Cookware Service

Bluetooth® Service Specification

- **Revision:** v1.0
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- **Prepared By:** Automation Working Group

Abstract:

This Cookware Service (CWS) is part of the Sensor-Assisted Cooking System, which defines how smartphones, pots and pans, or other sensor-equipped devices communicate with kitchen appliances to optimize the cooking process.

Version History

Version Number	Date (yyyy-mm-dd)	Comments
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Acknowledgments

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Contents

1 Introduction

The Cookware Service (CWS), part of the Sensor-Assisted Cooking System, supports use cases in which communication links exist between a smart device, a kitchen appliance such as an oven or a cooktop, and a smart Cookware Device (CWD) such as a pot, a pan, or a cooking temperature probe. By automating the process, this system can improve the consistency of cooking, reduce power consumption, and improve the user experience during cooking.

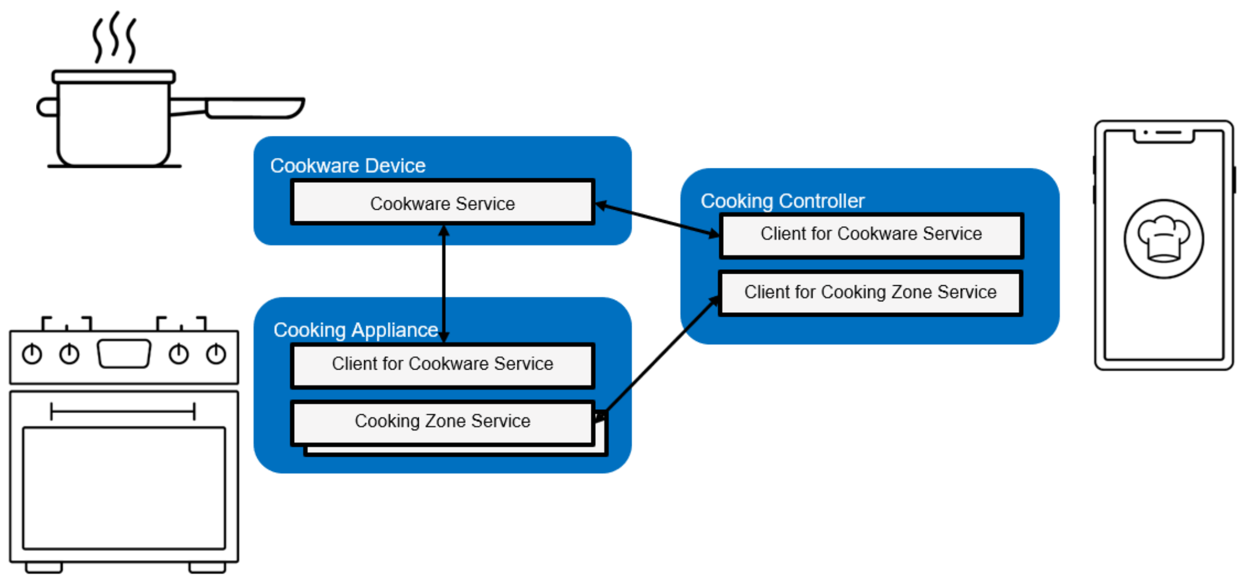

Figure 1.1Sensor-Assisted Cooking System

CWS is hosted by a CWD. CWS allows controlling devices to receive CWD sensor measurements. CWS also supports scenarios in which a CWD controls the appliance heating or cooling functions.

1.1 Language

1.1.1 Language conventions

In the development of a specification, the Bluetooth SIG has established the following conventions for use of the terms "*shall*", "*mandatory*", "*shall not*", "*should*", "*should not*", "*may*", "*optional*", "*must*", and "*can*". In this Bluetooth specification, the terms in Table 1.1 have the specific meanings given in that table, irrespective of other meanings that exist.

Term	Definition
shall *or* mandatory	—used to express what is required by the specification and is to be implemented exactly as written without deviation
shall not	—used to express what is forbidden by the specification

Term	Definition
should *or* may *or* optional	—not mandatory. Used to express either: 1. what is recommended by the specification without forbidding anything ("should") 2. what is permissible within the limits of the specification ("may" or "optional")
should not	—used to indicate that something is discouraged but not forbidden by the specification
must	—used to indicate either: 1. an indisputable statement of fact that is always true regardless of the circumstances 2. an implication or natural consequence if a separately-stated requirement is followed
can	—used to express a statement of possibility or capability

Table 1.1: Language conventions terms and definitions

Where more than one item is permitted but not required, the choices to include or support those items are independent from one another unless the specification explicitly states otherwise. Each item that is implemented shall be implemented exactly as written without deviation.

