Transport Discovery Service

Bluetooth® Service Specification

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Abstract:

This service enables a device using Bluetooth low energy wireless technology to expose services that are available on a transport other than Bluetooth low energy. When used together with a higher level specification (e.g., a specification which references and makes use of TDS), the information provided by this service can be used to facilitate discovery and utilization of BR/EDR or transports not defined by the Bluetooth SIG such as those defined by the Wi-Fi Alliance® or other organizations.

Revision History

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Contributors

Name	Member
Robert D. Hughes	Intel
Dominik Sollfrank	Berner & Mattner
Chris Church	CSR
Jaeho Lee	LG
Jingu Choi	LG
Masahiko Seki	Sony
Ash Kapur	Broadcom
Smith Kennedy	HP Inc.
HJ Lee	LG
Siegfried Lehmann	Apple
Scott Walsh	Plantronics

Document Terminology

The Bluetooth SIG has adopted portions 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 term *Reserved for Future Use (RFU)* is used to indicate Bluetooth SIG assigned values that are reserved by the Bluetooth SIG and are not otherwise available for use by implementations.

Contents

1 Introduction

The Transport Discovery Service (TDS) enables a device using Bluetooth low energy wireless technology to expose services that are available on a transport other than Bluetooth low energy. The term ‘transport’ when used in the context of this specification describes a communication technology that can be used for data transfers between a Server and Client. When used together with a higher level specification (e.g., a specification which references and makes use of TDS), the information provided by this service can be used to facilitate discovery and utilization of BR/EDR or transports not defined by the Bluetooth SIG such as those defined by the Wi-Fi Alliance® or other organizations. This service is designed such that it can be used by other organizations to describe their own transport and services using their own incremental requirements.

1.1 Conformance

If conformance to this specification is claimed, all capabilities indicated as mandatory for this specification 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 Dependencies

This service is not dependent upon any other services.

1.3 Bluetooth Core Specification Release Compatibility

This specification is compatible with Bluetooth Core Specification v4.0 or later.

1.4 GATT Sub-Procedure Requirements

Requirements in this section represent a minimum set of requirements for a GATT Server. Other GATT sub-procedures may be used if supported by both Client and Server.

Table 1.1 summarizes additional GATT sub-procedures required beyond those required by all GATT Servers.

GATT Sub-Procedure	Server Requirements
Write Characteristic Value	C.1
Indications	C.1
Read Characteristic Descriptors	C.1
Write Characteristic Descriptors	C.1

Table 1.1: *Additional GATT sub-procedure requirements for Server*

C.1: Mandatory if the Server supports the TDS Control Point characteristic; optional otherwise.

1.5 Transport Dependencies

Some portions of this specification require features only available when using the Bluetooth low energy transport including any requirements related to the use of advertising and scanning.

The term BR/EDR used throughout this document also includes the optional use of AMP.

1.6 Attribute Protocol Application Error Codes

This service does not define any Attribute Protocol Application Error codes.

1.7 Byte Transmission Order

All characteristics used with this service shall be transmitted with the least significant octet first (i.e., little endian). Refer to Section 3.2 for information related to the identification of the least significant octet.

2 Service Declaration

The Server shall either be a GAP Peripheral or a GAP Broadcaster.

If the Server is a GAP Peripheral, the following requirements apply:

- The Transport Discovery Service shall be instantiated as a Primary Service.
- Only one instance of the Transport Discovery Service shall be exposed on a device.
- The service UUID shall be set to «Transport Discovery Service» as defined in [3].

3 Service Advertising Data

This section defines the advertising data requirements for TDS.

3.1 Transport Discovery Data AD Type

This section describes the contents of and requirements for the Transport Discovery Data AD Type that enables a Client to determine the role of the device (i.e., whether it is seeking a service (Seeker) or providing a service (Provider) available on a specific transport), the organization and transport associated with the supported service and other information such as the transport state and other features.

The Transport Discovery Data AD Type shall be present in the Advertising Data (i.e., AdvData) and may also be present in the Extended Inquiry Response (EIR). EIR and Advertising Packets may be of different sizes and may contain different information within the Transport Discovery Data AD Type.

The definition of the Transport Discovery Data AD Type is shown in Table 3.1.

Refer to Section 3.2 for details regarding byte ordering.

Fields		Data Type	Size (octets)	Requirement
Transport Discovery Data AD Type Code (Section 3.1.1)		uint8	1	M
Transport Block (1 or more) (Section 3.1.2)	Organization ID (Section 3.1.2.1)	uint8	1	M
	TDS Flags (Section 3.1.2.2)	8bit	1	M
	Transport Data Length (Section 3.1.2.3)	uint8	1	M
	Transport Data (Section 3.1.2.4)	Variable	Variable (see Note 1)	O

Table 3.1: *Transport Discovery Data AD Type*

Note 1: Typically 0-26 (inclusive of the Flags AD Type), however larger values may be supported in future updates of the Core Specification.

