Common ISDN Access Profile

Abstract

The Common ISDN Access Profile defines provision of ISDN services over Bluetooth in a way that allows application interfaces to be implemented without loss of backward compatibility to existing (legacy) ISDN applications based on the Common-ISDN-Application Programming Interface (CAPI).

Compliance with this specification assures interoperability with ISDN services and applications within the existing Bluetooth architecture.

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Special Interest Group (SIG)

The following companies are represented in the Bluetooth Special Interest Group:

3Com Corp.

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AVM GmbH

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1 Introduction

1.1 Scope

The purpose of the Common ISDN Access Profile (CIP) is:

- to define how applications shall access ISDN over Bluetooth;
- to allow wherever possible unrestricted access to services, data or signaling provided by ISDN;
- to ensure that legacy ISDN applications do continue to work without any modification inside that application itself;
- to define how the ISDN access co-exists with Bluetooth Specifications and Profiles that possibly access ISDN in one way or other;
- to show how ISDN over Bluetooth can co-exist with existing ISDN in one application.

This Profile strongly limits overlap with other Bluetooth Specifications or Profiles (e.g. DUN, UDI) and addresses interoperability issues in case of unavoidable overlaps.

1.2 Profile dependencies

In Figure 1.1, the Bluetooth profile structure and the dependencies of the profiles are depicted. A profile is dependent upon another profile if it re-uses parts of that profile, by implicitly or explicitly referencing it. Dependency is illustrated in the figure. A profile has dependencies on the profile(s) in which it is contained – directly and indirectly.

As indicated in the figure, the *Common ISDN Access Profile* is dependent only upon the Generic Access Profile (GAP) [5]. The terminology, user interface and security aspects, modes and procedures as defined in the Generic Access Profile are applicable to this profile, unless explicitly stated otherwise.

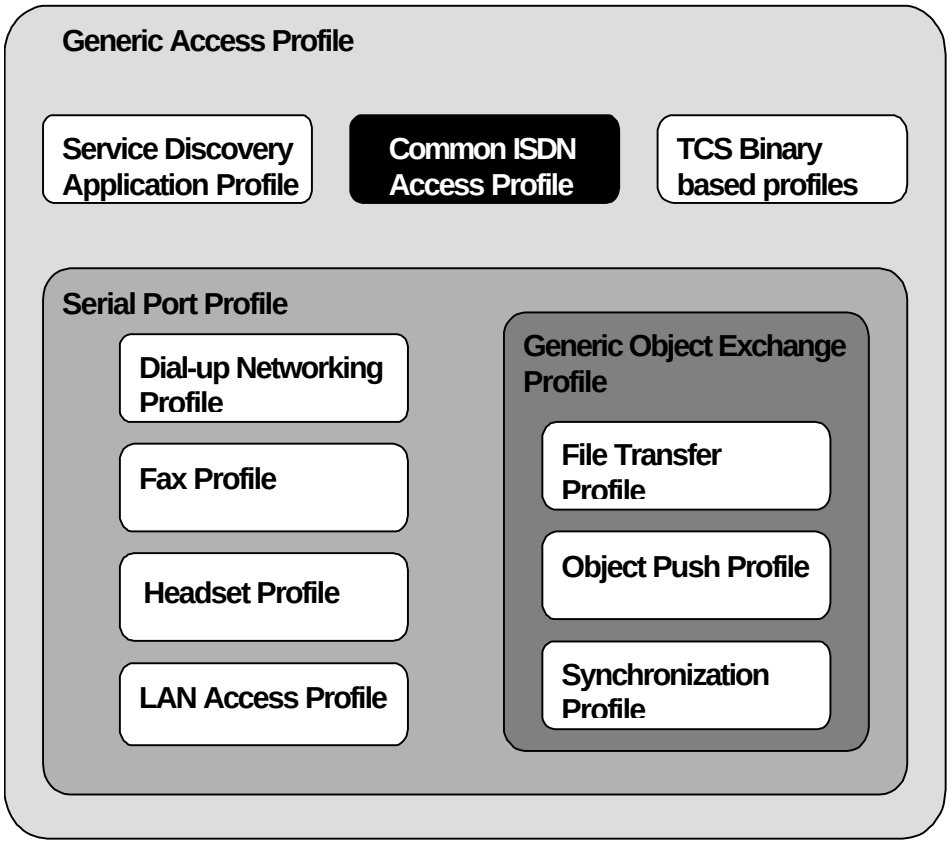

Figure 1.1: Bluetooth profile dependencies

1.3 Symbols and conventions

1.3.1 Requirement status symbols

In this document, the following symbols are used:

