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TIME PROFILE

Abstract

The Time profile enables the device to get the date, time, time zone, and DST information and control the functions related the time.

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Revision History

Revision	Date	Comments
D09r01	2010-11-17	Initial Draft
D09r02	2010-12-11	Updated due to fit the new template
D09r03	2010-12-24	Completed the draft
D09r04	2011-01-06	Fix the table of GATT Interoperability Requirements.
D09r05	2011-02-02	Remove Secondary Time related parts.
D09r07	2011-04-11	Edited in F2F for connection setup. Corrected role names.
D09r08	2011-04-18	Revised connection setup to match Proximity after GPA/BARB
D09r09	2011-04-27	Revised after call 26th April.
D09r10	2011-06-11	Removed BR/EDR and updated to latest connection setup
D09r11	2011-07-11	Editorial update to follow latest format.
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D09r13	2011-07-20	Responded to additional Barb comments
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D10r02	2011-08-10	Changed characteristic name of "CT Time" to "Current Time". Added "Service" to the name of the UUID for services
D10r03	2011-08-30	Added section 2.5, transport dependencies, removed duplicate 1.2, removed PS disclaimer and updated references to v1.0. Included some changes that were introduced in PAS after review of 1.0. One editorial in section 5 (font size)
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Document Terminology

The Bluetooth SIG has adopted Section 13.1 of the IEEE Standards Style Manual, which dictates use of the words ``shall'', ``should'', ``may'', and ``can'' in the development of documentation, as follows:

The word *shall* is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).

The use of the word *must* is deprecated and shall not be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

The use of the word *will* is deprecated and shall not be used when stating mandatory requirements; *will* is only used in statements of fact.

The word *should* is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is deprecated but not prohibited (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

The Time profile is used to obtain the date, time, and related information such as time zone as exposed by the Current Time service in the peer device. Information of when next change of daylight savings time (DST) will occur can be retrieved from the peer exposed by the Next DST Change service. This profile also enables the device to request updating the time on the peer device as exposed by the Reference Time Update service.

Table of Contents

1   Introduction

The Time profile is used to obtain the date and time, and related information such as time zone as exposed by the Current Time service in the peer device. Information of when next change of daylight savings time (DST) will occur can be retrieved from the peer exposed by the Next DST Change service. This profile also enables the device to request updating the time on the peer device as exposed by the Reference Time Update service.

1.1   Profile Dependencies

This profile is compatible with any *Bluetooth* core specification host that includes the Generic Attribute Profile (GATT).

1.2   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 for all optional and conditional capabilities for which support is indicated. All mandatory capabilities, and optional and conditional capabilities for which support is indicated, are subject to verification as part of the *Bluetooth* qualification program.

2 Configuration

2.1 Roles

The profile defines two roles: Time Server and Time Client.

- The Time Server shall be a GATT server.
- The Time Client shall be a GATT client.

2.2 Role / Service Relationships

The diagram below shows the relationships between service and the two profile roles.
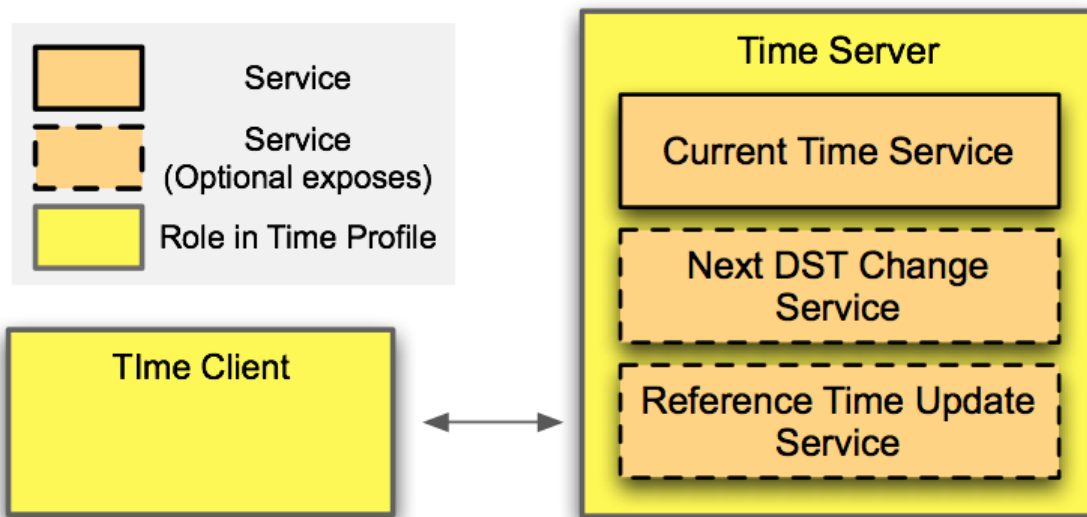
Figure 2.1: Role and Service relationships