3.1.1 Transport Discovery Data AD Type Code Field

The Transport Discovery Data AD Type Code field shall be included in the Transport Discovery Data AD Type.

This field shall contain the 1 octet Transport Discovery Data AD Type Code value as defined in the Generic Access Profile (GAP) section of the Bluetooth SIG Assigned Numbers [3].

3.1.2 Transport Block

A Transport Block includes the following fields: Organization ID, TDS Flags, Transport Data Length, and Transport Data.

One or more Transport Block(s) may be present in the Transport Discovery Data AD Type.

The value of the fields in this section relate only to the transport which the block describes (i.e., they pertain only to that Transport Block).

The data contained in the Transport Block shall be able to be fully parsed by Clients even if size or other restrictions require that full data is in the GATT database.

Refer to Section 3.1.2.5 for details on how this block may be repeated in case there are multiple services (perhaps from the same or different transports) that need to be advertised simultaneously in available space.

3.1.2.1 Organization ID Field

The Organization ID field shall be included in the Transport Block.

This field shall contain a 1 octet Organization ID value from the Bluetooth SIG Assigned Numbers [3] with the value set to the appropriate organization. Refer to Section 3.1.2.5 for details on how multiple services (related to the same or different Organization IDs) can be advertised in the same packet.

The values of this field defined in this version of the specification are shown in Table 3.2. Refer to the Bluetooth SIG Assigned Numbers [3] for a complete list of assigned numbers.

Value	Definition
0x00	Reserved for Future Use (RFU)
0x01	Bluetooth SIG
0x02 – 0xFF	RFU at the time of this writing. Refer to Bluetooth SIG Assigned Numbers [3] for complete list.

Table 3.2: *Organization ID Field*

Organizations requiring the assignment of a value for this field should contact specification.manager@bluetooth.com for guidance on the process for requesting a new assignment.

3.1.2.2 TDS Flags Field

The TDS Flags field shall be included in the Transport Block.

This field shall contain a 1 octet value that represents the role of the device and information about its state and supported features.

Bits defined as RFU shall be set to 0.

The values of this field are defined as:

Bits	Definition
0-1	Role: 0b00: Not specified 0b01: Seeker Only 0b10: Provider Only 0b11: Both Seeker and Provider
2	Transport Data Incomplete: 0: False 1: True
3-4	Transport State: 0b00: Off 0b01: On 0b10: Temporarily Unavailable 0b11: RFU
5-7	Reserved for future use

Table 3.3: *TDS Flags Field*

The definition and purpose of the bits listed in Table 3.3 are described in the sections to follow.

3.1.2.2.1 Role

The Role bits indicate whether the Transport Block represents a Provider of a service, a Seeker of a service, a combination of Seeker and Provider, or is unspecified.

The Server shall set these bits to an appropriate value for the Transport Block (i.e., whether the role of this specific block is seeking a service, providing a service, acting as a combination of the two, or is unspecified).

3.1.2.2.2 Transport Data Incomplete

The Transport Data Incomplete bit indicates whether the Transport Data field contains complete or incomplete data. If incomplete, then all fields of the Transport Block can be found in the in the GATT

database. This can be used when there is insufficient space in the Advertising Packet for the entire contents or due to other restrictions.

The Server shall set this bit to 1 if the Transport Data is incomplete and when the complete Transport Block can be found in the GATT database. Otherwise, it shall be set to 0.

3.1.2.2.3 Transport State

The Transport State bits indicate whether the transport providing access to the advertised service(s) is Off, On, or Temporarily Unavailable. When the bits are set to Off, the transport is not in a state that can accept a connection, however is available to be changed to the On state (e.g., using the TDS Control Point). When set to On, the transport is in a state that can accept a connection. When the bits are set to Temporarily Unavailable, the transport is in a transient state (e.g., if the device is servicing another request) and will change to Off or On as appropriate. For the case where the bits are set to Temporarily Unavailable, a higher level specification can include a 'hint' of the duration and/or cause of unavailability in the Transport Data or via other means.

3.1.2.3 Transport Data Length Field

The Transport Data Length field shall be included in the Transport Block.

This field shall contain a 1 octet value that represents the total number of octets in the Transport Data field that follows. This allows a scanning device to determine the length of the variable field that follows, and also allows for extensibility in the future. For example, a Transport Data Length value of 0x10 represents that a 16 octet Transport Data field follows. Similarly, a value of 0x00 represents that the Transport Data field is not present.