1.1.1.1 Implementation alternatives

When specification content indicates that there are multiple alternatives to satisfy specification requirements, if one alternative is explained or illustrated in an example it is not intended to limit other alternatives that the specification requirements permit.

1.1.1.2 Discrepancies

It is the goal of Bluetooth SIG that specifications are clear, unambiguous, and do not contain discrepancies. However, members can report any perceived discrepancy by filing an erratum and can request a test case waiver as appropriate.

1.1.2 Reserved for Future Use

Where a field in a packet, Protocol Data Unit (PDU), or other data structure is described as "Reserved for Future Use" (irrespective of whether in uppercase or lowercase), the device creating the structure shall set its value to zero unless otherwise specified. Any device receiving or interpreting the structure shall ignore that field; in particular, it shall not reject the structure because of the value of the field.

Where a field, parameter, or other variable object can take a range of values, and some values are described as "Reserved for Future Use," a device sending the object shall not set the object to those values. A device receiving an object with such a value should reject it, and any data structure containing it, as being erroneous; however, this does not apply in a context where the object is described as being ignored or it is specified to ignore unrecognized values.

When a field value is a bit field, unassigned bits can be marked as Reserved for Future Use and shall be set to 0. Implementations that receive a message that contains a Reserved for Future Use bit that is set to 1 shall process the message as if that bit was set to 0, except where specified otherwise.

The acronym RFU is equivalent to Reserved for Future Use.

1.1.3 Prohibited

When a field value is an enumeration, unassigned values can be marked as “Prohibited.” These values shall never be used by an implementation, and any message received that includes a Prohibited value shall be ignored and shall not be processed and shall not be responded to.

Where a field, parameter, or other variable object can take a range of values, and some values are described as “Prohibited,” devices shall not set the object to any of those Prohibited values. A device receiving an object with such a value should reject it, and any data structure containing it, as being erroneous.

“Prohibited” is never abbreviated.

1.2 Requirements in tables

Requirements in this specification are defined as "Mandatory" (M), "Optional" (O), "Excluded" (E), “Not Applicable” (N/A), or "Conditional" (C.#). Conditional statements (C.#) are listed directly below the table in which they appear.

- "M” for mandatory. See Table 1.1 Language conventions terms and definitions.
- "O” for optional. See Table 1.1 Language conventions terms and definitions.
- “E” for excluded. “Excluded” means not permitted in this context; cannot be supported or included for this purpose. The item can still be supported or included if allowed for some other purpose (e.g., a feature can be mandatory for one role and excluded for another; a device that supports both roles must support this feature).
- “C.#” for conditional. “Conditional” means that an item is required, optional, or prohibited based on whether one or more other items are supported or included (# represents any number). Within the definition of the condition, if those other items mean that “not permitted” applies, it has the same meaning as “E”.

1.2.1 Table requirements for unused cells

An unused cell is a table cell without a value or content, which is indicated with either the word “none” (without quotation marks) or a hyphen (i.e., a “minus” sign).

1.3 Conformance

Each capability of this specification shall be supported in the specified manner. This specification may provide options for design flexibility, because, for example, some products do not implement every portion of the specification. For each implementation option that is supported, it shall be supported as specified.

1.4 Byte transmission order

All characteristics used with this service shall be transmitted with the least significant octet (LSO) first (i.e., little endian). Where the format is described in tables in this document, the LSO is the first octet in the topmost field of the table; the most significant octet (MSO) is the last octet in the bottommost field of the table. Where characteristics are defined in the GATT Specification Supplement (GSS), see GSS Section 2.2 in [1] for more information on octet ordering.

1.5 Terminology

Table 1.2 defines terms that are used in the CWS.

Term	Definition Location
Associated Cooking Zone	A Cooking Zone is considered Associated with a Cookware Device (CWD) when the Cooking Zone can deliver power to the CWD. For example, when a pot is placed on an induction cooktop or in an oven.
Associated Cookware Device	A CWD is considered Associated with a Cooking Zone when the CWD is placed such that the Cooking Zone can deliver power to the CWD.
Control Loop	A procedure that calculates the necessary cooking conditions, such as power level, based on the target cooking conditions (e.g., the desired temperature) and the measured cooking conditions. The Control Loop can be executed on a Cooking Controller, a Cooking Appliance, or a CWD.
Cooking Appliance	A device that can emit power to change the cooking conditions for the CWD. In this specification, the term Cooking Appliance mostly applies to traditional or induction cooktops, but it may also be used with gas cooktops, ovens, grills, refrigerators, or other heating or cooling appliances.
Cooking Controller	A device such as a smartphone, a tablet, a wearable device, or a dedicated control panel that can observe and/or modify the Cooking Appliance behavior.
Cooking Zone	A zone of the Cooking Appliance that provides heat or cold to a CWD. This can be, for example, a burner of the cooktop or a chamber of the oven.
Cookware Device	A device such as a pot or pan, a temperature probe, or another external sensor that may be used to assist a cooking process that uses an oven, cooktop, or other food preparation device.
Recipe Parameters	In the context of the Sensor-Assisted Cooking System, Recipe Parameters is a set of cooking parameters, including target temperature, pressure, and humidity (i.e., the amount of steam) that should be maintained in a CWD for the duration of the cooking step.

