

LAN PROFILE

This document is a LAN Profile for Bluetooth devices. This profile is used to map existing LAN protocols into Bluetooth as the transport media. The frames to be transmitted and received use the Ethernet frame format. With this profile the Bluetooth devices will work as a normal LAN. It's possible to use the same applications on the operation system to address and connect to the Bluetooth device.

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1. Introduction

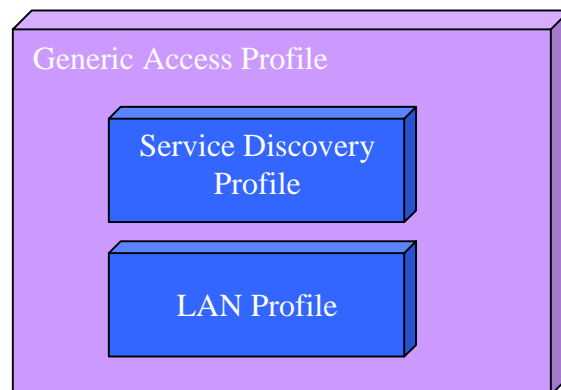
1.1. Scope

This profile defines how Bluetooth devices should map existing LAN protocols over L2CAP to work as a normal Ethernet LAN.

- The today's LAN offers a lot of functionality regarding,
 - Browsing of information
 - Accessing file servers
 - File transfer
 - Printing
- Most of the protocols are already implemented on network products. The future network products with Bluetooth capabilities will therefore only needs to implement the L2CAP, SDP profile and this LAN profile to be able to run an Ethernet LAN over Bluetooth.
- The different protocols uses different addresses, e.g. the TCP/IP protocol uses IP-addresses. This profile will give hints to how the Bluetooth device could get its protocol addresses.

1.2. Profile dependencies

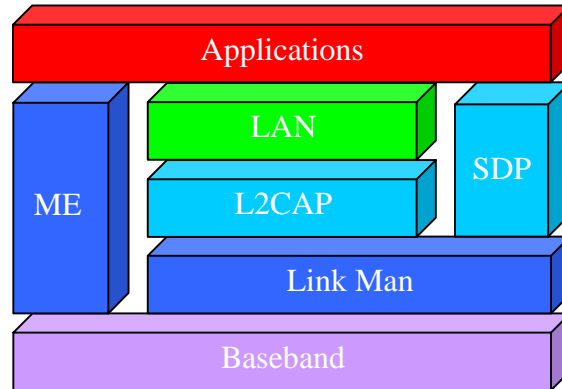
The figure below illustrates the Bluetooth structure and the profile dependencies.



2. Profile overview

2.1. Protocol stack

The figure below shows the protocols and entities used in this profile.



The LAN box is the protocols needed to access a normal Ethernet LAN, e.g. TCP/IP. This layer requires that the layer below is able to broadcast as well as send directly to a Bluetooth device. The LAN layer must be able to switch between the different types of packets, so the TCP/IP stack will get the TCP/IP packets, the IPX/SPX stack will get the IPX/SPX packets and so on. The type field in the packet header holds that information.

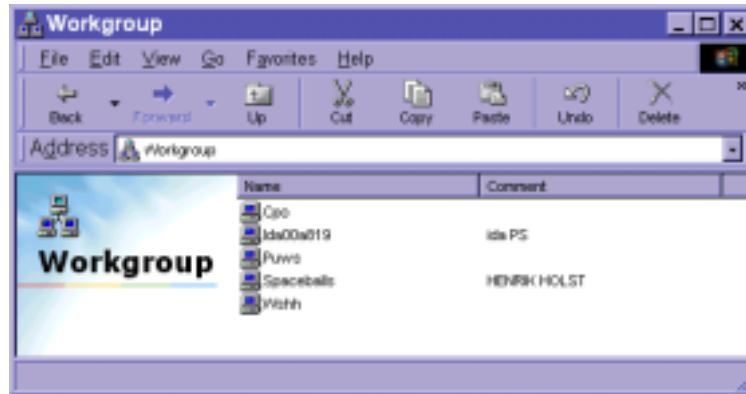
The Baseband [1], Link Manager [2] and L2CAP [3] are the OSI layer 1 and 2 Bluetooth protocols. The SDP is the Bluetooth Service Discovery Protocol [4]. The ME is the Management Entity, which coordinates procedures during initialization, configuration and connection management.

