Ericsson HCI Implemented Features and Limitations for Baseband C

ERICSSON ⧨

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INTRODUCTION

1.1 About this Document

The scope of this document is to list the commands and events that have been implemented of those that are specified in [1]. The grouping of the commands follows the grouping in [1]. If information to the customer regarding the implementation of a command or an event is needed, a comment containing this information is written below the table where the command or event is listed.

In Chapter 2, some general important information regarding the implementation is given. Chapter 3 lists which commands are implemented and which are not implemented. Chapter 4 lists which events are implemented and which are not implemented.

In the event that a referenced document is not included in the delivery, it is considered as unnecessary for immediate comprehension.

1.2 Purpose and Use

This document shall be read when an understanding of HCI implementation is needed

1.3 Delivery Objects

N/A

1.4 System Level Description

N/A

1.5 Abbreviations

Abbreviations	Explanation
N/A	Not Applicable

Table 2-1. Abbreviations.

1.6 Glossary

N/A

1.7 References

[1]   Title: Host Controller Interface Functional Specification",
                   part H:1 of "Specification of the Bluetooth System - Core
        Author: The Bluetooth Special Interest Group
        Doc no.:
        Version: 1.1

[2]   Title: Logical Link Control and Adaptation Protocol Specification",
                   part D of "Specification of the Bluetooth System - Core",
        Author: The Bluetooth Special Interest Group
        Doc no.:
        Version: 1.1

[3]   Title: Ericsson Specific HCI Commands and Events for Baseband C
        Doc no.:   3/0062-ROK 101 007 Uen
        Version: PA12

2   GENERAL IMPORTANT INFORMATION

We have common firmware for all physical interfaces. After a power-on or a hardware reset, the Host must send an HCI command on the physical interface which is to be used (e.g. UART1). After this has been done, the physical interface over which the command was sent will be used until a hardware reset is performed (it is not enough to issue the HCI Reset command to change interfaces). All other physical interfaces will be closed for HCI communication. No events and no data will be sent to the Host before the Host has sent a command to the Host Controller after a power-on or a hardware reset.

Note that the Packet_Type parameter in the commands `Create_Connection`, `Add_SCO_Connection` and `Change_Connection_Packet_Type` is interpreted in the following way: If at least one of the packet types specified in the Packet_Type parameter is supported, the command will succeed. If the command `Change_Connection_Packet_Type` succeeds, the value of the `Packet_Type` parameter in the event Connection Packet Type Changed event will be the same as in the `Change_Connection_Packet_Type` command. However, this does not necessarily mean that all the specified packet types are currently supported. The Connection Packet Type Changed event will only be returned when the command `Change_Connection_Packet_Type` has been issued. The event will not be returned unsolicited, e.g. when LM changes the used packet types among those that have been specified for the connection by the Host.

Note that all ACL data that is sent in HCI Data Packets must have the L2CAP format (the data in an HCI Data Packet where `the Packet_Boundary_Flag=10`$_b$ must begin with an L2CAP header). See [2] for more information.

3 COMMANDS

3.1 Link Control Commands

The link control commands are gathered in Table 3-1.

Item	HCI Command	Comment	Support
1	Inquiry	-	YES
2	Inquiry_Cancel	-	YES
3	Periodic_Inquiry_Mode	-	YES
4	Exit_Periodic_Inquiry_Mode	-	YES
5	Create_Connection	C1	YES
6	Disconnect	C2	YES
7	Add_SCO_Connection	C3	YES
8	Accept_Connection_Request	-	YES
9	Reject_Connection_Request	-	YES
10	Link_Key_Request_Reply	-	YES
11	Link_Key_Request_Negative_Reply	-	YES
12	PIN_Code_Request_Reply	-	YES
13	PIN_Code_Request_Negative_Reply	-	YES
14	Change_Connection_Packet_Type	C4	YES
15	Authentication_Requested	-	YES
16	Set_Connection_Encryption	-	YES
17	Change_Connection_Link_Key	C5	YES
18	Master_Link_Key	C6, C7, C8, C9, C10	YES
19	Remote_Name_Request	-	YES
20	Read_Remote_Supported_Features	-	YES
21	Read_Remote_Version_Information	-	YES
22	Read_Clock_Offset	-	YES

Table 3-1. Link control commands.

C1. Up to 7 active slaves are supported. If more than one packet type is enabled, the packet type is chosen in the following order: DH5, DM5, DH3, DM3, DH1, and DM1. If there is an SCO connection to the local device, the packet type DM1 will always be used for all ACL connections to the local device regardless of which packet types that have been specified as allowed in the `Create_Connection` command.

