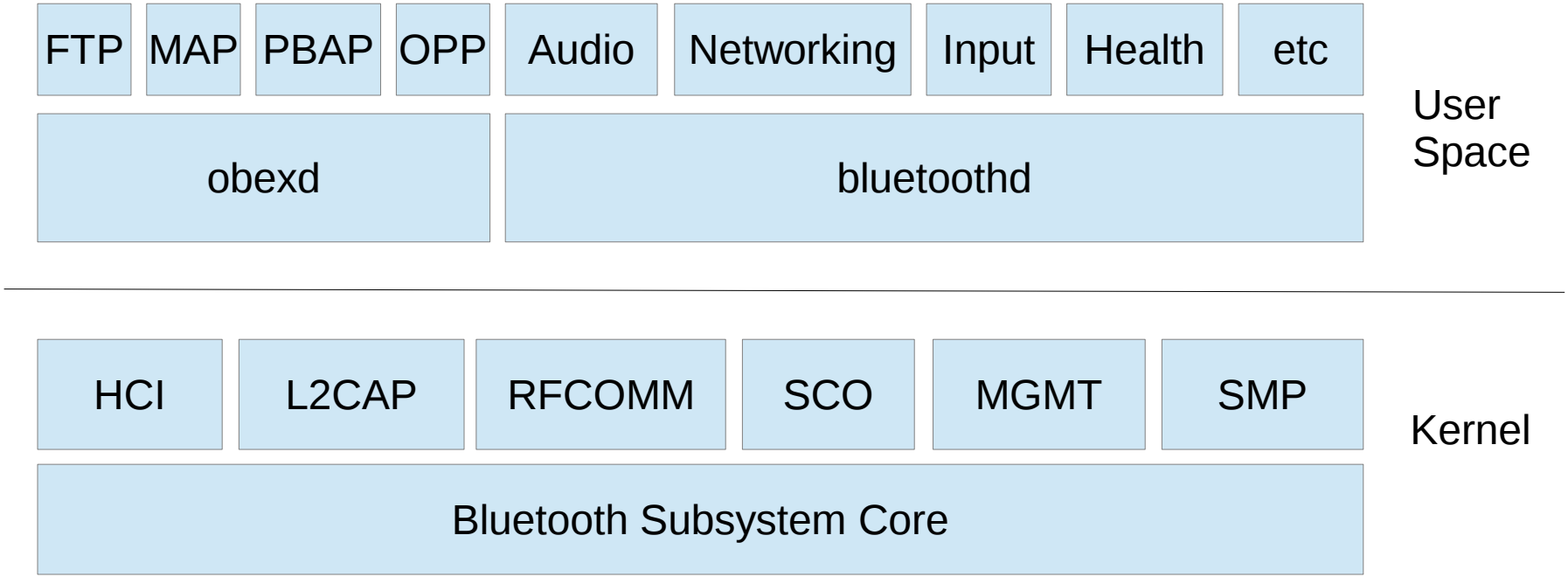
BlueZ – Main Features

- Core specification 4.0 (GAP, SDP, L2CAP, RFCOMM, GATT)
- Audio/media profile support (A2DP, AVRCP)
- Networking profile support (PAN)
- Input device profile support (HID)
- Health device support (HDP)
- File transfer (FTP, OPP)
- Message access (MAP)
- Phone Book Access (PBAP)
- ...and many more

BlueZ – General Architecture

- **Hardware (HCI) drivers and lower level protocols in the kernel**
  - All standard HCI transports supported (UART, 3-Wire UART, USB, SDIO)
- **BSD socket based abstraction to user space**
  - HCI, L2CAP, RFCOMM, SCO and Management sockets
- **Profiles and higher level protocols in user space**
- **Central user space daemon (bluetoothd) extensible with plugins**
  - Separate obexd daemon for OBEX profiles
- **D-Bus interfaces towards the UI and other subsystems**

BlueZ Architecture - Visualized



Integration with other subsystems

- **ConnMan**
  - Networking (PAN) support
- **oFono**
  - Hands-Free Profile (HFP) support
  - Dial-Up Networking (DUN) support
- **PulseAudio**
  - Audio streaming support (both HFP and A2DP)
- **neard**
  - NFC support (automatic pairing & connection creation)

BlueZ – Low Energy Support

- **Available since Linux Kernel 3.5 and BlueZ 5.0**
- **Kernel level features:**
  - Generic Access Profile (GAP)
  - Security Manager Protocol (SMP)
  - Interface to user space is mostly the same as for traditional Bluetooth
- **User space features:**
  - Attribute Protocol & Generic Attribute Profile
  - Profiles implemented through plugins
  - Profile-specific D-Bus interfaces
  - (WIP) Generic GATT D-Bus interface for external custom profiles

Current Low Energy Profiles in BlueZ

- Proximity (keep track of your things)
- Immediate alert (similar to proximity)
- Health thermometer
- Time (sync time from phone to watch)
- Battery (know when your LE device needs a new one)
- Human Interface Device (mice and keyboards)
- Heart rate (sport heart rate belts, medical)

Using & Developing LE profiles with BlueZ

- **GATT library available for bluetoothd plugins**
  - All existing profiles use this
  - Both server and client roles
- **Existing profiles have D-Bus interfaces to allow implementing UIs (e.g. a heart rate monitor)**
- **Custom/proprietary profiles need a custom plugin right now**
- **Generic GATT D-Bus API on its way**

Ongoing work and near-future features for BlueZ

- GATT D-Bus API
- AVRCP enhancements (AVRCP 1.5)
- HFP 1.6 with Wide-Band Speech (mSBC)
- MAP enhancements
- LE Connection model re-factoring
- Following up on upcoming (non-public) specifications

Low Energy and Tizen

- **Enables many new use cases across the different verticals**
- **Tizen already has a good Bluetooth API**
- **Proper LE API needs defining and making official**
- **Generic GATT D-Bus API for BlueZ**
  - Needed for custom GATT profiles external to BlueZ
  - Work on the way

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