Bluetooth
SIGnal
The official newsletter of the Bluetooth Special Interest Group

Issue no.6, June 2000

Bluetooth™

New Bluetooth figure mark

The scene is set for the Bluetooth™ brand to quickly become one of the most prominent trademarks ever. This is no exaggeration. Nearly 2000 companies have become members of the Bluetooth Special Interest Group (SIG), a large number of which are working towards launching products incorporating Bluetooth wireless technology. As a result of company interest, media attention, conferences and exhibitions, the Bluetooth name has spread around the world. And the Bluetooth Specification, Bluetooth Qualification Program and the Bluetooth Brand Book are in place to protect the brand.

Now that many qualified Bluetooth products are on the threshold to the global market, it is timely that a new Bluetooth figure mark has just been released. The figure mark is made up of the two runic characters (ancient Germanic alphabet) “H” and “B”, the initials of King Harald Bluetooth. Runic characters are very commonly seen on medieval runestones found throughout Scandinavia. In an analogous way to how the Danish Viking king unified Denmark and Norway in the 10th century, the Bluetooth wireless technology aims to unify the telecom datacom industries of today.

Disharmony in France

One European country where the Bluetooth brand may find it hard going, nevertheless, is France. Unlike most countries that have 79 frequencies available for license-free transmission within the 2.4 GHz ISM (Industrial, Scientific and Medical) band, France only allows 23 frequencies for public use. The armed forces use the remaining frequencies.

Qualified Bluetooth devices sold within the European Union (EU) will be CE-marked with notification that there are restrictions for use in certain countries. Import of Bluetooth devices into France is allowed, but they cannot be used! Rumors have it that you can get permission to use Bluetooth products on an individual basis. If so, then all Bluetooth enthusiasts are in for a bureaucratic roller coaster.

Ongoing discussions are taking place between major SIG members and the French authorities to resolve this problem. Let’s hope that these efforts, along with strong lobbying from the Bluetooth community in France will lead to complete harmonization of the ISM band throughout the EU.

Enough silicon

Several press articles have recently commented that a lack of silicon will delay the introduction of Bluetooth products. Really!? Just enter “Bluetooth silicon” into your Internet search engine and see what pops up. Among the many companies are: Atmel Corp. Cambridge Silicon Radio, Ericsson, Intel, Lucent Technologies, National Semiconductor, Peregrine Semiconductor, Philsar, Siemens, Silicon Wave, Inc., ST Microelectronics, Symbol Technologies, Texas Instruments, ……

In addition to its release in digital format at www.bluetooth.com, the Bluetooth SIGnal is printed for distribution at special events. And Bluetooth Congress 2000 in Monte Carlo is certainly one of these. It is the largest Bluetooth conference to be held in Europe so far. With over 1 500 delegates expected to attend and many prominent speakers, Bluetooth Congress 2000 reflects the intense investment in the Bluetooth wireless technology.

The Editor

The Bluetooth combination mark comprising the new figure mark and the word mark.

In this issue

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Bluetooth SIG membership

The Bluetooth Special Interest Group (SIG) exists to promote the Bluetooth wireless technology, to ensure the interoperability of diverse qualified Bluetooth products, to handle relevant legal matters and to drive the development of next-generation technology. The organizational structure of the Bluetooth SIG is presented in the diagram below.

Key definitions

The following key definitions help explain the SIG structure:

Promoter: a company that helps to lead the Bluetooth Special Interest Group. Current Promoter Companies are 3Com, Ericsson, IBM, Intel, Lucent Technologies, Microsoft, Motorola, Nokia and Toshiba.

Early Adopter: any company that has signed the Early Adopter 1.0 contract. It receives a Bluetooth license covering royalty-free intellectual property patent rights and, after signing the Trademark Agreement, will be allowed to use the Bluetooth brand. Of the nearly 1 900 SIG members, the vast majority are Early Adopters.

Associate Member: any company that has signed the Early Adopter 1.1 contract, the Associate member Amendment and paid the Associate Member annual fee.