C2. Disconnection of connections that are put in hold, sniff or park mode is not supported.

C3. Only one SCO connection is supported. If more than one packet type is enabled, the packet type is chosen in the following order: HV3, HV2, and HV1.

C4. If more than one packet type is enabled for an ACL connection, the packet type is chosen in the following order: DH5, DM5, DH3, DM3, DH1, and DM1. If there is an SCO connection to the local device, the packet type DM1 will always be used for all ACL connections to the local device regardless of which packet types that have been specified as allowed in the `Change_Connection_Packet_Type` command. Note that a slave may be forced by a master to only use 1-slot packets or to use packets that are a maximum of 3 slots in length (by the LMP message `LMP_max_slots`). This may force the device to use packet types that have been specified as not allowed in `Change_Connection_Packet_Type`. If more than one packet type is enabled for an SCO connection, the packet type is chosen in the following order: HV3, HV2, and HV1.

C5. Only supported when combination key is used. However, if a remote device has decided to use unit key, the local LM will support remote initiated change of this link key.

C6. The involved connections must not be parked when issuing the command.

C7. The command must be preceded by authentication of all involved connections.

C8. The involved connections must not be encrypted when issuing the command.

C9. Failing to meet requirement C7 or C8 will result in removal of the corresponding connection(s).

C10. Failing to successfully complete the switch of link key for any connection will result in the removal of the corresponding connection.

3.2   Link Policy Commands

The link policy commands is stated in Table 3-2.

Item	HCI Command	Comment	Support
1	Hold_Mode	C11	YES
2	Sniff_Mode	C12, C13, C14	YES
3	Exit_Sniff_Mode	-	YES
4	Park_Mode	C15	YES
5	Exit_Park_Mode	-	YES
6	QoS_Setup	C16	YES
7	Role_Discovery	-	YES
8	Switch_Role	C17	YES
9	Read_Link_Policy_Settings	-	YES
10	Write_Link_Policy_Settings	-	YES

Table 3-2. Link policy commands.

C11. We only support Hold with Hold_Mode_Max_Interval set to 0x0002 or higher.

C12. Sniff is only supported for a `Sniff_Max_Interval` set to `0x000A` or higher.

C13. Values lower than 0x000C for the Sniff_Timeout parameter result in low data throughput.

C14. It is recommended to use even values for the sniff interval. The reason for this is that a sniff interval has to be scheduled in terms of full frames (1 frame = 2 slots). LM will convert any received odd sniff interval downwards into the next even value. Note that this means that Sniff_Max_Interval = Sniff_Min_Interval = Odd value will result in an actual sniff interval which is 1 slot less than the requested Sniff_Min_Interval.

C15. We only support Park with Beacon_Max_Interval set to 0x00C6 or higher.

C16. For Service Type "No Traffic", the default poll interval will be used and other parameters are ignored.
For Service Type "Best Effort", a poll interval is calculated based on the parameters Token Rate and Latency. The calculated poll interval is at least 5 frames. Valid Token Rate depends on packet type. Note that high Token Rate corresponds to a low Poll Interval.
DM1 between 2267 and 45 bytes per second.
DH1 between 3600 and 72 bytes per second.
DV   between 1200 and 24 bytes per second.
DM3 between 16133 and 323 bytes per second.
DH3 between 24400 and 488 bytes per second.
DM5 between 29867 and 597 bytes per second.
DH5 between 45200 and 904 bytes per second.
Service Type "Guaranteed" is not supported.

C17. If there is an SCO connection between the local device and the device identified by the BD_ADDR parameter, an attempt to perform a role switch will be rejected by the local device.

3.3 Host Controller and Baseband Commands

Host Controller and Baseband Commands is stated in Table 3-3.

