



BLE RDk IR Service Specification

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Document Status Codes**Work in Progress (W)**

An incomplete document designed to guide discussion and generate feedback that may include several alternative requirements for consideration.

Draft (D)

A document in specification format considered largely complete, but lacking review. Drafts are susceptible to substantial change during the review process.

Issued (I)

A stable document that has undergone rigorous review and is suitable for product design and development. It will serve as a basis for testing requirements.

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1. Introduction

1.1 Overview

The RDK IR Service exposes data and associated formatting for programming infrared signals into an RDK Remote Control Device.

1.2 Purpose of Document

This document defines detailed requirements for the RDK IR Service. It is intended to specify download and management of IR descriptors between an RIR server and an RIR client.

1.3 Typographical Conventions

This specification uses different typefaces to differentiate and emphasize important information.

Table 1 - Typographical Conventions

Typeface	Usage
Boldface	Used to call attention to a piece of information. For example: This specification does not include headend diagnostic screens.
Boldface & Uppercase	Used to emphasize information and for readability. For example: ENTER, MUTE, INFO, VOL +/- and other buttons on the remote control.
Italics	Used to emphasize that the information being presented is for informational purposes only and is not a requirement even though it may contain conformance language. For example: <i>Note: The voice controller uses the Channel Check Request to verify that the voice target has disabled frequency agility.</i>
Uppercase	Used to define and signify a requirement. For example: MUST, SHOULD, and MAY.

1.4 Requirements (Conformance Notation)

Throughout this document, the words that are used to define the significance of particular requirements are capitalized. These words are:

“MUST” This word or the adjective “REQUIRED” means that the item is an absolute requirement of this specification document.

“MUST NOT” This phrase means that the item is an absolute prohibition of this specification document.

- “SHOULD” This word or the adjective “RECOMMENDED” means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
- “SHOULD NOT” This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before choosing a different course.
- “MAY” This word or the adjective “OPTIONAL” means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

1.5 Revision History

Version	Date	Author	Remarks
D01	15 May 2020	Comcast	Initial Version
D02	19 July 2024	Comcast	Added remote code extension details

2 References

Reasonable effort is made to keep references up to date with respect to versions and release dates, however manufacturers are responsible for ensuring they have the most recent version of a reference specification (unless otherwise noted).

Where conflicts exist between requirements contained in this specification and normative references, the specification requirements govern.

2.1 Normative References

[BLUETOOTH] Bluetooth Core Specification version 4.0 or later

3 Terms and Definitions

This document uses the following terms and definitions.

Table 2 - Terms and Definitions

Term	Definition

4 Abbreviations and Acronyms

This document uses the following abbreviations and acronyms.

Table 3 - Abbreviations and Acronyms

Abbrv	Acronym
RIS	RDK IR Service

Commented [SM1]: Update for IR

5 Introduction

The RDK IR Service (RIS) exposes data and associated formatting for programming infrared signals into an RDK Remote Control Device or other device with an IR transmitter.

5.1 Conformance

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.

5.2 Service Dependency

This service is not dependent upon any other services.

5.3 Bluetooth Specification Release Compatibility

This specification is compatible with any Bluetooth core specification [BLUETOOTH] that includes the Generic Attribute Profile (GATT) specification and the Bluetooth Low Energy Controller specification.

Commented [SM2]: references

5.4 GATT Sub-Procedure Requirements

Requirements in this section represent a minimum set of requirements for an RDK Remote Control Device (GATT Server). Other GATT sub-procedures may be used if supported by both Client and Server.

Table 4 below summarises additional GATT sub-procedure requirements beyond those required by all GATT Servers.

Table 4 - GATT Sub-Procedure Requirement

GATT Sub-Procedure	Requirement
Read Characteristic Value	M
Write Characteristic Value	M
Write Without Response	O
Queued Write Characteristic Value	C.1
Read Characteristic Descriptors	M
Write Characteristic Descriptors	M
C.1 Queued writes are required if infrared data is larger than 20 octets.	

5.5 Transport Dependencies

The service shall only operate over an LE transport.