'M' for mandatory to support (used for capabilities that shall be used in the profile);
'O' for optional to support (used for capabilities that can be used in the profile);
'C' for conditional support (used for capabilities that shall be used in case a certain other capability is supported);
'X' for excluded (used for capabilities that may be supported by the unit but which shall never be used in the profile);
'N/A' for not applicable (in the given context it is impossible to use this capability).

Some excluded capabilities are capabilities that, according to the relevant Bluetooth specification, are mandatory. These are features that may degrade operation of devices following this profile. Therefore, these features shall never be activated while a unit is operating as a unit within this profile.

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1.3.2 Signaling diagram conventions

The following arrows are used in diagrams describing procedures:

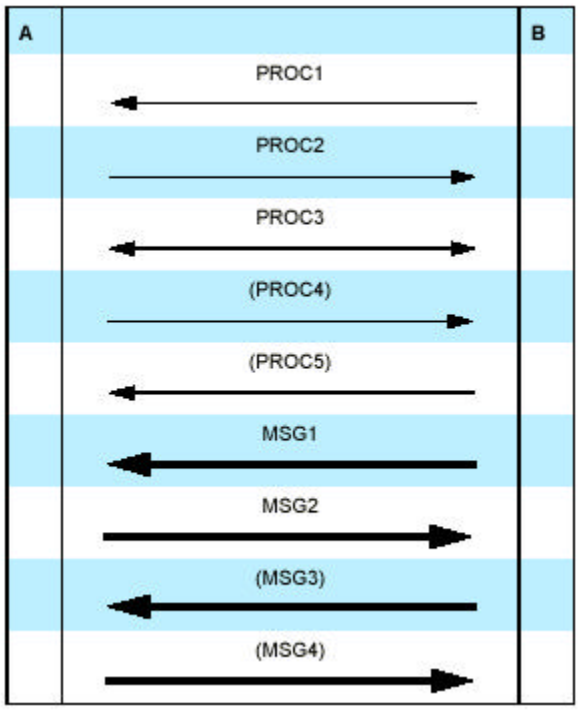

Figure 1.2: Procedure descriptions

In Figure 1.2 above, the following cases are shown: PROC1 is a sub-procedure initiated by B. PROC2 is a sub-procedure initiated by A. PROC3 is a sub-procedure where the initiating side is undefined (may be both A and B). PROC4 indicates an optional sub-procedure initiated by A, and PROC5 indicates an optional sub-procedure initiated by B.

MSG1 is a message sent from B to A. MSG2 is a message sent from A to B. MSG3 indicates an optional message from A to B, and MSG4 indicates an optional message from B to A.

1.3.3 Notation for timers and counters

Timers and counters may be introduced specific to this profile. To distinguish them from timers (counters) used in the Bluetooth protocol specifications and other profiles, these timers (counters) are named in the following format: 'T CIP-*nnn*' ('N CIP *nnn*').

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2 Profile overview

2.1 Protocol stack

Figure 2.1 below shows the protocols and entities used in this profile.