2.2. User requirements and scenarios

The following scenarios are covered by this profile.

1. Browsing the Bluetooth network.

I open my 'Network Neighborhood' folder on my Windows machine and get the following list of accessible Bluetooth devices.



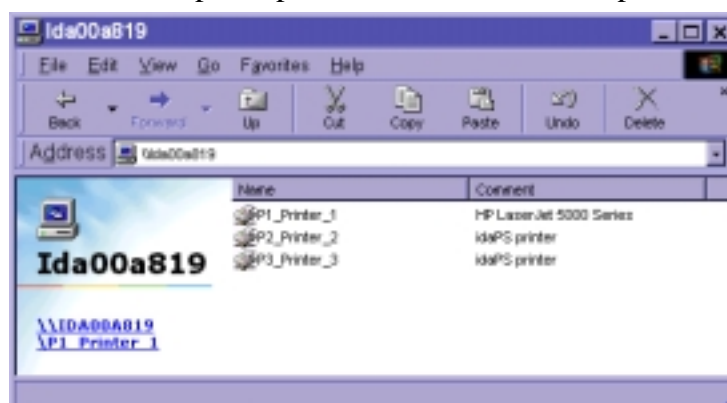
2. File transfer between two Bluetooth devices.

After I have found my computer 'Spaceballs' containing my document, I double click on 'Spaceballs', look for my document to print and open it.

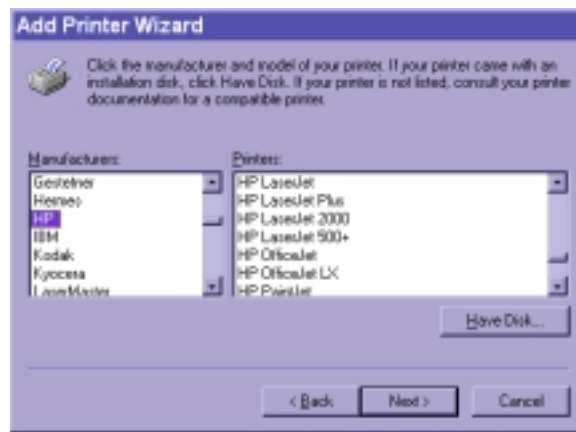


3. Print to a Bluetooth device.

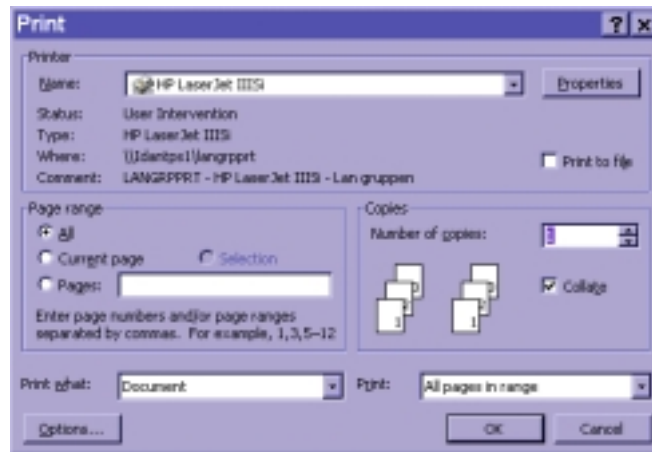
After I have opened my document I want to print it on a Bluetooth enabled printer. If it is first time I am going to print I have to install a print spool. First I have to find a printer,



