

Automation IO Service

Bluetooth® Service Specification



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Abstract:

The Automation IO Service is used to expose the digital and analog signals of a generic I/O module.

Revision History

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v1.0.0

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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*).

Contents

1	Introduction	6
1.1	Conformance	6
1.2	Service Dependency.....	6
1.3	Bluetooth Specification Release Compatibility	6
1.4	GATT Sub-Procedure Requirements	7
1.5	Transport Dependencies	7
1.6	Error Codes	7
1.7	Octet Transmission Order	7
2	Service Declaration.....	8
3	Service Characteristics	9
3.1	Digital Characteristic.....	10
3.1.1	Characteristic Behavior	10
3.1.2	Characteristic Descriptors	11
3.2	Analog Characteristic.....	13
3.2.1	Characteristic Behavior	13
3.2.2	Characteristic Descriptors	13
3.3	Aggregate Characteristic	14
3.3.1	Characteristics Behavior.....	15
3.3.2	Characteristics Descriptors.....	15
3.4	Number of Digitals Descriptor.....	16
3.5	Trigger Setting Descriptors and Custom Condition	16
3.5.1	Value Trigger Setting Descriptor	16
3.5.2	Time Trigger Setting Descriptor.....	18
3.5.3	General on Trigger Setting Descriptors	21
4	SDP Interoperability.....	22
5	Acronyms and Abbreviations	23
6	References.....	24

v1.0.0

1 Introduction

The Automation IO service is used to expose the analog inputs/outputs and digital input/outputs of a generic IO module (later called IOM); see [Figure 1.1](#).

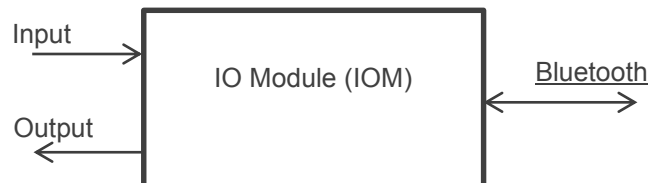


Figure 1.1 IO Module (IOM)

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).

v1.0.0

1.4 GATT Sub-Procedure Requirements

Additional GATT sub-procedures requirements beyond those required by GATT are indicated in Table 1.1.

GATT Sub-Procedure	Requirements
Write Characteristic Value	C.1
Write Without Response	C.2
Indications	C.3
Notifications	C.4
Write Characteristic Descriptors	C.5
Read Characteristic Descriptors	C.6
C.1: Mandatory if the “write” characteristic property is supported for either Digital or Analog characteristics. C.2: Mandatory if the “write without response” characteristic property is supported for either the Digital or Analog characteristics. C.3: Mandatory if the “indicate” characteristic property is supported for any characteristic. C.4: Mandatory if the “notify” characteristic property is supported for any characteristic. C.5: Mandatory if the writable characteristic descriptor is supported for any characteristic. C.6: Mandatory if a characteristic descriptor is supported for any characteristic. Note: If any of the requirements C.1 to C.6 is not met, corresponding procedure is excluded for this service.	

Table 1.1: GATT sub-procedure requirements

1.5 Transport Dependencies

None.

1.6 Error Codes

This service defines the following Attribute Protocol Application Error codes:

Name	Error Code	Description
Trigger condition value not supported.	0x80	An attempt was made to configure a trigger condition value not supported by this Automation IO Server.

Table 1.2: Application error codes

1.7 Octet Transmission Order

All characteristics and profile defined descriptors used with this service shall be transmitted with the least significant octet first (i.e., little endian).

2 Service Declaration

The Automation IO Service UUID shall be set to «Automation IO Service» as defined in [2].

3 Service Characteristics

Automation IO inputs and outputs are reflected in the GATT database as follows:

- Digital Inputs are exposed by Digital Characteristics with Read and optionally one of the Indicate or Notify properties.
- Digital Outputs are exposed by Digital Characteristics with Write and/or Write Without Response and optionally Read and one of the Indicate and Notify properties.
- Analog Inputs are exposed by Analog Characteristics with Read and optionally one of the Indicate or Notify properties.
- Analog Outputs are exposed by Output Characteristics with Write and/or Write Without Response and optionally Read or one of the Indicate and Notify properties.

The following characteristics may be exposed by this service.