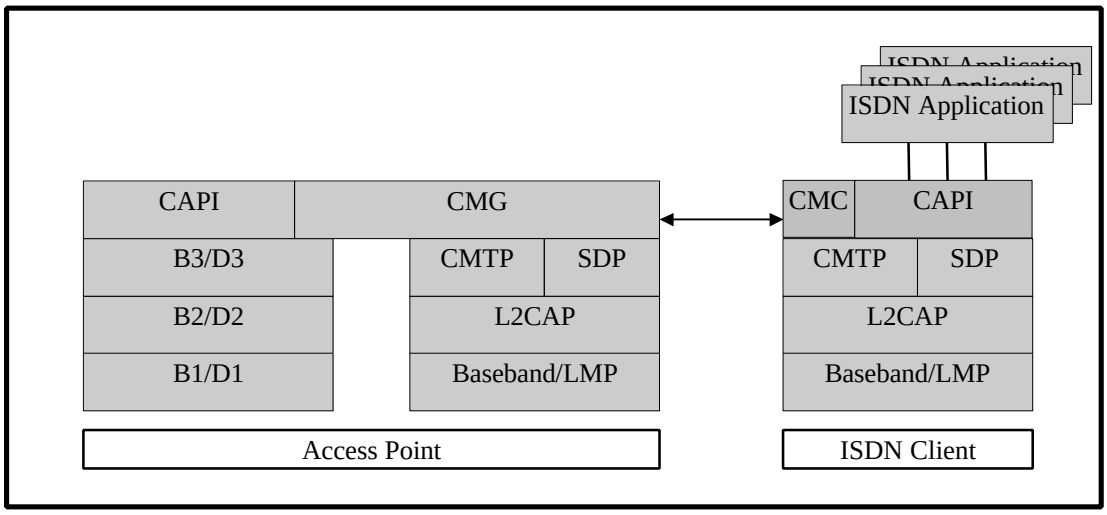

Figure 2.1: Protocol model

This profile defines the requirements for each of the layers in the protocol model above for the Common ISDN Access Profile.

The Baseband, LMP and L2CAP are the lower layer Bluetooth protocols [1,2,3].

SDP is the Bluetooth Service Discovery Protocol.

CMTP is the CAPI Message Transport Protocol (see Section 9)

CAPI stands for Common ISDN Application Programming Interface, which is defined in [7]. This profile refers especially to Common ISDN Application Programming Interface Part II, and PART IV Section 9.2.3.

The CAPI Message Gateway (CMG) is an optional, functional entity. Its presentation here only depicts the routing of the CAPI Messages between the Bluetooth protocol stack and the ISDN protocol stack with the OSI layer 1 to 3 for the ISDN B- and D-Channels. The CMG is a manufacturer dependent piece of software and out of scope in this profile.

The CAPI Message Client (CMC) is an optional, functional entity that routes CAPI Messages between the client CAPI Interface and the Bluetooth protocol stack. The CMC is manufacturer dependent and out of the scope of this profile.

2.2 Roles

The following roles are defined in this profile:

Access Point (AP): The AP acts as a terminal endpoint from the external network point of view and handles all interworking towards that network. The AP is the central point with respect to external calls, which means that it handles the D-Channel Protocol on the ISDN and routes the signaling requests and indications via CAPI Messages to the ISDN client.

The AP shall accept more than one IC in parallel.

ISDN Client (IC): The IC is the client that accesses the AP wireless and may offer CAPI to the user. The IC can for example be a laptop, PC, handheld, cordless phone or otherwise.

A device may implement both roles if suitable for its design.

2.3 User requirements and scenarios

Only one scenario has to be defined:

Connecting to the AP so that CAPI Messages can be routed from and to the IC.

This enables the IC to use all ISDN features defined in Common ISDN Application Programming Interface [7] like for instance: telephony, HDLC (internet), X.75, facsimile, supplementary services.

2.4 Profile fundamentals

The AP may be the master of the piconet in the Common ISDN Access Profile.

If the IC is not connected to an AP and wishes to establish a connection it shall attempt to page a local AP.

An AP should devote as much of its free capacity as possible (considering power limitations and ongoing signaling) to page scanning in order to allow roaming ICs that enter the range of the AP to find it as quickly as possible. This scheme minimizes radio traffic and gives reasonable access time when the IC comes into range of the AP.

When an IC has successfully paged an AP, the AP may request a master-slave switch. A connection-oriented L2CAP channel shall be established and is used for all data transfer.

Note: The AP may defer a master slave switch request. As an example, in a single IC environment this allows the IC to stay as master, so the IC can continue to drive other Bluetooth devices.

For security purposes, mutual authentication of ICs and AP shall be performed, and all data shall be encrypted.

