

Nearby Interaction Accessory Protocol Specification

Release R4

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1. Introduction

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1.1. Requirements, recommendations, and permissions

This specification contains statements that are incorporated by reference into legal agreements between Apple and its Licensees. The use of the words *must*, *must not*, *required*, *shall*, *shall not*, *should*, *should not*, *recommended*, *not recommended*, *may*, *optional*, and *deprecated* in a statement have the following meanings:

- *Must*, *shall*, or *required* means the statement is an absolute requirement.
- *Must not*, *shall not*, or *prohibited* means the statement is an absolute prohibition.
- *Should* or *recommended* means the full implications must be understood before choosing a different course.
- *Should not* or *not recommended* means the full implications must be understood before choosing this course.
- *May* or *optional* means the statement is truly optional, and its presence or absence cannot be assumed.
- *Deprecated* means the statement is provided for historical purposes only and is equivalent to “must not.”

The absence of requirements, recommendations, or permissions for a specific accessory design in this specification must not be interpreted as implied approval of that design. Licensee is strongly encouraged to ask Apple for feedback on accessory designs that are not explicitly mentioned in this specification.

1.2. Terminology

Throughout this document, these terms have specific meanings:

- The term *Apple device* is used to refer to an iPhone, iPad, iPod, or Mac (running iOS, iPadOS, or macOS).
- The term *accessory* is used to refer to any product intended to interface with a device through the means described in this specification.
- The term *embedded application* is used to refer to application code running on the accessory.

2. Requirements

2.1. Overview

The *Nearby Interaction Accessory Protocol Specification* defines a lightweight, transport-agnostic, and application-level protocol that facilitates configuring, starting, and maintaining an Ultra Wideband (UWB) ranging session between an accessory and an Apple device. An app on a supported UWB-enabled Apple device is required in order to allow users to set up, configure, and use their accessories. An accessory must integrate an approved UWB-interoperable solution [1]. The embedded application on the accessory must implement the requirements as described in this document.

2.2. Audience

The Nearby Interaction Accessory Protocol Specification is intended for accessory manufacturers or accessory iOS application developers who wish to integrate UWB ranging functionality into an accessory or app in accordance with Apple's Nearby Interaction API [2].

2.3. General

An app on an Apple device will need to set the expected mode of operation on the accessory, as well as the mode of operation of the Apple device. This setup is accomplished by exchanging two configuration data messages:

1. Accessory Configuration Data: From the accessory to the Apple device. May contain configuration parameters as well as capabilities.
2. Apple Shareable Configuration Data: From the Apple device to the accessory. Contains the final configuration parameter selection.

Once the two configuration messages are exchanged, a UWB ranging session may begin between the accessory and the Apple device. The accessory must be able to handle errors, timeouts, and other session life cycle events in accordance with the guidelines in this document and in the Nearby Interaction API [2].

2.4. Two-way data link

An app on the Apple device must establish and maintain a two-way data link to the accessory. The data link must be capable of facilitating the exchange of configuration data as defined in this specification, as well as handling any additional application-specific communications — e.g., starting and stopping interaction, error recovery and state synchronization. The mechanism to establish a two-way data link is out of scope of this document.

