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Reference Time Update Service

Abstract:

This service defines how a client can request an update from a reference time source from a time server using the Generic Attribute Profile (GATT).

Revision History

Revision	Date (yyyy-mm-dd)	Comments
D09r01	2010-11-16	Initial Draft
D09r02	2010-11-17	Edits in F2F
D09r03	2010-12-07	Updated due to template change & function change
D09r04	2010-12-22	Added the details (Security)
D09r05	2011-01-06	Security policy changes.
D09r06	2011-01-23	Fix the table of GATT Interoperability Requirements.
D09r07	2011-04-12	Small Caps
D09r08	2011-04-27	The section of Byte transmission order was added.
D09r09	2011-05-11	Removed BR/EDR
D09r10	2011-07-18	Responded to comments from RH, Tim, MER
V09r00	2011-07-26	Adopted by the Bluetooth SIG Board of Directors
D10r01	2011-08-10	First Draft D10
D10r02	2011-08-10	Corrected name of service UUID to include “Service”
D10r03	2011-08-30	Removed PS disclaimer. Some editorial from reviewer JL
V10r00	2011-09-15	Adopted by the Bluetooth SIG Board of Directors

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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*).

Table of Contents

1 Introduction

This service enables a *Bluetooth* device that can update the system time using reference time such as a GPS receiver to expose a control point and expose the accuracy (drift) of the local system time compared to the reference time source.

1.1 Conformance

If a server claims conformance to this service, all capabilities indicated as mandatory for this service 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.

1.2 Service Dependency

This service has no dependencies on other GATT-based services.

1.3 *Bluetooth* Specification Release Compatibility

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

1.4 GATT Sub-Procedure Requirements

Additional GATT sub-procedure requirements beyond those required by the GATT are indicated in the following table.

GATT Sub-Procedure	Requirements
Write Without Response	M

1.5 Transport Dependencies

The service shall operate over LE transport only.

1.6 Error Codes

No error codes are defined in this service.

1.7 Byte Transmission Order

All characteristics used with this service shall be transmitted with the least significant octet first (i.e., little endian). In the characteristic definitions in the Assigned Numbers [2], the least significant octet is the lowest numbered offset.

2 Service Declaration

The service shall be a «Primary Service» and the service UUID set to «Reference Time Update Service».

There shall be only one instance of the Reference Time Update service in the device.

3 Service Characteristics

The Reference Time Update service shall expose the Time Update Control Point characteristic and the Time Update State characteristic as shown in Table 3.1:

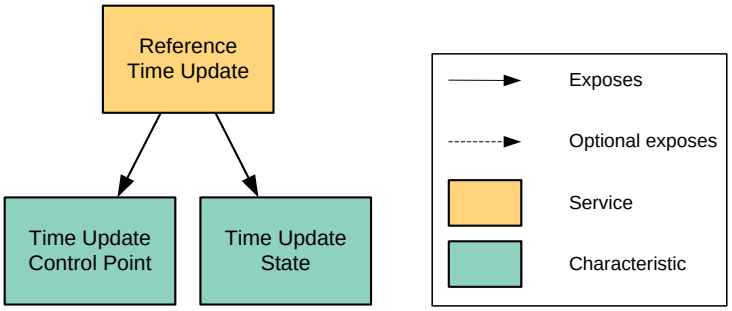

Table 3.1: Reference Time Update service relationships

The following characteristics are exposed in an instance of Reference Time Update service.

Characteristic	Ref.	Mandatory / Optional
Time Update Control Point	3.1	M
Time Update State	3.2	M

Table 3.2: Service characteristics

In Table 3.2, characteristics that are mandatory or characteristics that are optional that are implemented shall comply with the properties in Table 3.3:

	Broadcast	Read	Write without Response	Write	Notify	Indicate	Signed Write	Reliable Write	Writable Auxiliaries
Time Update Control Point	X	X	M	X	X	X	X	X	X
Time Update State	X	M	X	X	X	X	X	X	X

Table 3.3: Characteristic Properties

Requirements marked with ‘M’ are mandatory, ‘O’ are optional, and ‘X’ are excluded (not permitted).

The example characteristic database is shown in Appendix A.

3.1 Time Update Control Point

3.1.1 Characteristic Behavior

The Time Update Control Point characteristic is used to request a reference time update on the server when written using the *GATT Write Characteristic Value* sub-procedure.

The Time Update Control Point characteristic shall be writeable without response.

The Reference Time Update service shall support two commands sent to the Time Update Control Point characteristic.

Command	ID	Description
Get Reference Update	0x01	Forces the state machine to Update Pending and starts the time update procedure
Cancel Reference Update	0x02	Forces the state machine to Idle and stops the attempt to receive a time update

Table 3.4: Reference Time Update commands

All other commands shall be ignored and no change to the Time Update State shall be made.

For the service behavior in response to control point commands, see Section 4.1.

3.1.2 Characteristic Descriptors

No characteristic descriptors are required beyond those defined in the characteristic specification.

3.2 Time Update State

3.2.1 Characteristic Behavior

The Time Update State characteristic returns the current state of the reference time update on the Reference Time Update server when read using the *GATT Read Characteristic Value* sub-procedure. Detail of the behavior is described in Section 4.1.

When the reference time has been updated, the Current State field shall be set to 'Idle', and the Result field shall be set to one of the defined result values of the Time Update State characteristic.

The Current State and the Result fields are defined as follows:

- Idle
  The Reference Time Update server is not currently updating its time from the reference source time (such as GPS, NTP).
- Update Pending
  The Reference Time Update server is currently updating its time from reference source time.