2.5 Conformance

If conformance to this profile is claimed, all capabilities indicated as mandatory for this profile shall be supported in the specified manner (process-mandatory). This also applies to all optional and conditional capabilities for which support is indicated in the related PICS. All mandatory, optional and conditional capabilities, for which support is indicated, are subject to verification as part of the Bluetooth qualification program.

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3 Application layer

The following text, together with the associated sub-clauses, defines the feature requirements with regard to this profile.

Table 3.1: Application layer features

Item no.	Feature	Support in AP	Support in IC
1	Profile fundamentals	M	M
2	CAPI Message Transfer	M	M
3	Multi Client Support	M	N/A

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4 Interoperability requirements

This profile requires compliance to the Generic Access Profile. This section defines the support requirements with regards to procedures and capabilities defined in the Generic Access Profile.

4.1 Modes

Table 4.1 below shows the support status for modes within this profile.

Table 4.1: Modes

Mode	Procedure	Support in AP	Support in IC
1. Discoverability modes	Non-discoverable mode	C1	N/A
	Limited discoverable mode	O	N/A
	General discoverable mode	O	N/A
2. Connectability modes	Non-connectable mode	X	N/A
	Connectable mode	M	N/A
3. Pairing modes	Non-pairable mode	O	X
	Pairable mode	M	M

C1: If General discoverable mode is not supported, non-discoverable mode is mandatory, otherwise optional.

4.2 Security aspects

Table 4.2 below shows the support status for security aspects within this profile.

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Note: To efficiently protect critical data on its way through the air, security is restricted to the topmost levels. Refer to [5] for details on the Bluetooth security concept.

Table 4.2: Security aspects

Mode	Procedure	Support in AP	Support in IC
1. Authentication		M	M
2. Security modes	Security mode 1	X	X
	Security mode 2	C1	C1
	Security mode 3	C1	C1
C1: Support for at least one of the security modes 2 and 3 is mandatory. If security mode 2 is chosen, mutual authentication and encryption shall be done successfully before transmitting CMTP messages.			

4.3 Idle mode procedures

Table 4.3 below shows the support status for idle mode procedures within this profile.

Table 4.3: Idle mode procedures

Mode	Procedure	Support in AP	Support in IC
1	General Inquiry	N/A	O
2	Limited Inquiry	N/A	O
3	Name discovery	N/A	O
4	Device discovery	N/A	O
5	Bonding	M	M

4.4 Bonding

The IC shall support initiation of bonding, and the AP shall accept bonding.

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5 Service discovery procedures

Table 5.1 below lists all entries in the SDP database of the AP defined by this profile.

The 'Status' column indicates whether the presence of this field is mandatory or optional.

The codes assigned to the mnemonics used in the 'Value' column and the codes assigned to the attribute identifiers can be found in the Bluetooth Assigned Numbers database. (http://www.bluetooth.org/assigned-numbers.htm).

Table 5.1: SDP entry for AP service

Item	Definition	Type	Value	Status	Default
Service Class ID List				M	
Service Class #0		UUID	Common ISDN Access	M	
Protocol Descriptor List				M	
Protocol #0		UUID	L2CAP	M	
ProtocolSpecificParameter #0		Uint16	PSM value	M	
Protocol #1		UUID	CMTP	M	
Service Name	Display-able Text name	String	Service-provider defined	O	'Common ISDN Access'
External Network		Uint8	0x02 = ISDN 0x03 = GSM	O	0x02
BluetoothProfile-DescriptorList				M	
Profile #0		UUID	Common ISDN Access	M	
Parameter for Profile #0	Version	Uint16	0x0100 (Version 1.0)	M	

The following specific SDP ID values are defined in the Bluetooth Assigned Numbers database:

- Service Class ID: Common ISDN Access
- Protocol ID: CMTP

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6 L2CAP procedures

The following text, together with the associated sub-clauses, defines the mandatory requirements with regard to this profile.

6.1 Channel types

In this profile, only connection-oriented channels are used.

6.2 Configuration options

This section describes the usage of configuration options in the Common ISDN Access Profile.

6.2.1 Maximum transmission unit

The maximum transmission unit (MTU) a L2CAP implementation uses for this profile shall support at least 152 octets.