Working Group: a team that consists of Promoter and Associate Members. This team reports to the BARB and the Test and Interoperability Board. A Working Group defines a Bluetooth function and then generates the technical specification to implement the function.

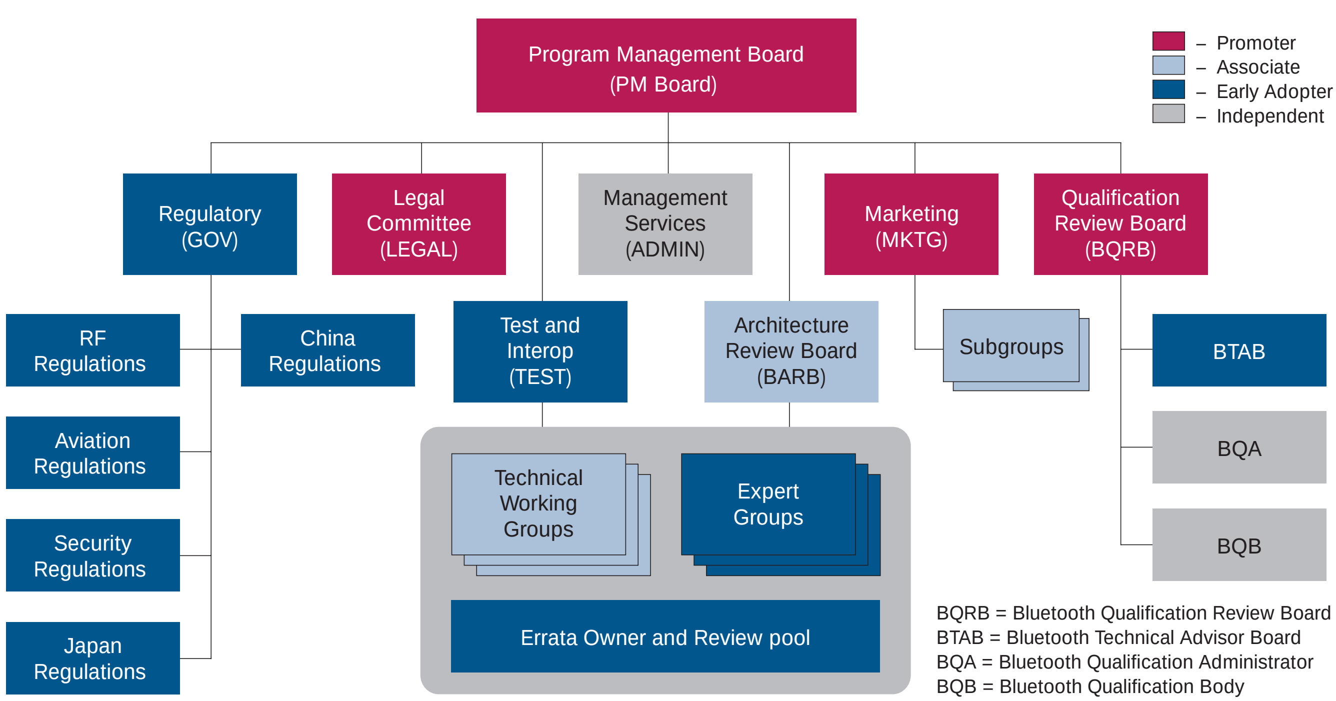
Expert Group: a team that may consist of Early Adopters, Promoters and Associates. An expert group is chaired by a Promoter or Associate Member and is formed to focus on potential Bluetooth usage models and functions for industrial groups such as automotive or aviation. The Expert Group acts in an advisory role to the Technical Working Groups.

Marketing subgroup: a team that consists of Promoter or Associate members that reports to the SIG Marketing team. Marketing subgroups form on an as needed basis to coordinate SIG activities such as Bluetooth conferences and pavilions.