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
Digital	C.1, C.3, C.4, C.5		Read, Indicate, Notify, Write, Write Without Response	None
Analog	C.1, C.3, C.4, C.5		Read, Indicate, Notify, Write, Write Without Response	None
Aggregate	C.2, C.4, C.5		Read, Indicate, Notify	None
C.1: At least one instance of either Digital or Analog characteristics shall be supported. C.2: Only one instance of the Aggregate characteristic shall exist if the Aggregate characteristic is supported. C.3: The Indicate and Notify properties are excluded for the Digital and Analog characteristics if the Aggregate characteristic is supported. C.4: The Indicate and Notify properties shall not be permitted simultaneously for any supported characteristic. C.5: If Read property for the characteristic is not supported, Indicate and Notify properties are excluded.				

Table 3.1: Service characteristics

Note:

- Security permissions set to “None” means that the service does not impose any requirements.

v1.0.0

3.1 Digital Characteristic

The Digital characteristic is used to expose and change the state of an IOM's digital signals. Several Digital Inputs may be grouped in to a single Digital Characteristic with Read and optionally one of the Indicate or Notify properties. Several Digital Outputs may be grouped in to a single Digital Characteristic with Write and/or Write Without Response and optionally Read and one of the Indicate and Notify properties.

3.1.1 Characteristic Behavior

The Digital characteristic is an array of n 2-bit values in a bit field:

Value
Array of n 2-bit values (see below)

Table 3.2: Digital Characteristic value

The mandatory descriptor Number of Digitals (see Section 3.4) describes the number of bits that are available (the value of n in Table 3.2).

The Digital characteristic contains the values of these bits in little endian order. This shall be $\left\lceil \frac{n}{4} \right\rceil$ octets¹ in length, where n is the number of bits defined in the Number of Digitals descriptor. The value of any bits beyond the number specified in the Number of Digitals descriptor is irrelevant, as these padding bits have no meaning. The maximum value of n is (ATT_MTU-3)*4.

Each of the 2-bit fields has the following definition:

- Value 0b00 defines the inactive state.
- Value 0b01 defines the active state.
- Value 0b10 defines the tri-state state (if available in the server).
- Value 0b11 defines the unknown state. If received in a write operation the server shall not update corresponding output. The server may use this value in a read or a notify operation to indicate that for some reason it cannot report the value of this particular input.

The Notify and Indicate properties shall not be permitted simultaneously for the Digital characteristic.

If an Aggregate characteristic is supported as part of this service, the Notify and Indicate properties are excluded for the Digital characteristic.

¹ The mathematical "ceiling" notation $\lceil x \rceil$ equals the smallest integer not less than x .

If the Notify or the Indicate property is set for the Digital characteristic and the *Client Characteristic Configuration* descriptor (see Section 3.2.2) is configured for notification or indication, this characteristic shall be notified or indicated respectively when any of the following conditions occurs:

- (a) The condition set by any combination of the *Value Trigger Setting*, *Time Trigger Settings* descriptors or a custom condition is fulfilled.
- (b) A connection is reestablished and required security procedure executed.
- (c) The *Client Characteristics Configuration* descriptor was just configured to enable notifications or indications.

3.1.2 Characteristic Descriptors

Descriptor Name	Requirement	Mandatory Permissions	Optional Permissions
Client Characteristic Configuration	C.1	Read, Write	
Characteristic Presentation Format	C.6	Read	
Characteristic User Description	O	Read	Write, C.2
Characteristic Extended Properties	O	Read	
Value Trigger Setting	C.3, C.5	Read, Write	
Time Trigger Setting	C.3, C.4, C.5	Read, Write	
Number of Digitals Descriptor	M	Read	
C.1 Mandatory if Indicate or Notify property is defined for the characteristic, otherwise excluded. C.2 Write permitted if «writable auxiliaries» is supported in the <i>Characteristic Extended Properties</i> descriptor, otherwise read-only. C.3 Excluded if a custom condition is available (see Section 3.5), otherwise Optional. C.4 Excluded if a Value Trigger Descriptor is not defined for the characteristic. C.5 Excluded if Indicate or Notify is not defined for the characteristic or for the Aggregate characteristic (if it is used), otherwise Optional. C.6 Mandatory if more than one instance of the Digital characteristic is supported, otherwise Optional.			