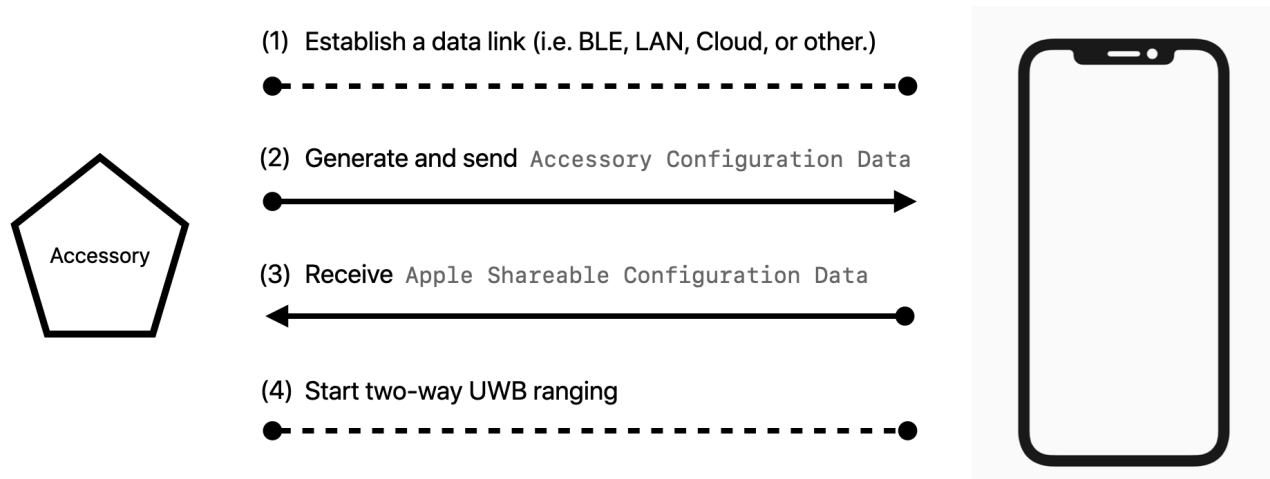


Figure 2-1: Interaction steps between the accessory and the Apple device from the point of view of the accessory

2.4.1. Endianness

All data sent and received as defined in this specification document shall be transmitted with the least significant octet first (that is, little endian).

2.5. Hardware

2.5.1. Application processor

The accessory must have a processor capable of handling the configuration messages specified in this document, utilize a data communication subsystem for sending and receiving data between the accessory and Apple device, control a UWB subsystem, and manage logic such as error handling, retries, and other session life cycle events as specified in this document and in the Nearby Interaction API [2].

2.5.2. Data communication subsystem

The accessory must have a data communication subsystem such as a Bluetooth Low Energy (LE) controller, or any other applicable transport subsystem in order to facilitate two-way data exchange between the accessory and the Apple device.

2.5.3. Ultra Wideband (UWB) chipset and middleware

An accessory must integrate an approved UWB-interoperable solution [1].

3. Nearby Interaction Application Protocol

3.1. Overview

The Nearby Interaction application protocol defines a set of configuration data messages that must be exchanged in order to begin UWB ranging between an accessory and an Apple device.

3.2. Required messages

The Nearby Interaction application protocol requires the exchange of the following messages:

1. Accessory Configuration Data (view section 3.4 below)
2. Apple Shareable Configuration Data (view section 3.5 below)

The format and timing of all other messages, including but not limited to those for UWB session life cycle management, are to be decided by the accessory manufacturer and the author of the iOS accessory app.

3.3. Versions

The message formats as well as the requirements defined in this chapter are tied to the following versions.

Table 3-1 Supported Versions

Version Type	Value
Major	1
Minor	0

3.4. Accessory configuration data

3.4.1. Overview

For every new UWB ranging session with an Apple device, the accessory must generate a new Accessory Configuration Data message, populate it with values as defined in this section, and send it to the iOS accessory app on the Apple device over the required two-way data link.

3.4.2. Message format

Table 3-2 Accessory Configuration Data

Parameter	Data type	Size (octets)	Description
MajorVersion	UInt16	2	Must match the major version in Table 3-1.
MinorVersion	UInt16	2	Must match the minor version in Table 3-1.
PreferredUpdateRate	UInt8	1	View 3.4.3.1 below.
RFU	Bytes	10	Reserved for future use.
UWBConfigDataLength	UInt8	1	View 3.4.4 below.
UWBConfigData	Bytes	Variable length	View 3.4.4 below.

3.4.3. Configurable parameters

The accessory must select a PreferredUpdateRate.

3.4.3.1. Preferred update rate

The PreferredUpdateRate parameter allows the accessory to indicate a preference for a ranging measurement update interval by selecting an option from the following enumeration in Table 3-3. All other values are reserved.

Table 3-3 Preferred Update Rate Options

Update Rate Option	Value	Description
Automatic	0	The Apple device will select an update rate, and may dynamically change the update rate over the course of the ranging session.
Infrequent	10	Periodic updates on a scale of approximately once every one to two seconds.
User Interactive	20	Update rate that is suitable for interactive experiences. On a scale of two to five updates per second.