New Associate category

Associate membership is now open to all companies that have signed the Bluetooth Adopters Agreement. The initial group of 50 companies was invited to join in a new level of participation with the Bluetooth organization. Companies were chosen because of their technical expertise in a given field, resources they could make

The Bluetooth SIG structure



Associate and Early Adopter Privilages[*]

Tasks	Associate	Early Adopter
Marketing meetings	Yes[†]	No
Marketing reflector	Yes	No
Marketing sub-group meetings	Yes	No
BARB vote	Yes (1)	No
BARB meetings	Yes (1)	No
BARB reflector	Yes (1)	No
Regulatory meetings	Yes (3)	Yes (3)
Regulatory reflector	Yes (3)	Yes (3)
Regulatory database	Yes	Yes
Test meetings	Yes (3)	Yes (3)
Test reflector	Yes (3)	Yes (3)
WG chairs	Yes (2)	No
WG meetings	Yes (3)	No
WG reflector	Yes (3)	No
WG drafts	Yes (4)	Yes (5)
Expert chairs	Yes (2)	No
Expert meetings	Yes (3)	Yes (3)
Expert reflector	Yes (3)	Yes (3)
Errata tracking	Yes	Yes
WG = Working Group BARB= Bluetooth Architecture Review Board		

(1) If Associates are WG chairs or elected members
(2) Requires Program Management vote for approval
(3) Based on individual contribution
(4) Access to drafts 0.5, 0.7, 0.9, and 0.95 (see below)
(5) Access to drafts 0.9 and 0.95 (see below)

The Project Plan (released to Associates and affiliated Expert Groups) requires market requirements and general strategy for achieving those requirements. Draft 0.5 (released to Associates) requires a clear mapping between material and requirements along with a basic test strategy. Draft 0.7 (released to Associates) requires all fundamentally aspects complete and all functional requirements have been addressed. Draft 0.9 (released to Early Adopters) requires content completeness and a draft Test Case Reference List (TCRL). Draft 0.95 (Post draft). All feedback addressed. Test Case Specifications fully completed.

[*]This and other information given in this article is based on the current Working Group Processs document and is subject to change.
[†]The Marketing group will invite Associates to participate on an as needed basis.

available in research and promoting of Bluetooth wireless technology, and other factors deemed critical in expanding participation in a rapidly evolving technology.

In order for an Adopter Company to apply for Associate membership, a Promoter Company must sponsor it. The application process is outlined on the member site at the official Bluetooth website, www.bluetooth.com.

Associate Members must pay an annual fee – between $5,000 to $40,000 per year – based on the company's annual revenues. This money is used to fund activities such as the Bluetooth Qualification Program and other SIG-related events. Adopter Companies may choose to become Associate Members and pay the annual fee in order to take advantage of membership benefits.

Benefits and privileges

Associate Members have access to the following information:

- Early access to preliminary specifications from Working Groups.
- Access to Associate website when released including detailed Working Group charter information, market requirements documents and early drafts.
- Access to viewing Reflectors which serve as Communication Forums for the various Working, Expert, Regulatory and Test Groups as outlined in the "Associate and Early Adopter Privileges" table.

Working Groups

Associate Members may apply to participate in one of the Working Groups listed at: *http://www.bluetooth.com/sig/sig/sig.asp*. A Working Group is responsible for defining a Bluetooth usage model and creating the specification to implement it. Working Groups report directly to the Bluetooth Architecture review board.

Each Group sets the number of members it needs according to the required task. If openings are available, companies are limited to 3 individuals per Group but 2 is the recommended limit.

Associate members are allowed to vote when sitting as Chair of a Working Group according to the Associate Agreement. When the Associate member is qualified to vote, it is only allowed one vote for its company no matter how many representatives are in the Group. Individuals should meet criteria set forth in the Working Group Participation Guidelines.

Bluetooth synchronization

Users of mobile devices are constantly faced with the problem of having their data up-to-date. Currently, a user can synchronize a schedule (for example, the schedule of events at Comdex) on a PDA while it is connected to their PC, but how can they know if the event schedule hasn't changed by the time they arrive at Comdex? If there is another PC with the correct cradle and software available somewhere at the event, they could possibly synchronize again. But what if one isn't available? How can the user get an updated schedule?