Table 3.3: Digital descriptors

If a characteristic can be notified or indicated, the characteristic may be configured for notification or indication using the *Client Characteristic Configuration* descriptor. The optional *Value Trigger Setting* and *Time Trigger Setting* descriptors (see Section 3.5) can be used to set the conditions for the notification or indication.

If a device has more than one instance of the Digital characteristic, each characteristic shall include a *Characteristic Presentation Format* descriptor that has a namespace / description value that is unique for that instance of the Digital characteristic. The Namespace «Bluetooth

SIG» as defined in [2] shall be used. Description values from 0x0001 and upwards shall be used to uniquely identify each Digital characteristic.

If the *Characteristic Presentation Format* descriptor is supported for this characteristic, the format field shall be set to the value «struct». The exponent, unit, and descriptor fields have no meaning for this characteristic and shall be set to 0.

The *Characteristic User Description* descriptor may be supported and its value is determined by the actual IO configuration or the application (the latter is only allowed if «writable auxiliaries» is supported in the *Characteristic Extended Properties* descriptor and the *Characteristic User Description* supports the write permission). If writable, the *Characteristic User Description* descriptor value shall be persistent between connections.

The *Number of Digitals* descriptor defines the number of digital signals available for the characteristics. See more details about this descriptor in Section 3.4.

3.2 Analog Characteristic

The Analog characteristic is used to read or write the value of one of the IOM's analog signals.

One or more Analog characteristics may be used, each one representing one analog signal.

3.2.1 Characteristic Behavior

The Analog characteristic represents the value of an analog signal as an unsigned 16-bit integer (uint16). The format of the analog value depends on the implementation.

The Notify and Indicate properties shall not be permitted simultaneously for the Analog characteristic.

If an Aggregate characteristic is supported as part of this service, the Notify and Indicate properties are excluded for the Analog characteristic.

If the Notify or the Indicate property is set for the Analog characteristic and the *Client Characteristic Configuration* descriptor (see Section 3.2.2) is configured for notification or indication, this characteristic shall be notified or indicated respectively when any of the following conditions occurs:

- (d) The condition set by any combination of the *Value Trigger Setting*, *Time Trigger Settings* descriptors or a custom condition is fulfilled.
- (e) A connection is reestablished and required security procedure executed.
- (f) The *Client Characteristics Configuration* descriptor was just configured to enable notifications or indications.

3.2.2 Characteristic Descriptors

Descriptor Name	Requirement	Mandatory Permissions	Optional Permissions
Client Characteristic Configuration	C.1	Read, Write	
Characteristic Presentation Format	C.3	Read	
Characteristic User Description	O	Read	Write, C.2
Value Trigger Setting	C.4, C.6	Read, Write	
Time Trigger Setting	C.4, C.5, C.6	Read, Write	
Characteristic Extended Properties	O	Read	
Valid Range	O	Read	

Descriptor Name	Requirement	Mandatory Permissions	Optional Permissions
C.1	Mandatory if Indicate or Notify property is defined for the characteristic.		
C.2	Write permitted if «writable auxiliaries» is supported in the Characteristic <i>Extended Properties</i> descriptor, otherwise read-only.		
C.3	Mandatory if more than one instance of the Analog characteristic is supported.		
C.4	Excluded if a custom condition is available, otherwise Optional (see Section 3.5).		
C.5	Excluded if a Value Trigger Setting descriptor is not defined for the characteristic.		
C.6	Excluded if Indicate or Notify is not supported for the characteristic or for the Aggregate characteristic (if it is used).		

Table 3.4: Analog descriptors

If this characteristic can be notified or indicated, the characteristic may be configured for notification or indication using the *Client Characteristic Configuration* descriptor. The optional profile defined *Value Trigger Setting* and *Time Trigger Settings* descriptors (see Section 3.5) can be used to set the conditions for the notification or indication.

If a device has more than one instance of the Analog characteristic, each characteristic shall include a *Characteristic Presentation Format* descriptor that has a namespace / description value that is unique for that instance of the Analog characteristic. The Namespace «Bluetooth SIG» as defined in [2] shall be used. Description values from 0x0001 and upwards shall be used to uniquely identify each Analog characteristic.