The Time Server has an instance of the Current Time Service, and optionally an instance of the Next DST Change Service and an instance of the Reference Update Time Service.

2.3 Concurrency

Both a Time Server and a Time Client may run other use cases concurrently with the time use case.

2.4 Topology

The Time Server shall implement the GAP Central role and may implement the GAP Peripheral role. The Time Client shall implement the GAP Peripheral role and may implement the GAP Central role.

2.5 Transport Dependencies

This profile shall operate over an LE transport.

3 Time Server Requirements

This profile does not impose any additional requirements on any of the instances of the Current Time service, Next DST Change service and Reference Time Update service beyond those defined by those specifications.

3.1 Current Time Service

The Time Server profile role shall have one instance of Current Time service.

If any events of time update occur while a bonded Current Time Client is disconnected, the Current Time Server shall send the notification of Current Time characteristic immediately after reconnection.

3.2 Next DST Change Service

The Time Server profile role may have one instance of Next DST Change service.

3.3 Reference Time Update Service

The Time Server profile role may have one instance of Reference Time Update service.

4 Time Client Requirements

The Time Client shall perform service discovery to discover the Current Time service and optionally Next DST Change and Reference Time Update services.

The Time Client profile role defines requirements for connecting, reading, and configuring a Time Server.

This section describes the procedure requirements for a Time Client.

	Procedure	Ref.	Support in Time Client
1.	Service Discovery	4.1	M
2.	Characteristic Discovery	4.2	M
3.	Get the Current Time	4.3	M
4.	Configure the Time Server to Deliver the New Time When It Is Adjusted	4.4	C1
5.	Receive new time when time is adjusted on the server	4.5	O
6.	Get the Local Time Information (Time Zone, DST)	4.6	O
7.	Get the Time Accuracy of Time Server	4.7	O
8.	Get the Next DST Change Information	4.8	O
9.	Get the time updating state of the Time Server	4.9	O
10.	Request to Update the Reference Time on Server	4.10	O
C1: Mandatory if 'Receive new time when time is adjusted on the server' is claimed, else excluded			

Table 4.1: The Procedure requirements for the Time Client

4.1 Service Discovery

The Time Server shall perform service discovery using the GATT *Discover All Primary Services* sub-procedure or the GATT *Discover Primary Services by Service UUID* sub-procedure as follows:

- Discover the Current Time service using «Current Time Service» for the service UUID.

- Discover the Next DST Change service with «Next DST Change Service» for the service UUID.

- Discover the Reference Time Update service, with «Reference Time Update Service» for the service UUID.

The Next DST Change and Reference Time Update services are optional, and a Time Client shall not assume that all devices expose these services.

4.2 Characteristic Discovery

The GATT sub-procedure *Discover All Characteristics of a Service* or the GATT sub-procedure *Discover Characteristics by UUID* shall be used to discover the characteristics of the following services:

- Current Time service
- Next DST Change service

- Reference Time Update service

4.2.1 Characteristic in the Current Time Service

For the Current Time characteristic, the GATT *Discover All Characteristic Descriptors* sub-procedure shall be used to discover the *Client Characteristic Configuration* descriptor. The handle of this descriptor can be stored in the Time Client.

The Local Time Information and Reference Time Information characteristics are optional, and a Time Client shall not assume that these characteristics are exposed in the Current Time service by all devices.

4.3 Get the Current Time

To get the current time information, the GATT *Read Characteristic Value* sub-procedure shall be used with the handle of the Current Time characteristic.

4.4 Configure the Time Server to Deliver the New Time when Adjusted

The Time Client can receive the adjusted time as notifications from the Time Server by configuring the *Client Characteristic Configuration* descriptor for the Current Time characteristic in the Time Server.

