Introduction of IVT
Bluetooth Host Protocol Stack and Profiles
--Bluelet™--

Revision History

Date (DD/MM/YY)	Version	Description	Author
20/11/07	1.0	Initial version	AB
1/03/08	1.1	Revised version	AB
3/03/09	1.2	Revised version	QG
4/25/09	1.2	Revised version	QG

Executive Summary

IVT is a major global supplier of Bluetooth software, Fixed-Mobile Convergence terminal solutions, proximity marketing systems and mobile healthcare systems (www.mHealthServices.com).

Since 1999, IVT has continually developed leading edge products. These include Bluetooth V3.0 host stack and profiles source code, application software BlueSoleil (www.BlueSoleil.com) which has shipped in excess of 30 million copies as of today to over one hundred and forty-five countries - for PCs, laptops, PDAs, MID, Personal Navigation Devices and Smart phones, Bluetooth CTP (Cordless Telephony Profile) enabled GSM phones, and PSTN/SIP/UMA Access Points, and mobile health care systems.

IVT's products and solutions are widely adopted with over one hundred and fifty customers worldwide, including Lenovo, HP, British Telecom, Motorola, Samsung, LG, Ricoh, Pansonic, Mitac, Wistron…. IVT also provides design services, interoperability testing services, and Bluetooth BQB qualification support via its Interoperability Testing Center (iotc@ivtcorporation.com).

Many of the worlds leading Bluetooth chip makers, such as **Accelsemi**, **Avago**, **CSR**, **3DSP**, **Intel**, **Marvell**, and **ISSC** work with IVT and supply IVT's Bluetooth software to their customers; Since 2008, IVT has become Intel's MID worldwide Bluetooth solution provider on Moblin. Today, MID's from Compal and BENQ are shipped with IVT BlueSoleil Linux version. IVT has filed 48 invention patents in China, among these, 19 patents were granted, IVT also had 18 PCT international filings.

IVT has been active in the Bluetooth Special Interest Group (SIG) since 2000. IVT has been actively involved in developing the Bluetooth standards on a number of Working groups and Study Groups. In the Past, IVT has chaired the Telephony Working Group. IVT is currently active members of the Core Working Group, which is developing the High Speed Bluetooth Specification, and active members of the Low Energy Working Group, which is developing the Bluetooth Low Energy Specification. IVT has spoken at many Bluetooth Conferences around the globe, from the US to Europe, and to Asia. IVT has been recognized by the Bluetooth SIG as a major contributor on developing the latest Bluetooth technology.

IVT Bluetooth host stack (Bluelet™) has a long history; It is widely used, mature, efficient with very small code size; it supports multi-OS, multiple Bluetooth silicon, almost all the Bluetooth profiles, and is the de facto standard for interoperability in industry; It is the core of IVT's most popular application software – BlueSoleil for Win 2000, XP, Vista, CE and Linux (e.g. Moblin and Android); it is suitable for embedded applications including mobile applications as well as desktop applications. IVT can offer the ANSI C source code of Bluetooth host stack.

1. IVT Bluetooth V2.1 Stack

IVT Bluetooth host stack (Bluelet™) was first released in November 1999. It is a full implementation of the Bluetooth host stack V2.1 + EDR using ANSI C. It includes all of the protocols in the Bluetooth host protocol stack (including TCS, SDP, RFCOMM, L2CAP and HCI). IVT performed protocol validation using the formal design technique, Specification Description Language (SDL), to assure that all protocols are logically correct before coding.

Using its specific separation of system dependent and independent code, IVT Bluelet™ can support **most operating systems** such as Windows 2000, Windows XP and Vista, Windows CE, Linux (Moblin and Android), Nucleus, REX, *µC/OS-II*, *µ*-Itron, VxWorks, pSOS+, and Palm. It has no particular requirements on processors, **supports almost all Bluetooth profiles** and different HCI transport drivers (USB, UART, PCMCIA, BCSP, SDIO).