The answer is Bluetooth wireless technology.

The Bluetooth Synchronization Profile was created so that Bluetooth devices can interoperate and synchronize data with other certified Bluetooth devices without requiring any cables or cradles. If the PDA supported the Bluetooth Synchronization Profile, it is possible to automatically synchronize the event schedule with the PDA as soon as the attendee walked through the front door!

How does synchronization work?

The Bluetooth Synchronization Profile is based on the IrMC synchronization standard co-authored by Extended Systems and adopted first by the Infrared Data Association (IrDA) and later by the Bluetooth Special Interest Group (SIG). IrMC defines a set of text objects that represent synchronization information such as which records have been modified or deleted, and it defines how the actual record data is exchanged in a device-independent manner. Using the Bluetooth Specification Generic Object Exchange Profile, these IrMC objects are then exchanged between devices to synchronize their data.

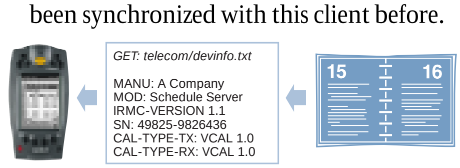
The following steps show the sequence of events and transfer of objects that happen when synchronizing two devices.

1. An IrMC client connects to an IrMC server.
2. The client gets the IrMC device info object to determine if it has ever synchronized with this server before.
3. The client gets the IrMC change counter object to find out if any changes have been made to the server's database.
4. The client gets the IrMC change log object to find out which records have changed in the database.
5. The client removes any deleted records from its copy of the database.
6. The client gets any modified/added records from the server and adds them to its database.

Synchronization example

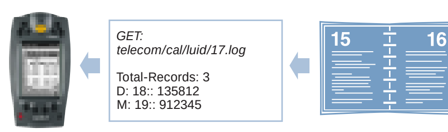
In our Comdex example, a user with a qualified Bluetooth device such as a PDA or cell phone (acting as an IrMC client) would simply walk by a schedule of events kiosk incorporating Bluetooth wireless technology (the IrMC server). When the user's device notices that the kiosk is in range, it automatically starts the synchronization process to get the updated schedule.

The PDA first establishes a Bluetooth connection to the server (allowing for any authentication and bonding if needed) and then gets the *device info object* from the server. This object tells the PDA which object formats are supported by the server, and can be used to tell if the server is known to the client (i.e. the client has synchronized with it before) or if it is a brand new server which has never been synchronized with this client before.

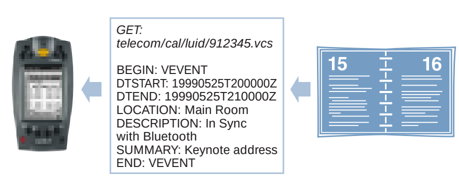


Assuming that the PDA has at one time been synchronized with this client, the next step is to get the IrMC server's *change counter object* to find out if there have been any changes since the last sync.

The number in this change counter object is incremented each time there is a change to the event database. If the last time a synchronization was performed the change counter was 17, but this time it is 19, the device can tell that two new changes have been made. To determine what these changes were, the PDA then gets the *change log object*, which lists the changes since a previous change counter value. The following example shows the PDA downloading the list of the two changes made since change counter 17.



This object tells the PDA that event ID 135812 has been deleted, and the event ID 912345 has been modified. The PDA now knows that it needs to get the new modified event by getting the record with ID 912345 from the server and then make the corresponding modification to it's internal version of the schedule.



Now that the PDA has the modifications, the only thing left to do is delete event ID 135812 from its version of the schedule. The PDA then just stores away the current change counter value for the next synchronization and disconnects.

Scott Jeide,
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Introducing Bluetooth testing

Many companies having no previous experience designing and producing wireless solutions will adopt the Bluetooth wireless technology. Even if the design is based on a “standard” Bluetooth module, the designers need to verify the basic functionality. In most cases, a full test as specified in the Bluetooth Test Specifications is not required. It is sufficient to concentrate on verifying transmitter output power, transmitter frequency, transmitter modulation quality, and receiver sensitivity.