Value	Definition
0x00	Transport Data field not present (i.e., 0 octets in length)
0x01 – 0xEF (Note 1)	Number of Octets in Transport Data field
0xF0 – 0xFF	Reserved for Future Use

Table 3.4: *Transport Data Length Field*

Note 1: Although the contents of the Transport Data will typically be 0-26 octets (inclusive of the Flags AD Type), larger values may be supported in future updates of the Core Specification.

3.1.2.4 Transport Data Field

The Transport Data field may be included in the Transport Block.

If used, this field contains organization-specific data and shall be byte-aligned. The value shall fit within the available space in the Advertising Packet. The contents of this field are defined by a higher level specification.

If multiple service identifiers are listed in the Transport Data field, the advertising device should list these in order of descending priority or preference. For example, if the list represents more than one supported service (corresponding to the Provider role), the order represents preferred support (e.g., perhaps a device is capable of transferring data using a faster method as well as a slower legacy method). If the list

represents more than one required service (corresponding to the Seeker role), the order represents preferred service order (e.g., perhaps a device requires an immediate service, but also another service that is of lower priority).

3.1.2.5 Advertising Using Multiple Transport Blocks

The structure of the Transport Block may be repeated in case there are multiple services (on the same or different transports) to advertise simultaneously. The structure may repeat as long as there is space available. These Transport Blocks may be from the same organization or from different organizations.

Where multiple Transport Blocks are used, the advertising device should list these in order of descending priority or preference. For example, if the blocks represent more than one supported service, the order represents preferred support (e.g., perhaps a printer is capable of printing using a faster technology from one organization, but also a slower technology from another organization). If the blocks represent more than one required service, the order represents preferred service order (e.g., perhaps a device requires an immediate service, but also another service that is of lower priority).

The example in Table 3.5 shows the Transport Block structure repeated twice.

Fields		Data Type	Size (octets)
Transport Discovery Data AD Type Code (Section 3.1.1)		uint8	1
Transport Block 1 (higher preference or priority)	Organization ID (Section 3.1.2.1)	uint8	1
	TDS Flags (Section 3.1.2.2)	8bit	1
	Transport Data Length (Section 3.1.2.3)	uint8	1
	Transport Data (Section 3.1.2.4)	Variable	Variable (see Note 1)
Transport Block 2 (lower preference or priority)	Organization ID (Section 3.1.2.1)	uint8	1
	TDS Flags (Section 3.1.2.2)	8bit	1
	Transport Data Length (Section 3.1.2.3)	uint8	1
	Transport Data (Section 3.1.2.4)	Variable	Variable (see Note 1)

Table 3.5: *Transport Discovery Data AD Type - Advertising using Multiple Transport Blocks*

Note 1: Typically 0-23 octets (inclusive of the Flags AD Type) for total length of the Transport Data of Transport Block 1 and Transport Data of Transport Block 2, however larger values may be supported in future updates of the Core Specification.

Where multiple Transport Blocks are present in an instance of the Transport Discovery Data AD Type, the value of the Role bits may be different between Transport Blocks.

3.2 Byte Ordering

Where characteristics and descriptors are comprised of multiple bytes (shown in several tables within this document), the Least Significant Octet (LSO) is the topmost field in the tables and the Most Significant Octet (MSO) is the bottommost field in the tables. Refer to Section 1.7 for requirements related to byte transmission order.

4 Service Characteristics

This section defines requirements related to GATT characteristics and descriptors for this service. Only one instance of each characteristic in Table 4.1 is permitted within this service.

Where a characteristic can be indicated, a Client Characteristic Configuration descriptor shall be included in that characteristic as required by the Core Specification [1].

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
TDS Control Point	O	Write, Indicate		None

Table 4.1: *Transport Discovery Service Characteristics*

Notes:

1. Properties not listed as Mandatory or Optional are excluded for this version of the service.
2. Security Permissions of “None” means that this version of the service does not impose any requirement.
3. The characteristics and the characteristic descriptors specified by this service are defined in this specification and in [3].

4.1 TDS Control Point

The TDS Control Point characteristic is used to request activation of a transport. Additional Op Codes may be added in the future for other purposes. Figure 4.1 shows an informative example of the flow of a TDS Control Point operation.

In this example, the Client writes the Activate Transport Op Code (0x01) to the TDS Control Point. The Server sends a Write Response to acknowledge the write to the TDS Control Point. The Server sets the desired transport into a connection-ready state. The Server sends a TDS Control Point indication with the Requested Op Code (0x01) followed by the Result Code for ‘Success’ (0x00). The Client sets the desired transport into a connection-ready state and responds with the ATT Confirmation. The Server and Client perform a transport-specific connection procedure.