Profiles that IVT Bluelet™ supports are listed below:

Profile (Bluetooth specification version)	Supported Roles
GAP (2.1)	(N/A)
SDAP (1.1)	Client, Server
SPP (1.1)	Client, Server
A2DP (1.2)	Source, Sink
VDP (1.0)	Source, Sink
AVRCP (1.3)	Target, Controller
Headset (1.0)	Audio Gateway, Headset
HFP (1.5)	Audio Gateway, Hands-Free
PAN (1.0)	GN, NAP, PANU
BPP (1.2)	Sender, Printer
BIP (1.0)	Initiator, Responder
DUN (1.1)	Gateway, Terminal

FAX (1.1)	Gateway, Terminal
CTP (1.1)	Gateway, Terminal
ICP (1.1)	Terminal
HID (1.1)	Host, Device
DI (1.3)	(N/A)
SAP (1.0)	Client, Server
HCRP (1.2)	Client, Server
FTP (1.1)	Client, Server
OPP (1.1)	Client, Server
PBAP (1.0)	Client, Server
Sync (1.1)	Client, Server

IVT has worked closely with the different Bluetooth chip manufacturers to ensure the interoperability of IVT Bluelet™ with their Bluetooth baseband chips through HCI. IVT Bluelet™ **supports most available Bluetooth silicon** such as that from AccelSemi, Avago, Atheros, 3DSP, Broadcom, CSR, Infineon, Intel, ISSC, Marvell, MTK，National Semiconductor, NXP, Qualcom (RFMD), Ralink, ST Micro and TI.

There are more than 150 customers who have their products with IVT Bluelet™ inside.

2. Efficient, reliable, mature and small in code size

IVT Bluelet™ is suitable for embedded applications as well as desktop applications. IVT Bluelet™ has been carefully designed for embedded systems with very small code size. In general situation, the RAM size is less than 12KB. Please see the table below for more detail information.

Memory Size Table

Basic Stack	RAM (KB)[*7]	ROM (KB)[*5]	MIPS[*6]	Comments
Stack+GAP+SDAP+SPP	12	115.6	4.95	RAM = initialization

Note 1. RAM in the column does not include the buffers for each profile. Different application can use different buffer number and buffer size. Buffer size can vary from 256 bytes to 64k bytes according to each profile. Typically it is 256bytes to 1516bytes in embedded environment. More buffer number usually can produce high performance. It can vary from 2 to 50 or even more. Typically it is 2 to 8 in embedded environment.

Note 2. Sync can support up to 4 different formats. Each format should have log, device info and UUIDMap which consume up to 1k bytes.

Note 3. PAN dose not include DHCP and NAT functionality.

Note 4. RAM for CTP and Intercom does not include buffers for each line. Each line can add 97 bytes to RAM

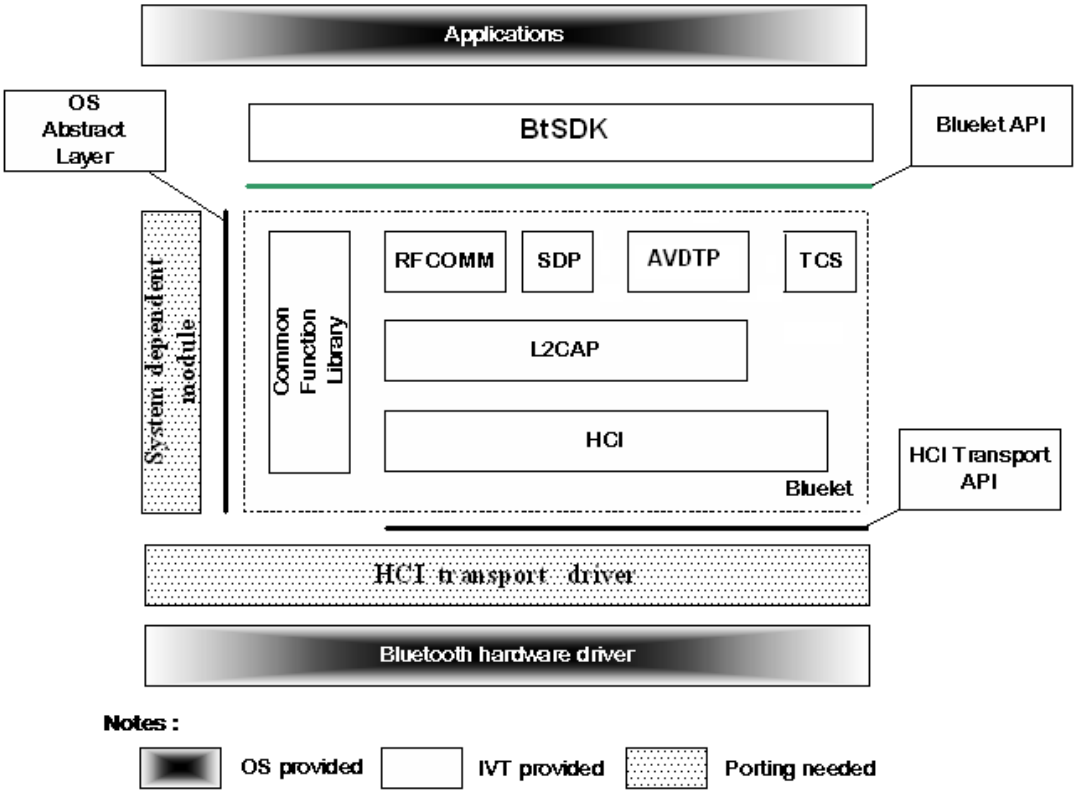
Note 5. The ROM can be a little different due to different compiler and different CPU.(TCS is excluded in stack)