Problems connected with high-volume production

Why are these basic parameters so important for the functionality of the Bluetooth device? In some way they all relate to the “coverage” in the sense the of the range of a Bluetooth piconet. The link quality is directly proportional to the transmitter output power and the sensitivity as they both are important factors in the link budget between Bluetooth master and slave. If the power is too low the range of the link is also too low, if it is too high it can create interference problems.

A large transmitter modulation deviation gives a better signal quality because the decision space of the receiver will be larger. Another parameter is type approval because a large transmitter deviation will change the spectrum of the carrier. The larger deviation the broader the 20 dB bandwidth of the modulated spectrum. The last parameter is the accuracy of the carrier that can give problems connecting to another Bluetooth device.

How can this be measured? Problems measuring this are related to the time division duplexing and frequency hopping nature of the Bluetooth signal. In a mass production situation it is not possible to use general laboratory measurement methods using spectrum analyzers with e.g. video trigging possibilities. In this situation the most suitable measurement tool is a one-box tester with the possibility of controlling the test mode of the Bluetooth device, see Figure 1. Basically this type of equipment is based on a Bluetooth controller combined with some measurement possibilities of doing signal analysis of the demodulated signal as well as the burst represented by sampled RSSI information in the receiver of the test equipment.

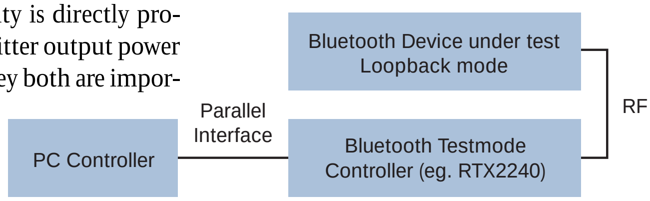

Figure 1. Measurement set-up for transmitter, modulation, and bit error rate measurements.

In the following the measurements of the basic parameters will be described. The tester must be able to extract the timing of the preamble, and each burst has to be considered one at a time to make valid measurements. All the measurements can hereafter be done by looking at the sampled power envelope and the received data. Only the BER measurement differs from this. This type of one-box tester is ideal for production purposes due to easy measurement set-up and remote control.

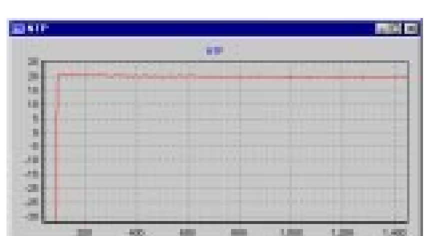

Figure 2. The normal transmitted power. The peak power is measured as the maximum value in the beginning of the burst[1].

Transmitter Output Power

The transmitter average power is measured as an average of between 20–80 % of the samples after bit 0 in the payload. These data can be averaged directly from the RSSI RAM buffer. Alternatively, the peak output power is the highest recorded value from all the RSSI data in the RAM buffer, regardless of the position of bit 0 in order to record the overshoot during power on of the PA.

Transmitter frequency accuracy

Measuring the frequency carrier offset gives an indication of how much “off” the carrier is compared to nominal. In this measurement the 4-bit preamble is analyzed and averaged. This average value’s difference from nominal is the offset. In this case timing, meaning the exact position of the preamble bits, is very important.

Transmitter modulation quality

This measurement is the deviation of the modulated signal. In this case two different payloads are used and that is 01010101 and 00001111. The 00001111 payload is used to check the Gaussian filtering of the modulator. For every 8-bit sequence an average deviation is computed as well as the maximum. See Figures 3 and 4.

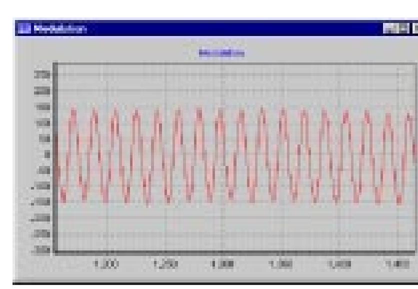

Figure 3. Parts of the payload during a frequency offset measurement where each 1 and 0 in the received payload is over-sampled 9 times. The used payload is 0101010[1].