To enable the notification of the Current Time characteristic, the GATT *Write Characteristic Descriptors* sub-procedure shall be used to set the Notification bit in the *Client Characteristic Configuration* descriptor.

4.5 Receive New Time when Time is adjusted on the Server

The Time Client, once notifications have been enabled, shall be able to receive notifications as sent using the GATT *Notification* sub-procedure of the Current Time characteristic.

Note: as defined in the Current Time service, if the Time Client and Time Server disconnect, notifications are not sent while the devices are disconnected.

Note: the Time Client cannot assume the Time Server always notifies the new time when the time in the Time Server is updated.

4.6 Get the Local Time Information

To get the time zone and the DST information from the Time Server, the Time Client can read the Local Time Information characteristic on the Time Server.

The GATT *Read Characteristic Value* sub-procedure shall be used with the handle of the Local Time Information characteristic.

4.7 Get the Time Accuracy of Time Server

To get the accuracy of the time information on the Time Server, the Time Client can read the Reference Time Information characteristic in the Time Server.

The GATT *Read Characteristic Value* sub-procedure shall be used with the handle of the Reference Time Information characteristic.

4.8 Get the Next DST Change Information

By reading the Time with DST characteristic in the Time Server, the Time Client can get the information when the next DST change will occur.

The GATT *Read Characteristic Value* sub-procedure shall be used with the handle of the Time with DST characteristic.

4.9 Get the Time Update State of the Time Server

By reading the Time Update State characteristic, the Time Client can get the information about the state of the reference update process (see [5]) in the Time Server.

The GATT *Read Characteristic Value* sub-procedure shall be used with the handle of the Time Update State characteristic.

4.10 Request to Update the Reference Time on Server

The Time Client can request that the Time Server update its local time from its reference Time Server by writing the Time Update Control Point characteristic of the Time Server.

The GATT *Write Without Response* sub-procedure shall be used with the handle of the Time Update Control Point characteristic to request an update of the time in the Time Server.

Note: If the Time Client writes this characteristic and the Time Server accepts the command, the time update state (as reflected in the Time Update State characteristic) of the Time Server may change according to the command written by the Time Client to this characteristic.

5   Connection Establishment

This section describes the connection establishment procedures used by a Time Client and Time Server. Since there are no topology restrictions imposed by this profile, the procedures are described in terms of GAP Peripheral role (referred to as the Peripheral) and GAP Central role (referred to as the Central).

5.1   GAP Peripheral Role Connection Establishment

5.1.1   Device Discovery

The Peripheral shall enter a GAP Limited Discoverable Mode when establishing an initial connection. The T_{GAP} (lim_adv_timeout) used during GAP *Limited Discoverable Mode* may be larger than the value specified in the Section 16, Appendix A in the GAP specification [1], but the value shall be less than or equal to 180 seconds.

5.1.2   Connection Procedure for Unbonded Devices

This procedure is used for device discovery and connection establishment when the Peripheral connects to a Central to which it is not bonded. This procedure is initiated by user interaction (like activating the device by battery insertion).

It is recommended that the Peripheral advertise using the parameters in Table 5.1. The interval values in the first row are designed to attempt fast connection during the first 30 seconds; however, if a connection is not established within that time, the interval values in the second row are designed to reduce power consumption for devices that continue to advertise.

Advertising Duration	Parameter	Value
First 30 seconds (fast connection)	Advertising Interval	20 ms to 30 ms
After 30 seconds (reduced power)	Advertising Interval	1 s to 2.5 s

Table 5.1: Recommended Advertising Interval Values

The advertising interval and time to perform advertising should be configured with consideration for user expectations of connection establishment time.

The Peripheral shall accept any valid values for connection interval and connection latency set by the Central until service discovery, bonding, and encryption setup is complete. Only after that should the Peripheral change to the preferred connection parameters that best suits the use case.

If a connection is not established within a time limit defined by the Peripheral, the Peripheral may exit the GAP connectable mode.

After bonding, the Peripheral should write the *Bluetooth* address of the Central in the Peripheral Controller's white list and set the Peripheral controller's advertising filter policy to 'process scan and connection requests only from devices in the White List'.