5.6 Error Codes

This service does not define any application error codes that are used in Attribute Protocol.

5.7 Byte Transmission Order

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

6 Service Requirements

6.1 Service Declaration

The service UUID shall be set to:

```
0000F801-BDF0-407C-AAFF-D09967F31ACD
```

6.2 Service Roles

A remote control or similar low power device enabled with an IR transmitter should function as an RIS Server.

A settop box or other host capable of supplying IR data should function as an RIS Client.

6.3 Service Introduction

Figure 1 depicts the characteristics and descriptors required of the service and the primary direction of data flow from / to the RDK STB host device.

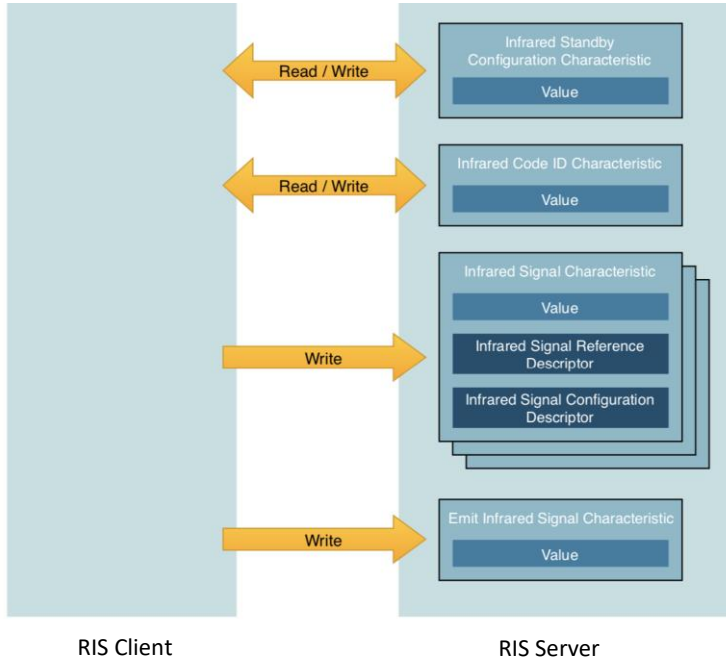


Figure 1 - RDK IR Service

6.4 Service Sequence Examples

TBD

6.5 Characteristic Overview

The RDK IR Service is composed of the following characteristics used to provide access to the infrared signal capabilities and data.

Unless otherwise specified, only one instance of each characteristic is permitted within an RDK IR Service.

Table 5 - Voice Service Characteristics

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
IR Standby Configuration	M	Read, Write, Write Without Response		None

IR Code ID	M	Read, Write, Write Without Response		None
IR Signal	C.2	Write, Write Without Response	Read, Queued Write	None
Emit IR Signal	M	Write, Write Without Response	Read	None

Commented [SM3]: Should this be optional?

c.2: Mandatory to support at least one Infrared Signal.

Notes:

- Security Permissions of “None” means that this service does not impose any requirements.
- Profiles utilising this Service may impose security requirements beyond those defined in Table 2.1 for all characteristics defined in Table 2.1.
- Properties not listed as mandatory (M) or optional (O) are excluded.

6.6 IR Standby Configuration Characteristic

The *IR Standby Configuration* characteristic controls the behaviour of an RIR Client when the physical standby button is pressed and the RIR Client is not connected but is bonded to an RIR Server. The purpose is to control the events (IR and BLE) used to bring an RIR Server out of standby.

The UUID of the IR Standby Configuration characteristic is :

0000EB01-BDF0-407C-AAFF-D09967F31ACD

A single instance of this characteristic shall exist as part of the RIR Service.

6.6.1 IR Standby Configuration Characteristic Behavior

The *IR Standby Configuration* characteristic value can be read using the GATT Read Characteristic Value and is written using the GATT Write sub-procedure.

6.6.2 IR Standby Configuration Characteristic Value

The characteristic contains a single octet, table 2.2 shows the allowed values.