Item	HCI Command	Comment	Support
1	Set_Event_Mask	-	YES
2	Reset	-	YES
3	Set_Event_Filter	C18	YES
4	Flush	-	NO
5	Read_PIN_Type	-	YES
6	Write_PIN_Type	C19	YES
7	Create_New_Unit_Key	C20	NO
8	Read_Stored_Link_Key	-	YES
9	Write_Stored_Link_Key	C21	YES
10	Delete_Stored_Link_Key	-	YES
11	Change_Local_Name	-	YES
12	Read_Local_Name	-	YES
13	Read_Connection_Accept_Timeout	-	YES
14	Write_Connection_Accept_Timeout	-	YES
15	Read_Page_Timeout	-	YES
16	Write_Page_Timeout	-	YES
17	Read_Scan_Enable	C22	YES
18	Write_Scan_Enable	C22	YES
19	Read_Page_Scan_Activity	-	YES
20	Write_Page_Scan_Activity	-	NO
21	Read_Inquiry_Scan_Activity	-	YES
22	Write_Inquiry_Scan_Activity	-	NO
23	Read_Authentication_Enable	-	YES
24	Write_Authentication_Enable	-	YES
25	Read_Encryption_Mode	C23	YES
26	Write_Encryption_Mode	C23	YES
27	Read_Class_Of_Device	-	YES
28	Write_Class_Of_Device	C24	YES
29	Read_Voice_Setting	-	YES
30	Write_Voice_Setting	C25	YES
31	Read_Automatic_Flush_Timeout	-	YES
32	Write_Automatic_Flush_Timeout	-	YES
33	Read_Num_Broadcast_Retransmissions	C26	NO
34	Write_Num_Broadcast_Retransmissions	C26	NO
35	Read_Hold_Mode_Activity	-	NO

36	Write_Hold_Mode_Activity	-	NO
37	Read_Transmit_Power_Level	-	YES
38	Read_SCO_Flow_Control_Enable	-	YES
39	Write_SCO_Flow_Control_Enable	-	NO
40	Set_Host_Controller_To_Host_Flow_Control	C27	YES
41	Host_Buffer_Size	C28	YES
42	Host_Number_Of_Completed_Packets	C29	YES
43	Read_Link_Supervision_Timeout	C30	YES
44	Write_Link_Supervision_Timeout	C30	YES
45	Read_Number_Of_Supported_IAC	-	YES
46	Read_Current_IAC_LAP	-	YES
47	Write_Current_IAC_LAP	C31	YES
48	Read_Page_Scan_Period_Mode	-	NO
49	Write_Page_Scan_Period_Mode	-	NO
50	Read_Page_Scan_Mode	-	YES
51	Write_Page_Scan_Mode	C32	YES

Table 3-3. Host controller and baseband commands.

C18. A maximum of four Class of Device filters and a maximum of four BD_ADDR filters can be set for the Inquiry Result Filter Type. A maximum of eight filters in total can be set for the Connection Setup Filter Type.

C19. The PIN type is automatically stored in non-volatile memory when the `Write_PIN_Type` command is issued. By default, it is set to variable PIN.

C20. In our implementation, we do not use unit key. We only use combination key. Therefore, this command is not implemented.

C21. The link keys given as parameters to this command are automatically stored in non-volatile memory, provided that there is room to store more link keys. A maximum of 32 link keys can be stored in non-volatile memory.

C22. The value of the Scan_Enable parameter reflects the behaviour of the local device when it is not connected. When the local device is connected as slave, or when the local device is connected as master with an SCO link, scanning will be turned off automatically.

C23. We only support point-to-point encryption. Encryption key lengths up to 128 bits are supported.

C24. The class of device is automatically stored in non-volatile memory when the `Write_Class_Of_Device` command is issued. It is by default set to 0x000000.

C25. This command specifies what voice settings will be used when setting up a new voice connection. It does not affect the settings for an existing voice connection. We do not support the combination "Input Coding: Linear" and "Input Sample Size: 8 bit".

C26. Currently we do not support broadcast. The value sent in the Write_Num_Broadcast_Retransmissions command is stored in LM and is used in QoS negotiation but actually not used when it comes to broadcast retransmissions. Broadcast data is always transmitted 5 times.

C27. We only support the values 0x00 and 0x01 for the `Flow_Control_Enable` parameter. The values 0x02 and 0x03 result in the error code "Unsupported Feature or Parameter Value" (0x11) being returned in the Status parameter of the Command Complete event.

C28. The minimum allowed value for the `Host_ACL_Data_Packet_Length` parameter is 339. Furthermore, HCI ACL Data Packets sent from the Host Controller to the Host will never contain more than 678 bytes of data even if the Host sets `Host_ACL_Data_Packet_Length` to a bigger value than 678 in the `Host_Buffer_Size` command.

C29. The Command Complete event is never returned for the command `Host_Number_Of_Completed_Packets` in our implementation. The command parameters are not checked. It is assumed that the command parameters of `Host_Number_Of_Completed_Packets` commands are always correct. Erroneous command parameters (an error in the Host software) may cause strange behavior.

C30. We do not have link supervision for parked connections. The `Write_Link_Supervision_Timeout` command is only allowed on the master side.

C31. At inquiry scan, support is only given for scanning for the GIACs, for one DIAC or for both a GIAC and a DIAC; i.e. a maximum of two IACs can be scanned for simultaneously, but the combination of two DIACs is not supported.