Note 6. We have tested the stack and profiles on ARM7 core CPUs such as Atmel40807 and Samsung4510b.We can not give accurate MIPs consumed only by stack and profiles because BSP and OS also get involved. But a reference can be useful is when we run LAP profile which have SPP working cost 10% cpu power of 49.5MIPS Samsung4510b. So, even full speed of the stack and SPP profile should not consume more than 4.95MIPS.

Note 7. RAM are configurable in application.

3. Multi-OS Architecture

IVT Bluelet™ supports a System dependent module in the Common Function Library for each specific OS platform (System dependent module). HCI transport drivers (USB, UART, PCMCIA, BCSP, SDIO drivers) for a specific hardware and OS (HCI transport driver). Interface between Bluelet™ and the OS existing software to implement profiles, such as Dial-up networking, OBEX profiles (API porting module).



IVT BtSDK has four modules, including Local service management, Device Management, Connection Management and Security Management. Application can concentrate on Bluetooth function exploration rather than managing complicate data structure based on BtSDK's easy-to-use API. BtSDK is available on various OS platform. On Windows OS, it is presented on BlueSoleil V5.0.0 and above.

4. De facto standard for Interoperability

IVT Bluelet™ is one of the top stacks in the industry for interoperability. Interoperability in one of the main foundations, and continues to be, upon which the Bluelet™ stack is built upon. It does so in four ways:

- Widespread of BlueSoleil
- Interoperability and Conformance Test tools
- On-going testing in IVT Interoperability Testing Center.
- Unplugfests

IVT Bluelet is the core of its widespread use of Bluesoleil. It has also added to the increased Interoperability of Bluelet™. Bluesoleil currently has a licensed install base of 30 Million Users. In addition there are many more unlicensed users, as IVT have always placed an evaluation version of Bluesoleil on our www.Bluesoleil.com website for free download for User testing and Interoperability testing of other manufacturers.

This has greatly helped the Bluetooth Industry, that the top selling Bluetooth PC software is freely available for test, promoting Interoperability and helping improve interoperability of other Bluetooth Products. ***Most Bluetooth developers have a copy of BlueSoleil for interoperability testing; Many headset manufactures test their headsets against BlueSoleil as the last procedure before they ship out the headsets.***

IVT has developed a Number of important test tools for Bluetooth. IVT was the first the first company to release a Bluetooth host stack conformance tester (BlueTester™) in September 2000 & Bluetooth Profile interoperability testers in September 2001 **.** With the aid of these tools our initial stack was developed in an interoperability focused manner.