And then install it,



And finally print my document

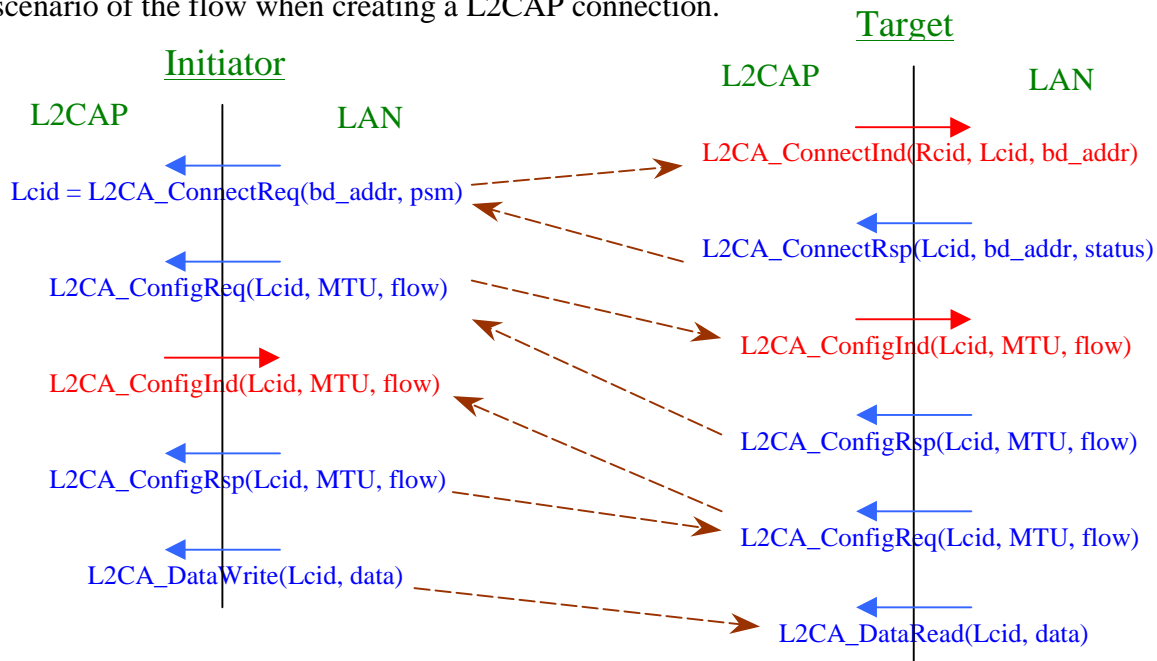


3. LAN layer

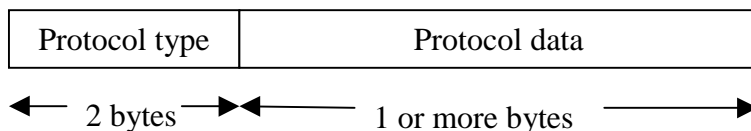
3.1. Sending to one Bluetooth device

When a network protocol knows the BD_ADDR of the device to connect to it will send the packets directly to that BD_ADDR. E.g. if a user wants to connect to another device using TCP/IP and the IP address is already in the ARP table, a L2CAP connection is created to the remote Bluetooth device.

This method is only used when the BD_ADDR of the remote Bluetooth device is known. Below is a scenario of the flow when creating a L2CAP connection.



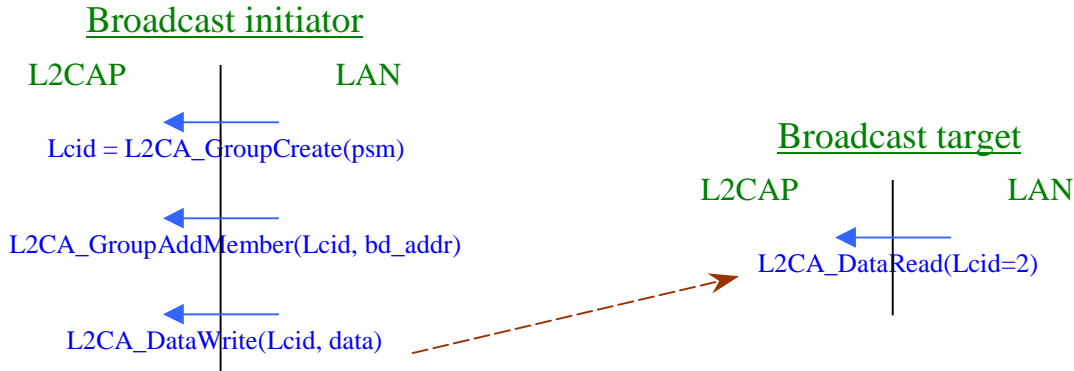
The frame format to send and receive on a L2CAP connection is,



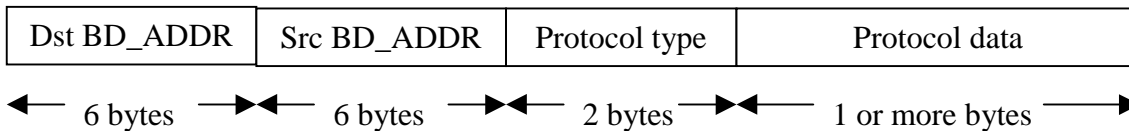
The LAN layer will add the destination and source BD_ADDR to the frame before sending it to the protocols layer.