The results of updating are defined as follows:

- Successful
  The time in the Reference Time Update server updated successfully.

- Canceled
  The update was canceled. The cancellation may be caused locally by user operation or sending the “Cancel Reference Update” command.
- No Connection to Reference
  The Reference Time Update Server tried to update the time from the reference time source, but it could not update because there are no connections to the time reference.
- Reference Responded With an Error
  The update on the Reference Time Update Server failed because of an error.
- Timeout
  The Update procedure was not successful because of timeout.

The state transitions are defined in Section 4.1.

3.2.2 Characteristic Descriptors

No characteristic descriptors are required beyond those defined in the characteristic specification.

4 Service Behavior

4.1 Time Update State Machine

Table 4.1 shows the state machine of the Reference Time Update Server.

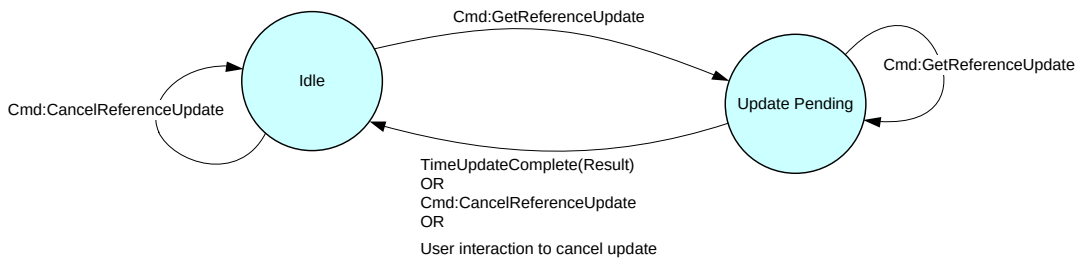

Table 4.1: Reference Time Update state machine

The Time Update state machine has two states: Idle and Update Pending. The state machine responds to six inputs: a request to update the reference time (StartReferenceUpdate), a request to cancel the reference time update from a client or user interaction (CancelReferenceUpdate), a report that the reference time could not be connected with (NoConnection), a report that the reference time responded with an error (TimeError), the reference time did not supply a time in a suitable time (Timeout), or a report that a new reference time has been acquired (NewTime).

Note: NoConnection, TimeError, Timeout, and NewTime inputs are internally generated inputs and therefore will never occur in the Idle state.

Current State	Input	New Time Update State : Current State	Time Update State : Result
Idle	CancelReferenceUpdate	Idle	Canceled
Idle	StartReferenceUpdate	Update Pending	
Update Pending	NewTime	Idle	Success
Update Pending	CancelReferenceUpdate	Idle	Canceled
Update Pending	StartReferenceUpdate	Update Pending	
Update Pending	NoConnection	Idle	No Connection To Reference
Update Pending	TimeError	Idle	Reference Responded With An Error
Update Pending	Timeout	Idle	Timeout

Table 4.2: Time Update State Machine transitions

In the Idle state, if the time reference update was canceled (CancelReferenceTime), the Result field of the Time Update state shall be set to "Canceled", and the state shall transition to the Idle state.

In the Idle state, if the time reference update was requested (StartReferenceTime), and the state shall transition to the Update Pending state and start to receive a time update from its reference time source.

In the Update Pending state, if the time reference update was successful (NewTime), the Result field of the Time Update State shall be set to ‘Successful’, and the state shall transition to the Idle state. Note: This may cause the Current Time service to notify the Current Time Characteristic.

In the Update Pending state, if the time reference update was canceled (CancelReferenceTime), the Result field of the Time Update State shall be set to "Canceled", and the state shall transition to the Idle state.

In the Update Pending state, if the time reference update was requested (StartReferenceTime), the state machine shall continue to update the time from the reference time source.

In the Update Pending state, if the time reference update could not establish a connection with a time source (NoConnection), then the Result field of the Time Update State shall be set to "No Connection To Reference", and the state shall transition to the Idle state.

In the Update Pending state, if the time reference update connected but the request to obtain the updated time failed (TimeError), then the Result field of the Time Update state shall be set to "Reference Responded With An Error", and the state shall transition to the Idle state.

In the Update Pending state, if the time reference update connected but the time did not update within an implementation specific period of time (Timeout), then the Result field of the Time Update state shall be set to "Timeout", and the state shall transition to the Idle state.

All other commands shall be ignored and no change to the Time Update state shall be made.

5 Acronyms and Abbreviations

Acronyms and Abbreviations	Meaning
DST	Daylight Saving Time
GATT	Generic Attribute Profile
LE	Low Energy
ATT	Attribute Protocol

Table 5.1: Acronyms and Abbreviations

6 References

[1] *Bluetooth* Core Specification v4.0
[2] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers.

Appendix A Example Characteristic Database

An example attribute database for Reference Time Update service is shown in Table 6.1.

UUID	Permissions	Mandatory / Optional	Value (Default)
<<Service>>	Read	M	<<Reference Time Update Service>>
<<Characteristic>>	Read	M	Properties = 0x04 (Write Without Response) Handle = Handle of Time Update Control Point UUID = <<Time Update Control Point>>
<<Time Update Control Point>>	Write	M	Section 3.1. See also [2]
<<Characteristic>>	Read	M	Properties = 0x02 (Read) Handle = Handle of Time Update State UUID = <<Time Update State>>
<<Time Update State>>	Read	M	Section 3.2. See also [2].

Table 6.1: Example attribute database for Reference Time Update Service