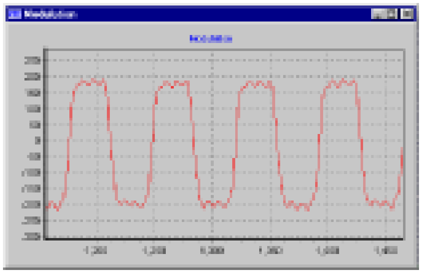

Figure 4. Parts of the Payload during a transmitter deviation measurement. The used payload is 00001111 [1].

Bit error rate.

The bit error rate (BER) measurement is done in loop back test mode using DH1 or DH5 packets, depending on whether it is a single or a multi-slot test. The tester generates the desired signal and sends it to the Bluetooth device, which transmits it back to the tester. The tester compares the sent and the received data resulting in the BER value. In the Bluetooth RF Test Specifications the BER measurement has to be integrated over 1.6 million bits, which takes time. In a production this can be speeded up using accelerated methods.

[1] (Measured with RTX2204 Bluetooth RF Tester/ RTX Telecom).

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The Bluetooth beast in a Jini World

What is Jini?

Basically Jini is a distributed computing application program interface (API). The philosophy of Jini is perhaps best illustrated by the quote found at the beginning of the Jini book:

> "When a man sets out to carry a cat by the tail, he learns something that is always valuable, and will never grow dim or doubtful."
>
> Mark Twain

Over the last 20 years the evolution of distributed computing has taken us from ad hoc protocols, to Remote Procedure Calls, and Remote Operations; from nodes and hosts to clients and servers; from UUCP to the Internet and the World Wide Web. However, perhaps the best view of distributed computing is from a user's perspective:

> A network is a place where some machine, somewhere, you have no knowledge of, can ruin your whole day.
>
> Source unknown

The essence of Jini to take everything we've learned about distributed computing and to design something to meet the needs and desires of the end user. Additionally, it should be easier for developers to build reliable, effective applications, and harder to do otherwise.

Java and RMI

While Jini is defined in terms of Java, and implemented using Java's Remote Method Invocation (RMI), Jini is primarily an API. As such, the programming language and underlying protocols are less important than the distributed computing methodology. For those with concerns about Java and RMI performance, especially in real-time applications, other languages, protocols, and techniques can be used instead.

On the other hand, the Java environment continues to promote portability of code, ease and safety of development, and unparalleled richness of innovation and worldwide acceptance. Additionally, new technologies like HotSpot can offer performance comparable to, and sometimes better, than natively compiled C++.

RMI provides an extremely general and flexible general-purpose protocol. The advantage of technologies like RMI and Remote Procedure Call (RPC) is that new encodings for new protocols need not be invented, rather the protocol reduces to an API definition. While RMI does trade-off performance penalties for such power, it does not have to be your application's only protocol. For example, you might use RMI to negotiate an HTTP, FTP, or even UDP based process.

Lease on life

One of the most significant features of Jini is that resources are leased, not owned. In a distributed computing environment you can never be sure that a service or client is still there. Consequently, if they go away, how do you know to reclaim any resources they have previously allocated?

Just as Java implements automatic garbage collection, Jini automatically reclaims network garbage. When a client needs a resource, such as registration in a lookup service, it requests a lease on that resource. It must then periodically, from a few milliseconds to a few minutes, renew the lease by contacting the service that granted the lease. If the lease is not renewed, the service that granted the lease assumes the client has gone away and then reclaims the resources allocated for the lease.

Unlike wide mobile Wide Area Networks like GSM, Bluetooth wireless technology is a mobile Local Area Network. LANs typically account for many more devices than WANs. Metaphorically, devices are like the leaves on a tree, LANs are like the branches, and WANs are like the trunks. This is why there is potentially far more revenue likely from mobile LANs than mobile WANs.