3.2. Broadcast to more Bluetooth devices

If the BD_ADDR of the remote device is not known a L2CAP group broadcast will be used instead (it's mapped to a piconet broadcast). The LAN layer must create and maintain that group. All the LAN devices must listen to the group broadcast CID=2. Below is also a group broadcast scenario.



The frame format to send and receive on a L2CAP group broadcast is,



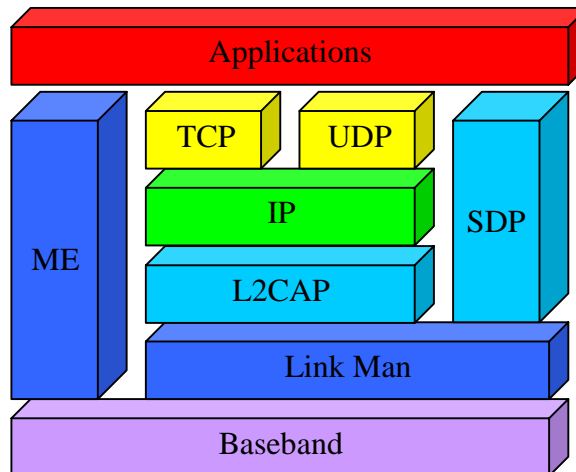
This frame will be forwarded to the protocols layer.

4. Protocol layer

4.1. TCP/IP

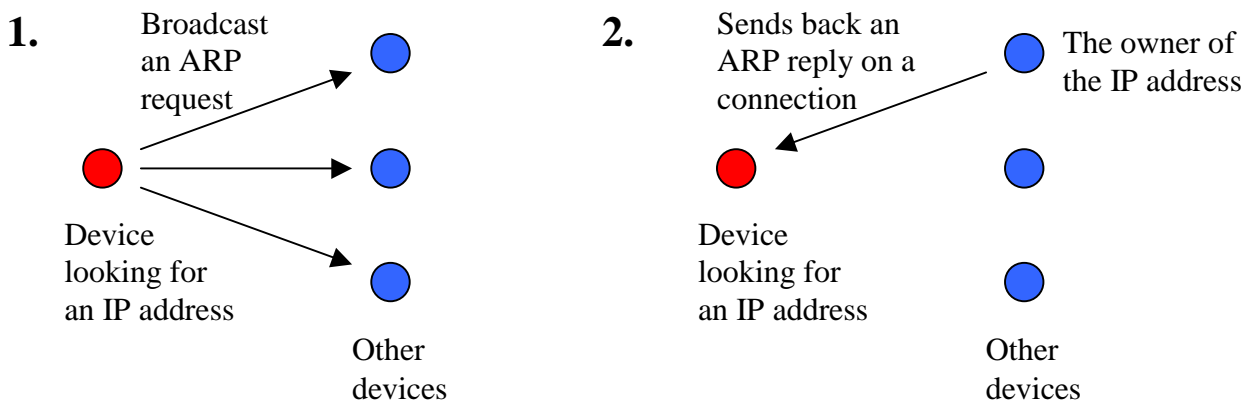
4.1.1. Protocol stack

The figure below shows the protocols and entities used in this profile when the LAN protocol is TCP/IP.



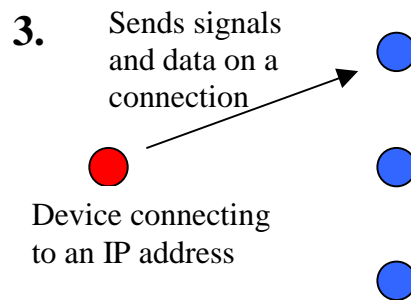
4.1.2. Finding an IP address

Most of the TCP/IP packets are sent to a specific BD_ADDR, but when a user wants to connect to a specific IP address the TCP/IP stack has to find the BD_ADDR first. It's done by broadcast an ARP request to all the devices in the piconet. The owner of the IP address will create a L2CAP connection to the device that sends the ARP request and sends the ARP reply on this connection. The IP stack has to accept L2CAP broadcast CID's (CID=2).