Table 6 - IR Standby Configuration Possible Values

Value	Description
0x00	IR Fallback mode when not connected
0x01	BLE directed advertising mode when not connected
0x02-0xFF	Reserved for future use

This characteristic value shall be persistent across connections for bonded devices. The *IR Standby Configuration* characteristic is unique for each RIR Client. An RIR Client may read and write this descriptor to determine and set the configuration for that client.

The default value for the *IR Standby Configuration* characteristic is 0x00. Upon connection of non-bonded clients, this characteristic value is set to the default value.

If the RIR Server stores client information for multiple clients then it is the last connected client's value that shall be used to determine the standby key mode.

6.7 IR Code ID Characteristic

The IR Code ID characteristic is used to expose the **current IR code set id of the RIR IR Service with which it is associated**, or to set the desired **code set id of the Service**.

Commented [SM4]: Unclear what this actually means

The UUID of the IR Code ID characteristic is :

0000EB02-BDF0-407C-AAFF-D09967F31ACD

Only a single instance of this characteristic shall exist as part of the RIR Service.

6.7.1 IR Code ID Characteristic Behaviour

Both IR code set id values are arbitrary signed 32-bit values that are written and read by the RIR Client. Their values shall not be interpreted or used by the RIR Server; the values shall be treated as opaque data.

The IR Code ID Characteristic value shall be maintained across power cycles and device bonding / un-bonding (i.e. the value should be stored in non-volatile memory and not linked to a bound client). The default shall be set to -1 by the service.

6.7.2 IR Code ID Characteristic Value

The characteristic shall contain two 32-bit signed integer fields, one for the *code set id* of a TV and one for an AV amplifier.

Table 7 shows the data format of the characteristic value.

Table 7 - IR Code ID Characteristic Values

Name	Requirement	Format
TV IR Code ID	Mandatory	sint32
AV Amplifier IR Code ID	Mandatory	sint32

Table 2.3: Infrared Code ID characteristic value

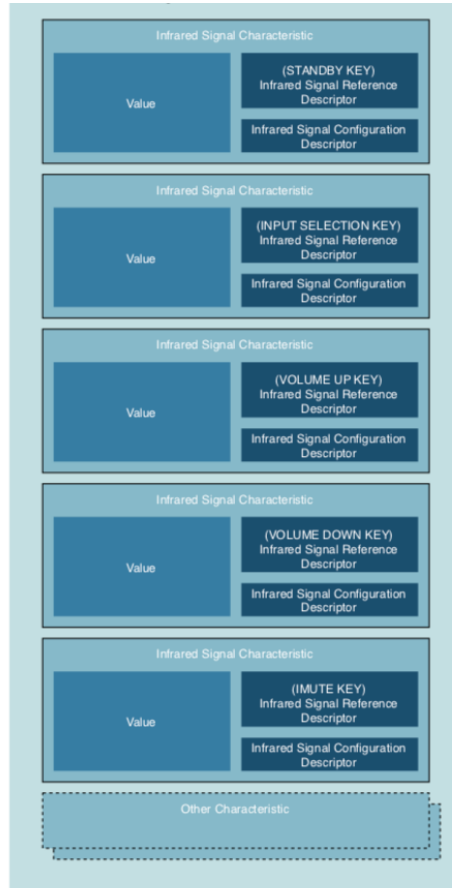
6.8 IR Signal Characteristic

The IR Signal characteristic is used to set the infrared signal data for a single physical button or function on an RIR Server.

The UUID of the Infrared Signal characteristic is :

0000EB03-BDF0-407C-AAFF-D09967F31ACD

Multiple instances of this characteristic shall exist as part of the RIR Service. There shall be single instance of this characteristic for each physical button or function that supports infrared programming.



6.8.1 IR Signal Characteristic Behavior

The IR Signal characteristic is used to store infrared format information such that the RIR Server can emit the given infrared signal when a physical button is pressed or an event happens.