The *Characteristic Presentation Format* descriptor format field, exponent, unit, and descriptor fields can be used to specify the format of the Analog characteristic. The allowed values for the format field are uint8, uint12, uint16, sint8, sint12, sint16, SFLOAT, and duint16 (see [1]).

The *Characteristic User Description* descriptor may be used and its value is determined by the actual IO configuration or the application (the latter is only allowed if «writable auxiliaries» is supported in the *Extended Properties* descriptor and the *Characteristic User Description* descriptor supports the write permission). If writable, the *Characteristic User Description* descriptor value shall be persistent between connections.

The *Valid Range* descriptor defined in [2] is an optional descriptor that allows an Automation Client to read the lower and upper bounds (inclusive) of an associated Analog characteristic value that are supported by the Automation Server.

3.3 Aggregate Characteristic

This characteristic is used to aggregate all Digital characteristics with the Read property set (if any available) and all of the Analog characteristics with Read properties set (if any available). If present, the Digital characteristic values in the aggregate shall precede the list of Analog characteristic values.

This characteristic allows the complete state of the IOM to be read, notified, or indicated in a single operation, reducing power consumption when the complete state is needed.

3.3.1 Characteristics Behavior

All of the defined Digital characteristics with the Read property set shall be part of Aggregate (if available). The length of each of the Digital characteristics that is part of the Aggregate is determined from the number of signals defined in the *Number of Digitals* descriptor of the Digital characteristic. The Digital part shall be byte aligned and trailing bits (if any) shall be set to 0. The order of the Digital characteristics is determined by the value in the Description field of the *Characteristic Presentation Format* descriptor with the lowest value first.

All of the defined Analog characteristics with Read property set shall be part of the Aggregate (if available). The order of the Analog characteristics is determined by the value in the Description field of the *Characteristic Presentation Format* descriptor with the lowest value first. The first analog input follows directly after the last Digital characteristic.

If the size of the Aggregate value is larger than ATT_MTU-3, the Aggregate characteristic shall not be used.

The Notify and Indicate properties shall not be permitted simultaneously for the Aggregate characteristic.

If the Notify or Indicate property is set for the characteristic and the Client *Characteristic Configuration* descriptor (see Section 3.3.2) is configured for notification or indication, this characteristic shall be notified or indicated respectively when either of the following conditions occurs:

- (a) The condition set by any combination of the *Value Trigger Setting*, *Time Trigger Setting* descriptors of the included Digital and Analog characteristics or a custom condition is fulfilled.
- (b) A connection is reestablished and required security procedures executed.
- (c) The *Client Characteristics Configuration* descriptor was just configured to enable notifications or indications.

3.3.2 Characteristics Descriptors

Descriptor Name	Requirement	Mandatory Permissions	Optional Permissions
Client Characteristic Configuration	C.1	Read, Write	
C.1 Mandatory if Indicate or Notify property is supported for characteristic, otherwise excluded.			

Table 3.5: Aggregate descriptors

If this characteristic can be notified or indicated, the characteristic may be configured for notification or indication using the *Client Characteristic Configuration* descriptor.

The *Value Trigger Setting* and *Time Trigger Setting* descriptors are excluded for the Aggregate characteristic. The optional *Value Trigger Setting* and *Time Trigger Setting* descriptors (see Section 3.5) used for the individual Digital and Analog characteristics can be used to set the

conditions for the notification / indication. The trigger settings for all of the included characteristics are used, and a logical OR is used to determine if an indication / notification shall be triggered or not (if the trigger for one or more of the included characteristics is fulfilled, the aggregate is considered as triggered).

3.4 Number of Digitals Descriptor

The *Number of Digitals* is a descriptor that is mandatory for the Digital characteristics. The value of the descriptor is the number of two-bit fields the Digital bit arrays respectively consist of. Each two-bit field represents one digital signal. It is represented as a uint8 value and is read-only. Maximum value is $(ATT_MTU-3)*4$.

3.5 Trigger Setting Descriptors and Custom Condition

A custom condition is a condition that is either automatically enabled or enabled offline and depends on the IOM internal design and functionality. When a custom condition is triggered, the value of the characteristic is sent. *Value Trigger Setting* and *Time Trigger Setting* descriptors shall not be used if a custom condition exists for a characteristic.