C32. The only value supported for the `Page_Scan_Mode` parameter is 0x00.

3.4   Informational Parameters Commands

The informational parameter commands are stated in Table 3-4.

Item	HCI Command	Comment	Support
1	Read_Local_Version_Information	C33	YES
2	Read_Local_Supported_Features	-	YES
3	Read_Buffer_Size	-	YES
4	Read_Country_Code	-	YES
5	Read_BD_ADDR	-	YES

Table 3-4. Informational parameters commands.

C33. Ericsson revision numbers for firmware releases have the format XYZ. X = "P" or X = "R" where "P" means preliminary release and "R" means final release. Y is an integer number (Y ≥ 1) that is increased with 1 for every new release where the functionality is changed compared to the previous release. Z is an alphabetic letter. It starts with "A" and increases to the next letter in the alphabet for every bug fix revision.
How the HCI_Revision number is coded is stated in Table 3-5 (except for FW revision P1A where `HCI_Revision` = 1).

Most significant bit (bit 7) of high-order byte	7 least significant bits of high-order byte	Low-order byte
X coded in the following way: **X** = "P": 0 **X** = "R": 1	**Y** in binary form	**Z** coded in the following way: **Z** = "A": 0x00 **Z** = "B": 0x01 **Z** = "C": 0x02 and so on ...

Table 3-5. How to code the HCI_Revision number.

3.5 Status Parameters Commands

The Status parmeter commands are stated in Table 3-6.

Item	HCI Command	Comment	Support
1	Read_Failed_Contact_Counter	-	NO
2	Reset_Failed_Contact_Counter	-	NO
3	Get_Link_Quality	-	NO
4	Read_RSSI	-	YES

Table 3-6. Status parameters commands.

3.6   Testing Commands

The testing commands are stated in Table 3-7.

Item	HCI Command	Comment	Support
1	Read_Loopback_Mode	-	YES
2	Write_Loopback_Mode	C34	YES
3	Enable_Device_Under_Test_Mode	-	YES

Table 3-7. Testing commands.

C34. We only return ONE connection handle for an SCO connection when entering local loopback mode. This is a deviation from reference [1] where it says that three connection handles for SCO connections should be returned. Furthermore, in remote loopback mode, we only allow a maximum of one SCO connection using the DMA SCO data path (see description of the Ericsson_Set_SCO_Data_Path command in reference [3]) and not three as it says in reference [1]. Entering remote loopback mode must be done BEFORE the SCO connection using the DMA SCO data path is established. An SCO connection using the DMA SCO data path that remains after remote loopback mode has been left (no loopback mode has been entered) will be unusable. The Host will not be able to send any SCO data for this connection. The Host should disconnect such an SCO connection. The Host is not allowed to send any ACL or SCO data when the local device is in remote loopback mode.
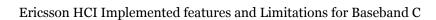
4 EVENTS

The events handled in HCI are stated in Table 4-1.

Item	Event	Comment	Support
1	Inquiry Complete event	-	YES
2	Inquiry Result event	-	YES
3	Connection Complete event	-	YES
4	Connection Request event	-	YES
5	Disconnection Complete event	-	YES
6	Authentication Complete event	-	YES
7	Remote Name Request Complete event	-	YES
8	Encryption Change event	-	YES
9	Change Connection Link Key Complete event	-	YES
10	Master Link Key Complete event	-	YES
11	Read Remote Supported Features Complete event	-	YES
12	Read Remote Version Information Complete event	-	YES
13	QoS Setup Complete event	C35	YES
14	Command Complete event	-	YES
15	Command Status event	-	YES
16	Hardware Error event	-	YES
17	Flush Occurred event	-	NO
18	Role Change event	-	YES
19	Number Of Completed Packets event	-	YES
20	Mode Change event	-	YES
21	Return Link Keys event	-	YES
22	PIN Code Request event	-	YES
23	Link Key Request event	-	YES
24	Link Key Notification event	-	YES
25	Loopback Command event	-	YES
26	Data Buffer Overflow event	-	YES
27	Max Slots Change event	-	YES
28	Read Clock Offset Complete event	-	YES
29	Connection Packet Type Changed event	-	YES
30	QoS Violation event	-	NO
31	Page Scan Mode Change event	-	NO
32	Page Scan Repetition Mode Change event	-	NO

Table 4-1. Events.

C35. The parameters will not be the same as in the initiating `QoS_Setup` command at the remote side. This is due to mismatches between the LMP and HCI specifications, and is therefore not a flaw in our implementation. Latency and Token Rate will be calculated from the received Poll interval.