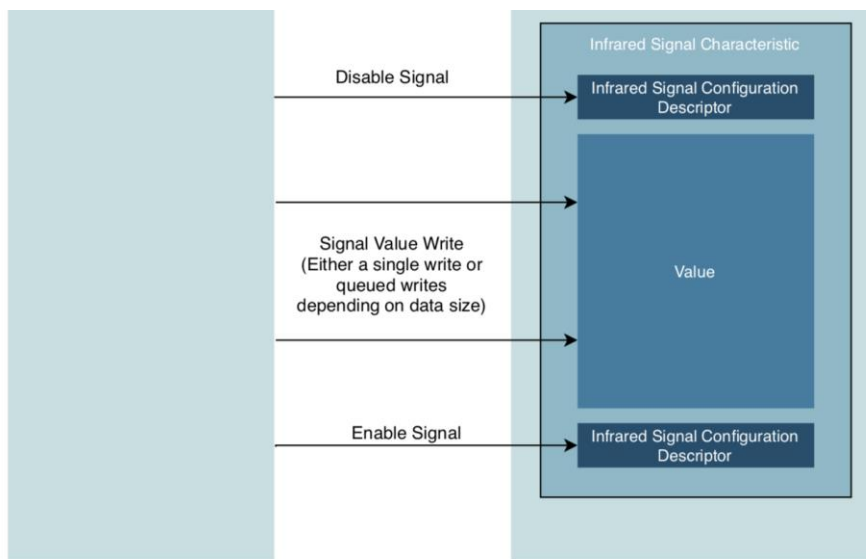
Each characteristic shall have a single instance of the *IR Signal Reference* descriptor and a single instance of the *IR Signal Configuration* descriptor. The *IR Signal Reference* descriptor shall be used to identify which physical button the characteristic represents.

6.8.2 IR Signal Characteristic Value

The Infrared Signal characteristic value shall be variable length octet array, it's format is outside of the scope of this document. It is expected that the RIR Client will receive an opaque blob of data from a vendor supplied infrared database. The complete blob of data will be written to this characteristic value.

On any Infrared Signal characteristic value write the enabled state of the characteristic shall be set to `FALSE` and a read of the *Infrared Signal Configuration Descriptor* shall indicate the signal is disabled.

The RIR Server will enable the signal with a write to the *Infrared Signal Configuration Descriptor* once it has completed the write to the Infrared Signal characteristic value. Figure 2.2 depicts the expected sequence for programming an infrared signal.



6.8.2.1 Large IR Signal Data Characteristic Values

If writes of larger than `ATT_MTU - 3` (20 octets) are required, then the device shall support *Queued Writes* as described in *Bluetooth Core v4.0, Volume 3, Part F, Section 3.4.6*.

If queued writes are used then the device shall support at least one buffer of a size large enough to store a single infrared signal blob. The RIR Server will guarantee that only

one infrared signal characteristic is written at a time. A device may reject a queued write request if a queued write on another characteristic is in progress.

6.8.3 IR Signal Characteristic Descriptors

6.8.3.1 IR Signal Reference Descriptors

The Infrared Signal Reference characteristic descriptor is used to provide the physical button identifier for the Infrared Signal characteristic value.

The UUID of the Infrared Signal Reference descriptor is:

0000EB04-BDF0-407C-AAFF-D09967F31ACD

The descriptor shall contain a single read only octet attribute. Table 2.2 shows the definition of the Infrared Signal Reference characteristic descriptor Attribute Value field.

Value	Description	Notes
0xFF	Reserved	NA
0x0C	Standby Key	
0x29	Input Key	
0x10	Volume Up Key	
0x11	Volume Down Key	
0x0D	Mute Key	
0x5C	Select Key	
0x58	Up Key	
0x59	Down Key	
0x5A	Left Key	
0x5B	Right Key	
All Other Values	Reserved	

6.8.3.2 IR Signal Configuration Descriptor

The IR Signal Configuration characteristic descriptor is used to expose the signal enable / disable setting of the infrared signal.

The UUID of the Infrared Signal Configuration descriptor is :

0000EB05-BDF0-407C-AAFF-D09967F31ACD

The descriptor shall contain a 1 octet readable and writeable attribute. Table 2.3 shows the definition of the Infrared Signal Configuration characteristic descriptor Attribute Value field.