In a LAN, devices are expected to join and leave the network much more frequently than in a WAN. In mobile network, this is even more the case because of the dynamic nature of the devices. Returning to our metaphor, it's sort of like the wind; the leaves and branches bounce around the most, while the trunk stays relatively stable. In the mobile WAN this stability is manifest in hands-off procedures from one cell to another.

In short, Jini was designed to handle exactly the type of challenges Bluetooth wireless technology presents to robust distributed computing environments.

Making a commitment

Just as it's important to know when it's time to clean up, it's also important to know that information has been passed reliably; sort of like sending a letter to someone who has changed addresses. In many cases the letter ends up in the garbage because the person who resides at the original address can't be bothered to return it to the post office. This why people send registered letters when the information is important. Since the post office 'commits' to obtaining a signature in order to complete the delivery, they are more likely to be informed that the recipient no longer resides at this address.

In computer database systems, methods like two-phase and three-phase commit have traditionally been used to ensure operations complete correctly. In Jini, two-phase commit is used to ensure information is passed completely, and that operations are either performed or not performed, and not left in an inconsistent state.

Once around the park

Passenger: "Driver, once around the park please."

Driver: "And which park would that be ma'am?"

Passenger: "Oh any park will do."

One of the most frustrating issues many computer users face is not having the right device driver for their software. Often may hours are spent hunting through floppy disks, CD-ROMs, and web pages for the right device driver. Why not put the device drivers in the devices themselves?

This is exactly what Jini supports. Through the magic of Java Beans, it is possible for a client to search the local network for a device, say a printer, and if necessary download the latest device driver for the printer, from the device. As long as the device driver conforms to the standard API, say printing, it can do pretty much whatever it wants.

In a Bluetooth network it is expected that clients will routinely encounter devices they have never seen before. For example, as soon as you walk into a room with your trusty Bluetooth Personal Digital Assistant (PDA), it will already have introduced itself to every device in the place. As soon as you try to access one of these devices, whether telephone, TV set, stereo equipment, or home security system, your PDA will download the appropriate device drivers and then use the device as you wish.

Jack and the beanstalk

As children, few of us questioned the logic of a beanstalk which reached the sky, leading to the giant's castle. Rather the excitement and majesty of the adventure allowed us to ignore such mundane impossibilities. Fortunately, Jini makes such dreams possible.

Those magic Java beans have another side. Just as they enable devices to download code like drivers, they also allow us to send code to other places on the network. For example, while most of us would expect our PDA to search for all the dentist's in our address book, we would not expect it to find all the dentists in Los Angeles. With Jini, the PDA could send a bean to one or more servers that would seek out dentists. On the other hand the PDA could just as easily have submitted an HTTP query to a web server. The difference, though, is that the bean is a custom piece of code, with far more versatility than an HTTP request. Also, the same bean can run in either the PDA, or a 5-terabyte data warehouse. Software and API reusability at its best.

In the Bluetooth world it is expected that many devices will have very limited computing resources. However, we shouldn't have to change protocols or access methods because of the amount of resources in our devices, rather, our access methods should be portable, and easily distributed.

The Jini world

Bluetooth wireless technology is only one part of a world of computer network technologies such as Ethernet, PPP, firewire & HAVi, X.10, RF Home, GPRS, EDGE, UMTS, 1EXTREME, and many others. In many cases people continue to invent or adopt special purpose solutions like the Bluetooth Service Discovery Protocol or Wireless Application Protocol when general-purpose solutions like Jini are not only sufficient, but also far more powerful and versatile. From the applications deployment perspective it should not matter if the client is mobile or stationary, a picocontroller, PDA or a mainframe, connected to a WAN, LAN, or home entertainment center. Development effort is more profitably spent on developing goods and services than on new protocols and standards.

Jini is designed to address distributed computing as a general-purpose solution, just as RMI is a general-purpose protocol and Java is a general purpose programming language. Those companies which learn to exploit general-purpose tools will expend less resources than companies which have to adopt and support multifarious special purpose tools. Time and money spent training people to use equivalent, yet different technologies, is time and money not spent on developing product.