3.4.4. UWBConfigDataLength and UWBConfigData

UWBConfigDataLength and UWBConfigData shall be provided by the UWB middleware to the embedded application through a dedicated interface. The rest of the Accessory Configuration Data message shall be generated by the embedded application on the accessory.

3.5. Apple shareable configuration data

3.5.1. Overview

After a successful receipt and processing of the Accessory Configuration Data, the Apple device may provide the Apple Shareable Configuration Data message to the iOS accessory app. The iOS accessory app must then send this data to the accessory over the required two-way data link without any delay.

The embedded application on the accessory must provide the configuration data contained in this message to the UWB middleware. UWB ranging must start on the accessory immediately following this message.

3.5.2. Message format

Table 3-4 Apple Shareable Configuration Data

Parameter	Data type	Size (octets)	Description
AppleUWBConfigData	Bytes	Variable length	Parameter selection intended to be consumed by the UWB middleware.

3.5.3. Handling on the accessory

The Apple Shareable Configuration Data is conveyed to the iOS accessory app. The iOS accessory app shall send this data to the embedded application on the accessory through the required two-way data link.

The Apple Shareable Configuration Data contains the final UWB configuration parameters selected by the Apple device within the AppleUWBConfigData parameter. Once the embedded application on the accessory receives the Apple Shareable Configuration Data, it shall provide AppleUWBConfigData, as-is, to the UWB middleware through the dedicated interface.

3.6. Session life cycle management

3.6.1. Overview

To ensure a high-quality user experience, conserve resources, and increase reliability, the accessory should be able to coordinate the following activities with the accessory iOS app on the Apple device.

- Prepare the accessory for operation.
- Exchange configuration messages and start a UWB ranging session.
- Stop a UWB ranging session.
- Retry following an unsuccessful session initiation.
- Handle errors by returning to an expected state.

For additional guidelines, see the Nearby Interaction API [2]. For design guidance, go to [Human Interface Guidelines > iOS > Spatial Interactions](#).

4. Nearby Interaction Service

4.1. Overview

Some Nearby Interaction APIs defined in the Nearby Interaction Framework [2] are intended for use with accessories that support both UWB and Bluetooth Low Energy (LE).

In order to use these APIs:

1. An app and accessory must implement the application protocol described in Section 3.
2. In addition, the accessory must implement Nearby Interaction Service, described in this section.

The accessory uses Nearby Interaction Service to make its UWB configuration data readable over Bluetooth LE. This enables the Apple device to associate an ongoing UWB ranging session with an existing Bluetooth LE connection.

The Nearby Interaction service is **not** discoverable by iOS apps directly. It is intended to be used by the Apple device and its subsystems.

4.2. Service details

4.2.1. Service dependencies

This service is not dependent upon any other services.

4.2.2. Bluetooth Core Specification release compatibility

This service uses the Generic Attribute Profile (GATT) and is compatible with any version of the Bluetooth Core Specification host that includes GATT, and the Bluetooth Low Energy Controller specification.

4.2.3. GATT sub-procedure requirements

Additional GATT sub-procedure requirements are indicated in Table 4-1.

Table 4-1 GATT Sub-Procedure Requirements

GATT Sub-Procedure	Requirements
Read Characteristic Descriptors	Mandatory

4.2.4. Transport dependencies

This service shall only operate over Bluetooth LE transport.

4.2.5. Service declaration

This service must be declared as a primary service, and must declare only a single instance of this service.

The service UUID is defined in Table 4-2.

Table 4-2 Service UUID

Service	UUID
Nearby Interaction Service	48fe3e40-0817-4bb2-8633-3073689c2dba

4.3. Characteristics

This section defines the characteristic and descriptor requirements for Nearby Interaction Service. While only a single instance of Nearby Interaction Service may exist on a device, multiple instances of the characteristics listed below may exist.

Table 4-3 defines the characteristic and descriptor requirements.