6.2.2 Flush timeout option

The flush timeout value used for both the AP and the IC shall be the default value of 0xFFFF.

6.2.3 Quality of service parameters

CMTP does not rely on a guaranteed quality of service (QoS), therefore the client shall set-up the connection with default QoS values as defined in [3].

Due to the nature of the ISDN Client applications the optimum bandwidth can be determined by the Access Point while connected. To achieve optimal bandwidth usage, the Access Point should reconfigure the QoS parameters of each connection dynamically, if necessary.

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7 LMP procedures overview

In this section the LMP layer is discussed. Table 7.1 below lists all LMP features. It is shown which LMP features are mandatory, optional or excluded with respect to the *Common ISDN Access Profile*. The reason for excluding features is that they may degrade operation of devices in this profile. Therefore, a unit active in this profile shall never activate these features.

Table 7.1: LMP procedures

	Procedure	Support in LMP	Support in IC	Support in AP
1.	Authentication	M		
2.	Pairing	M		
3.	Change link key	M		
4.	Change the current link key	M		
5.	Encryption	O	M	M
6.	Clock offset request	M		
7.	Slot offset information	O	M	M
8.	Timing accuracy information request	O		
9.	LMP version	M		
10.	Supported features	M		
11.	Switch of master slave role	O	M	M
12.	Name request	M		
13.	Detach	M		
14.	Hold mode	O		
15.	Sniff mode	O		
16.	Park mode	O		
17.	Power control	O		
18.	Channel-quality driven data rate	O		
19.	Quality of service	M		
20.	SCO links	O		
21.	Control of multi-slot packets	M		
22.	Paging scheme	O		
23.	Link supervision	M		
24.	Connection establishment	M		

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7.1 Master-slave switch

The AP may be the master of the piconet. The AP may request a master-slave switch when an IC connects. If the IC rejects the request, the AP shall detach it.

Consequently, an IC shall accept master-slave switch requests of the AP.

The AP may refuse a connection.

Note: See also 2.4, "Profile fundamentals."

7.2 Authentication and Pairing

Only Combination keys shall be used for authentication This also yields for the mutual authentication during the pairing procedure or any change of the connection link key.

7.3 Encryption

The encryption key size should be negotiated to 16 bytes (128 bits). If restricted by any regulation, a smaller key size shall be accepted.

The AP shall initiate encryption immediately after successful authentication.

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8 LC features

8.1 Inquiry scan

A device, which is active in the AP role of the *Common ISDN Access Profile* may, in the Class of Device field:

1. Indicate the value for ‘Phone’ as Major Device Class
2. Indicate the value for ‘Common ISDN Access’ as Minor Device Class

The device shall set the ‘Networking’ and ‘Telephony’ bits in the Service Class field.

This may be used by an inquiring device to filter the inquiry responses.

The codes assigned to the values can be found in the Bluetooth Assigned Numbers database (http://www.bluetooth.org/assigned-numbers.htm).

8.2 Inter-piconet capabilities

Inter-piconet capability is the capability, as master, to keep the synchronization of a piconet while page scanning in free slots and allowing for new members to join the piconet. While a new unit is joining the piconet (until the master-slave switch has been performed), operation may temporarily be degraded for the other members.

The AP should be able to accept requests from other clients and such may need limited inter-piconet capabilities.

The case that a piconet is full shall be handled by the application.

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9 CAPI Message Transport Protocol

9.1 Structure of transferred data

The CAPI Message Transport Protocol (CMTP) is used to transfer *Common ISDN Application Interface* messages. The data is transferred via L2CAP.

The CAPI Messages itself are specified in the *Common ISDN Application Interface* [7], which is publicly available from the CAPI Association e.V. under http://www.capi.org.

To achieve the use of maximum Bluetooth bandwidth it is reasonable to concatenate several messages in one (L2CAP) data block. For data delay reason it is sensible to transport the data as quickly as possible.

Therefore data should be sent immediately after reception from the ISDN line. In case of a receive error the partly transferred blocks can be discarded by setting an error value in the last part of the message.