Value	Description
0x00	IR Signal Disabled
0x01	IR Signal Enabled

The RIR Server may choose to not enable the given signal if it detects that the current Infrared Signal Characteristic value is invalid. In such cases a read of the attribute shall indicate the signal is still disabled.

6.8.4 IR Code extensions

Below table has the full list of IR code extensions with Linux keycodes

Button Name	BLE Code	Linux Keycode
1	0x1E	KEY_1 (2)
2	0x1F	KEY_2 (3)
3	0x20	KEY_3 (4)
4	0x21	KEY_4 (5)
5	0x22	KEY_5 (6)
6	0x23	KEY_6 (7)
7	0x24	KEY_7 (8)
8	0x25	KEY_8 (9)
9	0x26	KEY_9 (10)
0	0x27	KEY_0 (11)
Select/OK	0x28	KEY_ENTER (28)
Back	0x29	KEY_ESC (1)
Standby	0x3A	KEY_F1 (59)
Settings/Help	0x3B	KEY_F2 (60)
Search	0x3C	KEY_F3 (61)
RESERVED	0x3D	NA

Plus	0x3E	KEY_F5 (63)
Record	0x40	KEY_F7 (65)
Voice/Mic	0x41	KEY_F8 (66)
Info/...	0x42	KEY_F9 (67)
Rewind	0x43	KEY_F10 (68)
Play/Pause	0x44	KEY_F11 (87)
Fast Forward	0x45	KEY_F12 (88)
RESERVED	0x49	NA
Home	0x4A	KEY_HOME (102)
Channel +	0x4B	KEY_PAGEUP (104)
RESERVED	0x4C	NA
RESERVED	0x4D	NA
Channel -	0x4E	KEY_PAGEDOWN (109)
Right	0x4F	KEY_RIGHT (106)
Left	0x50	KEY_LEFT (105)
Down	0x51	KEY_DOWN (108)
Up	0x52	KEY_UP (103)
Mute	0x55	KEY_KPASTERISK (55)
Volume -	0x56	KEY_KPMINUS (74)
Volume +	0x57	KEY_KPPLUS (78)
Option	0x68	KEY_F13 (183)
RESERVED	0x69	NA
Input Select	0x6A	KEY_F15 (185)
RESERVED	0x6B	NA
RESERVED	0x6D	NA
RESERVED	0x6E	NA
RESERVED	0x85	NA
RESERVED	0xB6	NA
RESERVED	0xB7	NA

6.9 Emit IR Signal Characteristic

The Emit Infrared Signal characteristic is used to request that the service emit an infrared signal.

The UUID of the Emit Infrared Signal characteristic is :

0000EB06-BDF0-407C-AAFF-D09967F31ACD

A single instance of this characteristic shall exist as part of the RIR Service.

6.9.1 Emit IR Signal Characteristic Behavior

Either the GATT Write or GATT Write Without Response sub-procedure is used to write to the Emit Infrared Signal characteristic.

A write shall trigger an infrared signal to be emitted for a period of 200 milliseconds. If an infrared signal is programmed and enabled via the Infrared Control Point Characteristic then that shall be used for the signal. If an infrared signal is not programmed or disabled then the default infrared signal shall be emitted.

The signal shall be immediately stopped if another GATT write to this characteristic is received.

A GATT Read is optional, if implemented it shall return the current signal being emitted, this should only apply to signals being emitted that were triggered by a write to this characteristic (i.e. an infrared signal emitted in response to a physical button press shall not be indicated in the value read).

6.9.2 Emit IR Signal Characteristic Value

The Emit Infrared Signal characteristic value is a single octet containing an enumeration of values as shown in Table 2.7.

Value	Description
0xFF	No Signal
0x0C	Standby/Power Toggle Key
0x29	Input Key

0x10	Volume Up Key
0x11	Volume Down Key
0x0D	Mute Key
0x5C	Select Key
0x58	Up Key
0x59	Down Key
0x5A	Left Key
0x5B	Right Key
0xE0	Power On
0xE1	Power Off
All Other Values	Reserved

A GATT write of `0xFF` can be used to cancel a previous request to emit an infrared signal.