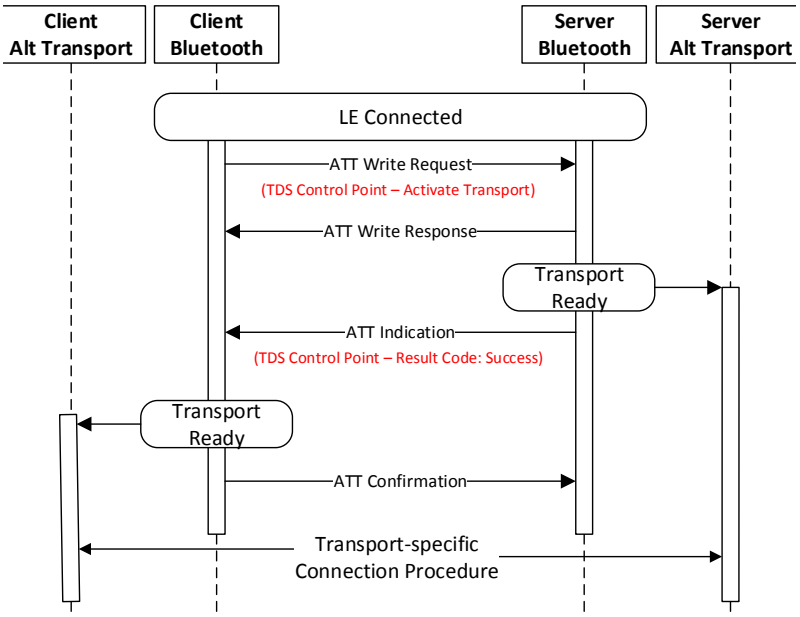

Figure 4.1: *Example Flow of TDS Control Point*

Only one instance of the TDS Control Point characteristic shall be exposed.

Table 4.2 shows the required structure of the TDS Control Point characteristic:

Fields	Data Type	Size (octets)	Requirement
Op Code (See Table 4.3)	uint8	1	M
Organization ID	uint8	1	M
Parameter	Variable	0 to 19 octets (see Note 1)	O

Table 4.2: *Structure of TDS Control Point Characteristic*

Note 1: Parameters larger than 19 octets are permitted if a larger MTU is negotiated.

4.1.1 TDS Control Point Procedure Requirements

Table 4.3 shows the op code requirements for the TDS Control Point characteristic:

Op Code Value	Procedure	Requirement	Organization ID	Parameter
0x00	Reserved for Future Use			
0x01	Activate Transport	M	This field shall contain the relevant 1 octet Organization ID.	This field shall contain relevant transport-specific data up to 19 octets (see Note 1).

Op Code Value	Procedure	Requirement	Organization ID	Parameter
0x02-0xFF	Reserved for Future Use			

Table 4.3: *TDS Control Point Procedure Requirements*

Note 1: Parameters larger than 19 octets are permitted if a larger MTU is negotiated.

Table 4.4 shows the required structure of the TDS Control Point Indication:

Fields	Data Type	Size (octets)	Requirement
Requested Op Code	uint8	1	M
Result Code	uint8	1	M
Response Parameter (See Table 4.5)	Variable	0 to 19 octets (see Note 1)	O

Table 4.4: *Structure of TDS Control Point Indication*

Note 1: A Response Parameter larger than 19 octets is permitted if a larger MTU is negotiated.

The Response Parameter field, if present, shall contain the relevant 1 octet Organization ID followed by transport-specific data.

The Result Codes that can be sent in a TDS Control Point Indication are defined in Table 4.5:

Result Code	Definition	Description
0x00	Success	Response for successful operation.
0x01	Op Code Not Supported	Response if unsupported or RFU Op Code is received.
0x02	Invalid Parameter	Response if Parameter received does not meet the requirements of the higher level specification.
0x03	Unsupported Organization ID	Response if unsupported or RFU Organization ID is received.
0x04	Operation Failed	Response if the requested procedure failed for any reason other than those enumerated in this table.
0x05-0xFF	Reserved For Future Use	

Table 4.5: *List of Result Codes associated with the TDS Control Point Indication*

A higher level specification may include additional information within the Parameter of the Response Value. It may include, for example, additional details relating to the reason for a failed operation.

4.1.2 Characteristic Behavior

The TDS Control Point is used by a Client to control certain behaviors of the Server.