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WPANs™ – A progress report

Issue 5 of the Bluetooth SIGnal provided a summary of the IEEE 802.15 projects and our efforts at creating standards for WPAN environments. The following column provides a progress report on a single project – Task Group 1 (TG1). The IEEE 802.15 TG1 is deriving a Wireless Personal Area Network standard based on the Bluetooth v 1.0 Foundation Specification.

The IEEE draft standard was recently updated to reflect the latest Bluetooth v1.0 B Foundation Specification. By the time of this publication, the TG1 will have submitted the draft standard to the whole IEEE 802.15 Working Group and be in the midst of conducting a 40-day working group ballot of it. The results will be available on TG1's website in the next few weeks.

Even though the IEEE draft standardizes "L2CAP and below" (PHY layer and MAC sublayer), the Bluetooth community should find this latest draft of special interest. Specifically, we have included in the IEEE draft standard a Specification and Description Language (SDL) model, which describes the IEEE standardized protocols using the formal, object-oriented language defined by ITU-T in recommendation Z.100.

The new draft also provides a section on layer interfaces (referred to as service access points or SAPs), see figure, and a Protocol Implementation Conformance Statement (PICS) proforma. The PICS proforma lists all the mandatory features called for in the standard and all optional ones that must be included in a particular implementation. The supplier of a protocol implementation that is claimed to conform to IEEE Std 802.15.1-2001 shall complete this PICS proforma declaring that all mandatory features have been implemented and additionally identify which of the optional ones are implemented.

The next column in the series will discuss the IEEE 802.15 Task Group 2 (TG2), which is developing Recommended Practices for coexistence of 802.15 WPANs or short-distance wireless networks with other systems from the 802 family of standards that operated in the 2.4 GHz spectrum, e.g., 802.11 WLANs.

Mr. Ian Gifford
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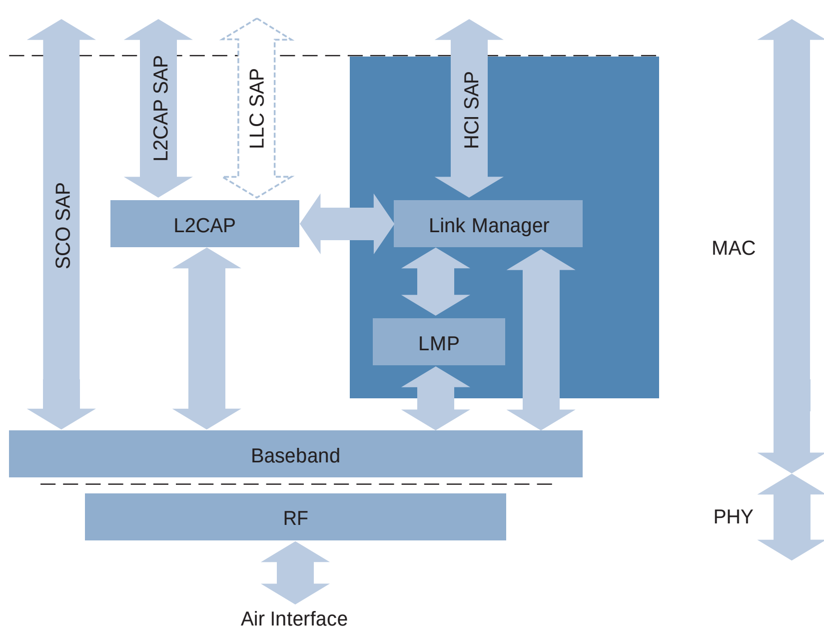

COMING UP

June 6–9
CommunicAsia, Singapore

June 13–16
Bluetooth Congress 2000, Monte Carlo

Sep 26–29
PCIA GlobalXChange, Chicago

Oct 17–20
World PC Expo, Tokyo

Oct 23–27
Full Internet World, New York

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