Only one instance of the *Value Trigger Setting* and *Time Trigger Setting* descriptor shall be defined for each Digital and Analog characteristic.

The triggers may only be used for characteristics with Indicate or Notify property set, or when there is an Aggregate characteristic with Indicate or Notify property set.

3.5.1 Value Trigger Setting Descriptor

The *Value Trigger Setting* descriptor is an optional writable descriptor used to set the trigger point and condition for certain input signals or an aggregate of input signals. It may be used for the Digital and Analog characteristics.

The value of the *Value Trigger Setting* descriptors shall be persistent between connections.

The value of the descriptor has two parts. Part one is a condition field and occupies one octet, and part two is the comparison value (trigger point) that the characteristic value is checked against.

Descriptor value format:

Condition Value	Comparison Value
1 octet – contains the code for the condition	1-n octets depending on the format of the value (see list of available conditions in Table 3.8).

Table 3.6: *Trigger Setting value format*

Available comparison value formats:

Format	Description
None	No comparison value required
Analog	Analog, 16-bit unsigned integer (uint16)
Bit Mask	Array of n bits. Consists of two-bit fields where each field represents a digital signal. Shall be the same size and format as the corresponding Digital characteristic. See more in Section 3.1.1. The maximum value of n is (ATT_MTU-3)*4 (see Note below).
Analog Boundaries	Analog One (uint16), Analog Two (uint16)

Table 3.7: Value formats for the Trigger Setting descriptor

Note: Following is an example of using the Bit Mask field. If a digital characteristic represents two digital input signals and the value of the Bit Mask is 0x04, changing of the second digital input in any way (for example 0 to 1, 0 to 2, 1 to 0, etc.) will cause the state change. Changing of the first digital input will not cause the state change.

Available conditions:

Condition Value	Condition	Valid for	Comparison Value Format
0x00	The state is changed if the characteristic value is changed.	Digital, Analog	None
0x01	Crossed a boundary. The state is changed if the value of the analog characteristic changes from less than to greater than a settable Analog value, or from greater than to less than a settable Analog value.	Analog	Analog
0x02	On the boundary. The state is changed if the value of an analog characteristic changes from less than to equal to a settable Analog value, or from greater than to equal to a settable Analog value, or from equal to less than or to greater than a settable Analog value.	Analog	Analog
0x03	The state is changed if the value of the analog characteristic is changed more than a settable Analog value.	Analog	Analog
0x04	Mask then compare (logical-and of the Digital and the Bit Mask, condition is true if the result of this is different from the last stet).	Digital	Bit Mask

Condition Value	Condition	Valid for	Comparison Value Format
0x05	Inside or outside the boundaries. The state is changed if the value of the analog characteristic changes from less than a settable Analog One value and greater than a settable Analog Two value to greater than a settable Analog One value or less than a settable Analog Two value.	Analog	Analog Interval
0x06	On the boundaries. The state is changed if the value of the analog characteristic changes from equal to a settable Analog One value or settable Analog Two value to any other value.	Analog	Analog Interval
0x07	No value trigger. This condition causes no state change regardless if the characteristic value changes. It can be used for example when the value of one or more characteristic should not cause indication or notification of the Aggregate characteristic.	Digital, Analog	None
0x08-0xFF	Reserved for future use		

Table 3.8: Available Value Trigger Setting conditions

Not all Trigger condition values may be supported by a specific Automation IO Service. If an attempt is made to configure a non-supported Trigger condition value, the error code “Trigger condition value not supported” shall be returned (see Section 1.6).

Trigger condition “Indicated or notified whether state has changed” (0x00) shall always be supported if the *Value Trigger Setting* descriptor is used and should be used as default value.

3.5.2 Time Trigger Setting Descriptor

The *Time Trigger Setting* descriptor is an optional writable descriptor used to set a timer or counter based condition as an additional or alternative condition to the *Value Trigger Setting*. It may be used for the Digital and Analog characteristics and shall only be used if a *Value Trigger Setting* descriptor exists for the same characteristic.

The value of the *Time Trigger Setting* descriptors shall be persistent between connections.

The value of the descriptor has two parts. Part one is a condition field and occupies one octet, and part two is the comparison value (trigger point) that the characteristic value is checked against.