Table 4-3 Nearby Interaction Service Characteristics

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Excluded Properties	Security Permissions
Accessory Single Configuration Data	Mandatory	Read	None	Write, Notify	Encryption required
Accessory Single Configuration Data Characteristic User Description	C.1	Read	None	Write	Encryption required
Accessory Multiple Configuration Data	Optional	Read	None	Write, Notify	Encryption required
Accessory Multiple Configuration Data Characteristic User Description	C.2	Read	None	Write	Encryption required

C.1: Mandatory if more than one instance of the Accessory Configuration Data characteristic is present, otherwise optional.

C.2: Mandatory if more than one instance of the Accessory Multiple Configuration Data characteristic is present, otherwise optional.

4.3.1. Characteristic declarations

Table 4-4 contains the UUIDs of the Nearby Interaction Service characteristics.

Table 4-4 Characteristic UUIDs

Characteristic	UUID
Accessory Single Configuration Data	95e8d9d5-d8ef-4721-9a4e-807375f53328
Accessory Multiple Configuration Data	1176cf7b-bed2-4690-bd69-5f34001e820c

4.3.2. Accessory Single Configuration Data Characteristic

Whenever an accessory starts a ranging session with an Apple device, the accessory is required to generate a new Accessory Configuration Data message and send it to the iOS device via an application-specific two-way data link. This is described in Section 3.4.

If an accessory supports Nearby Interaction Service, then *in addition* to Section 3.4, the accessory must *also* populate the value of the Accessory Single Configuration Data characteristic with the contents of that Accessory Configuration Data message.

The Apple device will read the Accessory Single Configuration Data characteristic value, and compare it to the data provided in Section 3.4, before ranging can continue.

If the accessory supports multiple simultaneous UWB ranging sessions, it must instantiate an Accessory Single Configuration Data characteristic for each session. It may also additionally instantiate one or more Accessory Multiple Configuration Data characteristics. This is described in Section 4.3.3.

4.3.3. Accessory Multiple Configuration Data Characteristic

An accessory that supports multiple simultaneous UWB ranging sessions *may* instantiate an Accessory Multiple Configuration Data characteristic. The characteristic value should have the format described in Table 4-5.

Table 4-5 Accessory Multiple Configuration Data Characteristic Value

Field	Size	Description
NumConfigs	1	The number of Accessory Configuration Data messages contained herein
Config[0].Length	1	The number of bytes in the first Accessory Configuration Data message
Config[0].Data	Config[0].Length	The first Accessory Configuration Data message
...	...	The remaining Accessory Configuration Data messages (length and data fields)

If the Apple device supports the Accessory Multiple Configuration Data characteristic, and the accessory instantiates this characteristic, the Apple device will read *only* the value of this characteristic (and not the Accessory Single Configuration Data characteristic). It will compare the Accessory Configuration Data messages contained therein to the data provided in Section 3.4, before ranging can continue.

The accessory must still instantiate instances of the Accessory Single Configuration Data characteristic in order to range with Apple devices that do not support the Accessory Multiple Configuration Data characteristic.

The accessory may instantiate more than one Accessory Multiple Configuration Data characteristic, each of which can contain different Accessory Configuration Data messages.

4.3.4. Characteristic User Description

If multiple instances of the Accessory Single Configuration Data characteristic are supported, each one shall include a Characteristic User Description descriptor. That descriptor's value shall be unique to that instance of the characteristic.

If multiple instances of the Accessory Multiple Configuration Data characteristic are supported, each one shall include a Characteristic User Description descriptor. That descriptor's value shall be unique to that instance of the characteristic.

5. References

[1] Nearby Interaction with UWB FAQ (<https://developer.apple.com/nearby-interaction>)

[2] Nearby Interaction Framework, Developer Documentation (<https://developer.apple.com/documentation/nearbyinteraction>)

6. Revision History

This chapter describes the changes to *Nearby Interaction Accessory Protocol Specification* from the previous revision.

- R1: Initial release
- R2: Added Nearby Interaction service
- R3: Clarified preferred update rate options. Added new characteristics to Nearby Interaction service.
- R4: Updated terms of use



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