5.1.3 Connection Procedure for Bonded Devices

This procedure is used after the Peripheral has bonded with the Central device using the Connection procedure in Section 5.1.2 when the user initiates a connection.

A Peripheral shall enter the GAP *Undirected Connectable Mode* when commanded by the user to initiate a connection to a Central device.

The Peripheral should use the advertising filter policy configured when bonded using the Connection procedure in Section 5.1.2.

The Peripheral should use the recommended advertising interval values shown in Table 5.1.

The advertising interval and time to perform advertising should be configured with consideration for user expectations of connection establishment time.

The Peripheral shall accept any valid values for connection interval and connection latency set by the Central until service discovery and encryption setup is complete. Only after that should the Peripheral change to the preferred connection parameters that best suits its use case.

If a connection is not established within a time limit defined by the Peripheral, the Peripheral may exit the GAP connectable mode.

5.1.4 Link Loss Reconnection

When a connection is terminated due to link loss, a Peripheral should attempt to reconnect to the Central by using the procedures described in Sections 5.1.2 or 5.1.3.

5.2 GAP Central Role Connection Establishment

5.2.1 Device Discovery

The Central should use the GAP *Limited Discovery Procedure* to discover a Peripheral.

5.2.2 Connection Procedure for Unbonded Devices

This procedure is used for connection establishment when the Central connects to a Peripheral to which it is not bonded. This procedure is normally initiated by user interaction.

A Central may use one of the following GAP connection establishment procedures based on its connectivity requirements:

- *General Connection Establishment Procedure.* The Central may use this procedure when it requires connection to one or more Peripheral devices. This procedure allows a Central to connect to a Peripheral discovered during a scan without using the white list.

- *Direct Connection Establishment Procedure.* The Central may use this procedure when it requires connection to a single Peripheral.

- *Auto Connection Establishment Procedure*. The Central may use this procedure when it requires connection to one or more Peripheral devices. This procedure will automatically connect to a Peripheral in the white list.

- *Selective Connection Establishment Procedure*. The Central may use this procedure when it requires connection to one or more Peripheral devices. This procedure allows a Central to connect to a Peripheral discovered during a scan while using the white list.

A Central should use the recommended scan interval and scan window values shown in Table 5.2. For the first 30 seconds (or optionally continuously for mains powered devices), the Central should use the first scan window / scan interval pair to attempt fast connection. However, if a connection is not established within that time, the Central should switch to one of the other scan window / scan interval options as defined below to reduce power consumption.

Scan Duration	Parameter	Value
First 30 seconds (fast connection)	Scan Interval	30 ms to 60 ms*
	Scan Window	30 ms
After 30 seconds (reduced power) - Option 1	Scan Interval	1.28 s
	Scan Window	11.25 ms
After 30 seconds (reduced power) - Option 2	Scan Interval	2.56 s
	Scan Window	11.25 ms

Table 5.2: Recommended scan interval and scan window values

* A scan interval of 60ms is recommended when the Central is supporting other operations to provide a 50% scan duty cycle versus 100% scan duty cycle.

Option 1 in Table 5.2 uses the same background-scanning interval used in BR/EDR so that the power consumption for LE will be similar to the power consumption used for background scanning on BR/EDR. Option 2 uses a larger background-scanning interval (e.g., twice as long) than used in BR/EDR so the power consumption for LE will be less than the power consumption used for background scanning on BR/EDR. Connection times during background scanning will be longer with Option 2.

After bonding, the Central should write the *Bluetooth* address of the Peripheral in the Central Controller's white list and set the Central Controller's initiator filter policy to 'process connectable advertisement packets'.

5.2.3 Connection Procedure for Bonded Devices

This procedure is used after the Central has bonded with the Peripheral using the connection procedure in Section 5.2.2, and the user initiates a connection.

A Central may use one of the following GAP connection establishment procedures based on its connectivity requirements:

- *General Connection Establishment Procedure*. The Central may use this procedure when it requires connection to one or more Peripheral devices. This procedure allows a Central to connect to a Peripheral discovered during a scan without using the white list.

- *Direct Connection Establishment Procedure.* The Central may use this procedure when it requires connection to a single Peripheral.