Descriptor value format:

Condition	Comparison Value
1 octet – contains the code for the condition	1-n octets depending on the format of the value (see list of available conditions in Table 3.11).

Table 3.9: Trigger Setting value format

Available comparison value formats:

Format	Description
Time Interval	Time interval in seconds (uint24)
Count	16 bit unsigned integer (uint16)

Table 3.10: Value formats for the TimeTrigger Setting descriptor

Available conditions:

Condition Value	Condition	Valid for	Comparison Value Format
0x00	No time-based triggering used.	Digital, Analog	None
0x01	Indicates or notifies unconditionally after a settable time. This condition will cause server to periodically send notification or indication for the corresponding characteristic regardless of the Value Trigger state. The value triggering is suppressed and will be ignored when this time trigger condition is used.	Digital, Analog	Time Interval
0x02	Not indicated or notified more often than a settable time. After a successful indication or notification, the next indication or notification shall not be sent for the Time Interval time. When the Time Interval expires, the characteristic is indicated or notified if the corresponding Value Trigger has a different state than at the time of the last successful indication or notification.	Digital, Analog	Time Interval
0x03	Changed more often than. This condition will cause server to count number of times the Value Trigger has changed its state and send the notification or indication for the corresponding characteristic on the “count” occurrence of the state change.	Digital, Analog	Count
0x04 -0xFF	Reserved for future use		

Table 3.11: Available Time Trigger Setting conditions

Not all Trigger condition values may be supported by a specific Automation IO Service. If trying to configure a Trigger condition value non-supported value, the error code “Trigger condition value not supported” shall be returned (see Section 1.6).

Trigger condition “No time-based triggering used” (0x00) shall always be supported if the *Time Trigger Setting* descriptor exists and should be used as default value.

If both the *Value Trigger Setting* and the *Time Trigger Setting* descriptors are present for a characteristic, changing of the value of the *Value Trigger Setting* descriptor resets the *Time Trigger Setting* descriptor to its default value - “No time-based triggering used”.

3.5.3 General on Trigger Setting Descriptors

If a *Value Trigger Setting* descriptor exists but not a *Time Trigger Setting* descriptor, the behavior shall be the same as a *Time Trigger Setting* descriptor with the value “No time-based triggers used”.

Some examples on the use *Value Trigger* and *Time Trigger Settings* descriptors:

- 1) Trigger when an analog value changed more than the value 100. This will require a *Value Trigger Setting* descriptor with *condition value* = 0x03 and *analog comparison value* = 100.
- 2) Assume there are 8 digital inputs and it is required to trigger when one of the four first inputs changes its value (from active to not active or from not active to active). This will require a *Value Trigger Setting* descriptor with *condition value* = 0x04 and a *bit mask comparison value* = 0x55 (hexadecimal).
- 3) Trigger not more often than every 10 seconds if an analog value changes from above 100 to below 100 or from below 200 to above 200, i.e. a setpoint of 150 with a hysteresis of +-50. This will require one *Time Trigger Setting* descriptors with *condition value* = 0x02 and *time interval comparison value* = 10 seconds and a *Value Trigger Setting Descriptor* with *condition value* = 0x05 and *analog interval comparison value* = 100, 200.

For the Aggregate characteristic the respective trigger settings for any included characteristics are used. A logical OR is used to determine if an indication/notification shall be triggered (i.e., if one of the included characteristics has fulfilled its trigger requirements, the Aggregate characteristic shall be considered to be triggered).

4 SDP Interoperability

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

Item	Definition	Type	Value	Status
Service Class ID List				M
Service Class #0		UUID	«Automation IO 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 4.1: SDP record

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

5 Acronyms and Abbreviations

Acronyms and Abbreviations	Meaning
BR/EDR/HS	Basic Rate / Enhanced Data Rate / High Speed
GAP	Generic Access Profile
GATT	Generic Attribute Profile
LE	Low Energy
ATT_MTU	ATT_MTU is the maximum size of any packet sent between a client and a server (see reference [1]).
IOM	IO Module

Table 5.1: Acronyms and abbreviations

6 References

- [1] Bluetooth Core Specification v.4.0 or later
- [2] Characteristics and Descriptors descriptions accessible via [Bluetooth SIG Assigned Numbers](#)