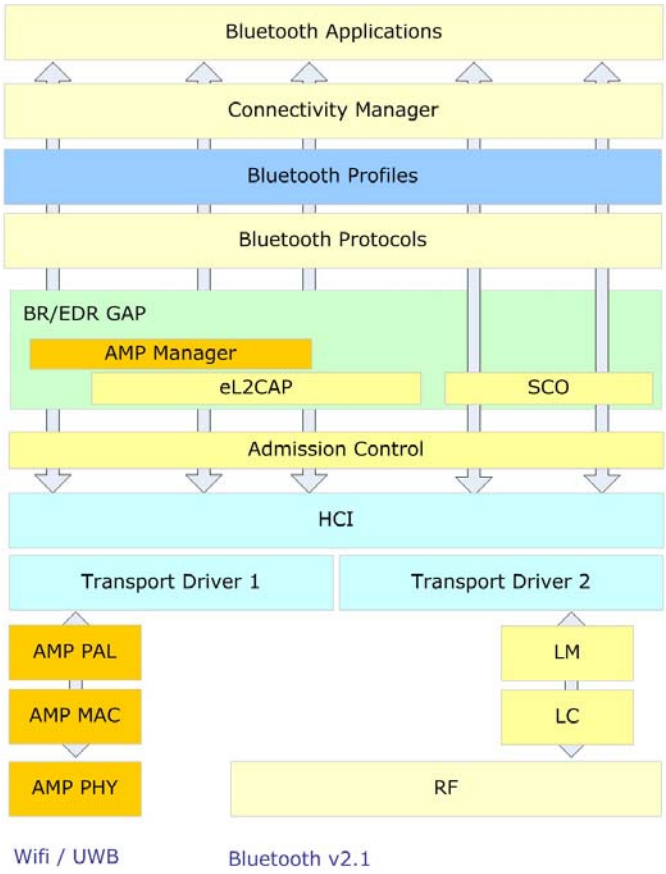
IVT enhances its Interoperability is with its own Interoperability Lab. In early 2007, IVT set up its own Bluetooth Interoperability Lab based in its R&D centre in Beijing. This lab contains its Test tools, the Bluetooth SIG Test tools, independent Test tools and critically an ever increasing Device Library. The Device library is made up of a large number of Bluetooth Products on the market. This library allows of engineers to test our Stack and profiles against the majority of corresponding Bluetooth products in the market easily. We allow our customers, and other Bluetooth companies to test their products against our Device Library in our Interoperability Lab. ***It is an on-going process that IVT performs on daily basis with ever increasing products coming out on the market.***

IVT attends the majority of Unplugfests (UPFs). Unplugfests are week-long interoperability test events. Three UPFs are held annually, one in each global region, where, Engineers work together to improve interoperability.

5. IVT New Stack for Bluetooth 3.0 + HS

IVT has developed a new host stack to support Bluetooth 3.0 + HS.

Features:
· Fully Bluetooth v3.0 + HS compliant
· High speed about 20Mbps on 802.11g
· Expandable for other high speed radio
· Uses standard Bluetooth profiles
· Backwards compatibility with Bluetooth 2.1
· Easy to port on different OS
· Transparent to the end user



Bluetooth v3.0 + HS gets its speed from the 802.11 radio. The 802.11 Protocol Adaptation Layer (PAL) provides increased throughput of data transfers at the approximate rate of 24 Mbps. In addition, mobile devices including Bluetooth v3.0 + HS will realize increased power savings due to enhanced power control. This newest version of Bluetooth technology builds on the current 2.1 + EDR version, including Simple Secure Pairing and built-in, automatic security. Bluetooth v3.0 + HS provides developers and manufacturers with the benefit of backwards compatibility, enabling both the expansion and enhancement of this technology with every new specification release.

Bluetooth v3.0 + HS modifies the standard Bluetooth architecture, an Alternative Mac and Phy based Architecture (AMPs). This architecture enables multiple alternate radios under L2CAP. The standard 2.4GHz Bluetooth *radio* is still used for discovery and connection setup. However, new AMP such as 802.11 is used for high speed channels. The generic AMP architecture includes an AMP manager and a set of generic HCI commands and events. Each AMP may support specific HCI commands and events. And each AMP may have its own PAL beneath HCI.

With the availability of Bluetooth v3.0 + HS, users can expect to move large data files of videos, music and photos between their own devices and the trusted devices of others wirelessly.

6. Rich Applications on Top of Bluelet Stack and Good Customer Support

IVT has continually developed rich applications on top of its Bluetooth host stack, such as application software (BlueSoleil) which shipped in exceed 30 million copies as of Dec 31, 2008 to over one hundred forty-five countries for PCs, laptops, PDAs, MID, Personal Navigation Devices and Smart phones; Bluetooth CTP (Cordless Telephony Profile) enabled GSM phones, and PSTN/SIP/UMA Access Points for fixed-mobile convergence; Bluetooth multi-media broadcaster, (BlueCaster) for proximity marketing.

IVT's products and solutions are widely adopted with over one hundred fifty customers worldwide including Lenovo, HP, British Telecom, Motorola, Samsung, LG, Ricoh, Panasonic, Mitac, Wistron, etc. IVT' s R&D center is located in Beijing, being close to OEM/ODM in Asia. IVT also provides design services, interoperability testing services, and Bluetooth BQB qualification support via its Interoperability Testing Center (iotc@ivtcorporation.com) to its customers.