Besides concatenation of CAPI Messages as stated above, CAPI Messages may be split over several CMTP messages. CMTP messages shall not be split over multiple L2CAP packets.

Parts of different CAPI Messages may be interleaved by using different CMTP Block IDs.

CMTP Head	Length	CAPI Msg 1	CMTP Head	Length	CAPI Msg 2	CMTP Head	Length	CAPI Msg 3

Figure 9.1: Example of CAPI Message concatenation using CMTP

CMTP Head	Length	CAPI Msg 1 start	CMTP Head	Length	CAPI Msg 2	CMTP Head	Length	CAPI Msg 1 end

Figure 9.2: Example of CAPI Message interleave using CMTP

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9.2 Structure of a CMTP message

A single CMTP message shall consist of at least a message header, which shall be followed by the length field and the payload body (see Figure 9.3) as indicated in the header. The payload shall transport the CAPI Message. For coding of the payload length Little Endian format is used. The payload length shall be in the range of zero to 2^{16}-1 Bytes (0..65535 Bytes). If there is no length field then the payload length is 0.

As indicated in Table 9.1 the CAPI Block ID shall be used to identify the segmented parts of CAPI Messages if CAPI Messages are interleaved. Adjacent, non interleaved CAPI Messages may use the same CAPI block ID. Up to 16 segmented not yet completed CAPI Messages may be outstanding.

Message header	Length	0 - 0xFFFF bytes of CAPI Message data

Figure 9.3: Structure of a CMTP message

Table 9.1, Table 9.2 and Table 9.3 define the message transport protocol header and the use of its status bits and length bits respectively.

Table 9.1: Structure of CAPI Message transport protocol header

Bit	Function	Usage
0(LSB) - 1	block status	see Table 9.2: Status bits defined in CAPI Message transport protocol header
2 – 5	CAPI-Block-ID	4 Bit number
6 – 7(MSB)	number of length bytes	see Table 9.3: Length field description

Table 9.2: Status bits defined in CAPI Message transport protocol header

Value	Block status
0	complete CAPI Message or last part of a segmented message
1	part of a segmented not completed CAPI Message
2	error, message shall be discarded, also all previously received parts of this message
3	reserved extension, message shall be discarded, also all previously received parts of this message

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Table 9.3: Length field description

Value	Number of length bytes
0	no length bytes, no payload follows
1	1 length byte
2	2 length bytes
3	Reserved

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10 References

[1] Bluetooth Baseband Specification – Bluetooth Specifications Part B

[2] Bluetooth Link Manager Protocol – Bluetooth Specifications Part C

[3] Bluetooth Logical Link Control and Adaptation Protocol Specification – Bluetooth Specifications Part D

[4] Bluetooth Service Discovery Protocol – Bluetooth Specifications Part E

[5] Bluetooth Generic Access Profile - Bluetooth Profiles Part K:1

[6] Bluetooth Assigned Numbers, see http://www.bluetooth.org/assigned-numbers.htm.

[7] Common ISDN Application Interface (CAPI), publicly available under http://www.capi.org. Alternate contact: CAPI Association e.V. Secretary, Alt-Moabit 95, D-10559 Berlin, Germany

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11 List of Acronyms and Abbreviations

Abbreviation or Acronym	Meaning
AP	Access Point
CAPI	Common ISDN Application Programming Interface
CIP	Common ISDN Access Profile (this Profile)
CMC	CAPI Message Client
CMG	CAPI Message Gateway
CMTP	CAPI Message Transport Protocol
DUN	Dial Up Network (Bluetooth Profile)
GAP	Bluetooth Generic Access Profile [5]
HDLC	High-level Data Link Control
IC	ISDN Client
ISDN	Integrated Services Digital Network
L2CAP	Bluetooth Logical Link Control and Adaptation Protocol [3]
LMP	Bluetooth Link Manager Protocol [2]
MTU	Maximum Transmission Unit
PICS	Profile Implementation Conformance Statement
QoS	Quality of Service
SDP	Bluetooth Service Discovery Protocol [4]
UDI	Unrestricted Digital Interface (Bluetooth Profile)
X.75	ITU-T Recommendation X.75

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