A procedure is triggered by writing a value that includes an Op Code specifying the operation and this may be followed by a an Organizational ID and Parameter that is valid within the context of that Op Code (see Table 4.3). For the procedure described in the next section, the Server shall indicate the TDS Control Point characteristic along with the Requested Op Code and “Success” or other appropriate Result Code contained in the response as listed in Table 4.5.

Refer also to Section 4.1.4 for information on General Error Handling.

4.1.3 Activate Transport Procedure

When the Activate Transport Op Code is written to the TDS Control Point and the response is “Success”, the actions to follow are defined by a higher level specification.

The contents of the organization-specific octets in the parameter for this Op code are defined by a higher level specification.

In the event that an error condition occurs, the applicable Error Response shall be sent.

4.1.4 General Error Handling

Writing an Op Code to the TDS Control Point may result in an ATT Error response or a Control Point Error response as described in the sections to follow.

4.1.4.1 ATT Error

An ATT Write Request to the TDS Control Point characteristic may be rejected with an Attribute Protocol Error Response under certain conditions as defined in [1]. Reasons for sending an ATT Error Response include but are not limited to Insufficient Encryption, Client Characteristic Configuration Descriptor Improperly Configured, Procedure Already in Progress, or Invalid Attribute Value Length. See also Section 1.6 for Attribute Protocol Application Error codes defined by this service.

4.1.4.2 Control Point Error

If the ATT Write Request to the control point characteristic was successful but the requested control point procedure could not be performed or could not be completed successfully, an appropriate Result Code from the following sections shall be indicated in the Response Value as described above and in this section.

4.1.4.2.1 Op Code Not Supported

The Op Code Not Supported error response shall be indicated if the Op Code written to the control point is not supported by the Server. This includes Op Code values that are reserved for future use.

4.1.4.2.2 Invalid Parameter

The Invalid Parameter error response shall be indicated if the value of the parameter written to the control point did not meet the requirements of the service.

Note that a parameter of an incorrect size, including any parameter sent with an Op Code for which no parameter was actually required, should be trapped by an ATT Error response as described in Section 4.1.4.1 and in this case, it should not generate a control point error response.

4.1.4.2.3 Unsupported Organization ID

The Unsupported Organization ID error response shall be indicated if the value of the Organization ID written to the control point is RFU or otherwise not supported by the Server.

4.1.4.2.4 Operation Failed

The Operation Failed error response shall be indicated if a requested control point procedure failed for any reason not otherwise enumerated.

4.1.4.3 Procedure Timeout

In the context of the TDS Control Point characteristic, a control point procedure is started when an ATT Write Request to the TDS Control Point characteristic is successful (i.e., when the Server sends the ATT Write Response).

The Server may then use an implementation-specific timeout that should be a maximum of 10 seconds. If the timeout expires before the requested control point procedure has been completed, the Server may abort the service procedure and indicate the Operation Failed error response described in Section 4.1.4.2.4.

A control point procedure is not considered started and not queued in the Server when a Write Request to the TDS Control Point characteristic results in an ATT Error response as described in Section 4.1.4.1.

5 SDP Interoperability

If this service is exposed over BR/EDR, then it shall expose the following SDP record.

Item	Definition	Type	Value	Status
Service Class ID List				M
Service Class #0		UUID	«Transport Discovery Service»	M
Protocol Descriptor List				M
Protocol #0		UUID	L2CAP	M
Parameter #0 for Protocol #0	PSM	uint16	PSM = ATT	M
Protocol #1		UUID	ATT	M
Parameter #0 for Protocol #1	GATT Start Handle	uint16	First handle of this service in the GATT database	M
Parameter #1 for Protocol #1	GATT End Handle	uint16	Last handle of this service in the GATT database	M
BrowseGroupList			PublicBrowseRoot*	M

Table 5.1: *SDP Record*

* PublicBrowseRoot shall be present; however, other browse UUIDs may also be included in the list.

6 Acronyms and Abbreviations

Abbreviation or Acronym	Meaning
AD	Advertising Data
AMP	Alternate MAC PHY
ATT	Attribute Protocol
BR / EDR	Basic Rate / Enhanced Data Rate
CSS	Core Specification Supplement
GAP	Generic Access Profile
GATT	Generic Attribute Profile
LE	Low Energy
MTU	Maximum Transmission Unit
RFU	Reserved for Future Use
SDP	Service Discovery Protocol
TDS	Transport Discovery Service
UI	User Interface
UTF	Unicode Transformation Format
UUID	Universally Unique Identifier

Table 6.1: *Abbreviations and Acronyms*

7 References

[1] Bluetooth Core Specification v4.0 or later

[2] Core Specification Supplement v6 or later

[3] Bluetooth SIG Assigned Numbers