- *Auto Connection Establishment Procedure.* The Central may use this procedure when it requires connection to one or more Peripheral devices. This procedure will automatically connect to a Peripheral in the white list.

- *Selective Connection Establishment Procedure.* The Central may use this procedure when it requires connection to one or more Peripheral devices. This procedure allows a Central to connect to a Peripheral discovered during a scan while using the white list.

The Central should use the recommended scan interval and scan window values shown in Table 5.2. For the first 30 seconds (or optionally continuously for mains powered devices), the Central should use the first scan window / scan interval pair to attempt fast connection. However, if a connection is not established within that time, the Central should switch to one of the other scan window / scan interval options as defined below to reduce power consumption.

The Central should use a scan window and scan interval suitable to its power and connection time requirements. Increasing the scan window increases the power consumption, but decreases the connection time.

The scan interval and scan window should be configured with consideration for user expectations of connection establishment time.

The Central shall start encryption after each connection creation to verify the status of the bond. If encryption fails upon connection establishment (i.e., The bond no longer exists), the Central must, after user interaction, re-bond, perform service discovery (unless the Central had previously determined that the Peripheral did not have the «Service Changed» characteristic), and reconfigure the Peripheral before using any of the services referenced by this profile in case the configuration was altered or lost.

5.2.4 Link Loss Reconnection

When a connection is terminated due to link loss, a Central should attempt to reconnect to the Peripheral using any of the GAP connection procedures and using procedures described in sections 5.2.2 or 5.2.3.

5.2.5 Fast Connection Interval

To avoid very long service discovery and encryption setup times, the Central should use the connection intervals defined in Table 5.3 in the connection request.

Parameter	Value
Minimum connection interval	50 ms
Maximum connection interval	70 ms

Table 5.3: Recommended connection interval values

Any time a key refresh or encryption setup is required — for example, to perform key refresh — it should be preceded with a connection parameter update to the minimum and maximum connection interval values in Table 5.3, and a latency of zero. This fast connection interval should be maintained as long as low latency is required. After that, it

should switch to the preferred connection parameters as determined by the Peripheral using the GAP *Connection Parameter Update* procedure.

5.2.6 Connection Parameters Update to Improve Accuracy of Receiving Time

If the Central is acting in the Time Server role, the Central should accept requests to change the connection parameters from the Peripheral device. The Peripheral can request short connection intervals for short periods of time for improved accuracy during time update, and it can request long connection intervals to save power when latency is not important.

6 Security Considerations

This section describes the security requirements for a Time Client and Time Server. Since there are no topology restrictions imposed by this profile, the requirements are described in terms of GAP Peripheral Role (referred to as the Peripheral) and GAP Central Role (referred to as the Central).

The Peripheral shall support LE Security Mode 1 and Security Levels 2 or 3. The Peripheral should use the SM Slave Security Request procedure only when bonded with the Central to inform the Central of its security requirements.

The Central shall support LE Security Mode 1 and Security Levels 2 and 3. The Central should accept the LE Security Mode and Security Level combination requested by the Peripheral.

7 GATT Interoperability Requirements

The following GATT sub-procedures are required to be implemented for the Time Client profile role.

GATT Sub-Procedure	Time Client requirements
Discover All Primary Services	C.1
Discovery Primary Services by Service UUID	C.1
Discover All Characteristic of a Service	C.2
Discover Characteristics by UUID	C.2
Discover All Characteristic Descriptors	M
Read Characteristic Value	M
Write Characteristic Descriptors	C.3
Notification	C.3
C.1: Mandatory to support at least one of these sub-procedures	
C.2: Mandatory to support at least one of these sub-procedures	
C.3: Mandatory to support if the 'Receive new time when time is adjusted on the server' procedure is claimed	

8 Acronyms and Abbreviations

Acronyms and Abbreviations	Meaning
AD	Advertising Data
ATT	Attribute Protocol
BR/EDR	Basic Rate / Enhanced Data Rate
DST	Daylight Saving Time
GAP	Generic Access Profile
GATT	Generic Attribute Profile
LE	Low Energy
UUID	Universally Unique Identifier

9 References

[1] *Bluetooth* Core Specification v4.0
[2] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers.
[3] Current Time Service v1.0
[4] Next DST Change Service v1.0
[5] Reference Time Update Service v1.0