4.1.3. Connect to an IP address

After the BD_ADDR to connect to is known, all the TCP or UDP packets are send on a L2CAP connection.



4.1.4. Getting an IP address

Before a device is able to communicate with the TCP/IP protocol, it needs an IP address. There are a lot of methods how to get it,

- Configured by the user
- Arp/Ping method
- Bootp method
- Dhcp method
- Dynamic Configuration of IPv4 link-local addresses [5]

The best method in this case would be the last one. The device tries one of the IP addresses in the range 169.254.1.0 to 169.254.254.255, ping the address, and if no response is received the address is free to use.

5. Printing

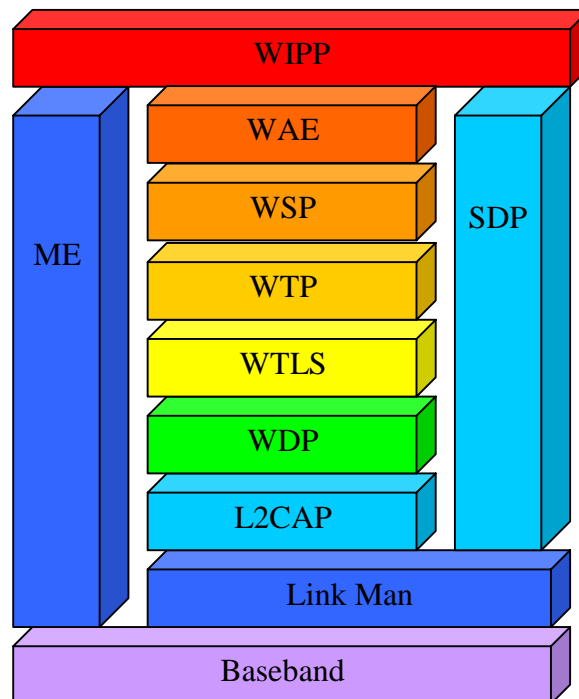
5.1. Using LAN printing protocols

When the Bluetooth device support this profile, the Bluetooth network will look like a normal LAN. Therefore, the existing printing protocols used today in LAN environment can be used.

How many mobile phones, PDA's and other equipment does today support LAN protocols? Not many, but the latest year a lightweight version of a similar TCP/IP and HTTP stack has been developed, called WAP (Wireless Application Protocol).

5.2. Printing with WIPP

A new IETF standardized printing protocol called IPP [6], [7], [8] (Internet Printing Protocol) is developed to work independing of the transport, but the only defined IPP transport today is HTTP. If IPP is going to be used with WAP a new protocol document is going to be created, maybe with some limitations to make it to a lightweight version. This version of IPP, we could call it WIPP. The following figure illustrates the protocol layer of that printing profile.



The Baseband [1], Link Manager [2] and L2CAP [3] are the OSI layer 1 and 2 Bluetooth protocols. The SDP is the Bluetooth Service Discovery Protocol [4]. The ME is the Management Entity, which coordinates procedures during initialization, configuration and connection management. WDP is the Wireless Datagram Protocol layer. WTLS is the Wireless Transport Layer Security layer. WTP is the Wireless Transaction Protocol layer. WSP is the Wireless Session Protocol layer. WAE is the Wireless Application Environment layer. WIPP is the Wireless Internet Printing Protocol layer.

6. References

- [1] Bluetooth Baseband specification (See version 1.0b Volume 1, Part B)
- [2] Bluetooth Link Manager Protocol (See version 1.0b Volume 1, Part C)
- [3] Bluetooth Logical Link Control and Adoption Protocol Specification
(See version 1.0b Volume 1, Part D)
- [4] Bluetooth Service Discovery Protocol (See version 1.0b Volume 1, Part E)
- [5] Internet draft "draft-cheshire-ipv4-linklocal-00.txt" by Stuart Cheshire the 8th March 2000
- [6] R. deBry, T. Hastings, R. Herriot, S. Isaacson, P. Powell, "Internet Printing Protocol/1.0: Model and Semantics", RFC 2566, April 1999.
- [7] Herriot, R., Butler, S., Moore, P., Tuner, R., "Internet Printing Protocol/1.0: Encoding and Transport", RFC 2565, April 1999.
- [8] Wright, D., "Design Goals for an Internet Printing Protocol", draft-ietf-ipp-req-03.txt, November, 1998.

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