Table 1.2: Terminology used in CWS

2 Service

2.1 Service dependencies

CWS does not depend on other services.

2.2 Core Configuration dependencies

An implementation of this service requires an implementation of a Core Configuration that includes the Generic Attribute Profile (GATT) and supports either the LE or the BR/EDR transport or both.

2.3 Dependencies on other specifications external to the Core

There are no dependencies on other specifications external to the Bluetooth Core Specification [3].

2.4 Attribute Protocol Application error codes

CWS references common profile and service error codes that are defined in Part B, Section 1 of the Core Specification Supplement (CSS) [2].

CWS defines the Attribute Protocol Application error codes listed in Table 2.1.

Name	Error Code	Description
Cooking Zone Capabilities Not Set	0x80	A client attempts to write to the Recipe Parameters characteristic before setting capabilities of the cooking zone.
Unsupported by Cooking Zone	0x81	The CWD detects that one or more Recipe Parameters requested by the client cannot be fulfilled in the Associated Cooking Zone.
Invalid Cooking Step Index	0x82	The Cooking Step index field specified in the Recipe Control characteristic is not valid.
Too Many Recipe Steps	0x83	The CWD cannot store additional recipe steps.

Table 2.1: Attribute Protocol Application error codes defined by the CWS

2.5 GATT inter-layer dependencies

Dependencies in this section represent a minimum set of capabilities for a Cookware Server. Other GATT inter-layer dependencies may be used if supported by both the GATT Client and GATT Server.

Table 2.2 summarizes additional GATT inter-layer dependencies beyond those required by all GATT Servers defined in Table 4.1 in Volume 3, Part G of the Bluetooth Core Specification [3].

GATT Inter-layer Dependency	Support
Write Characteristic Value	C.1
Read Characteristic Descriptors	M
Write Characteristic Descriptors	M
Characteristic Value Notification	M
Characteristic Value Indication	M

Table 2.2: GATT inter-layer dependencies

C.1: Mandatory if the CWD supports execution of the Control Loop, otherwise Optional.

2.6 Declaration

CWS should be instantiated as a «Primary Service».

Only a single instance of CWS shall be present on a CWD.

The service Universally Unique Identifier (UUID) for CWS shall be set to «Cookware Service» as defined in the Bluetooth Assigned Numbers [4].

2.7 Behavior

CWS provides services that allow clients to do the following:

- Discover CWD capabilities, including the type, shape, number, and location of sensors
- Configure how the CWD sends sensor measurements to the client
- Read sensor measurement data and register to receive sensor measurement data

If the CWD supports execution of the Control Loop, then CWS also allows clients to:

- Set Recipe Parameters for the cooking step
- Control execution of the cooking step
- Receive notifications about the desired cooking conditions

3 Service characteristics

This section defines the characteristic and descriptor requirements. Where a characteristic can be indicated or notified, a Client Characteristic Configuration descriptor must be included in that characteristic, as required by GATT in Section 3.3.1.1 in [3].

Characteristic / Descriptor Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
Cookware Description (see Section 3.1)	M	Read	Indicate	Encryption required
Recipe Parameters (see Section 3.2)	C.1	Read, Write, Notify	-	Encryption required
Recipe Control (see Section 3.3)	C.1	Write	-	Encryption required
Cooking Step Status (see Section 3.4)	C.1	Read, Notify	-	Encryption required
Cooking Zone Capabilities (see Section 3.5)	C.1	Write	-	Encryption required
Cooking Zone Desired Cooking Conditions (see Section 3.6)	C.1	Indicate	-	Encryption required
Cooking Zone Actual Cooking Conditions (see Section 3.7)	C.1	Write	-	Encryption required
Cookware Sensor Data (see Section 3.8)	M	Read, Notify	-	Encryption required
Cookware Sensor Data descriptors (see Section 3.8.3)	M	Read, Write	-	Encryption required
Cookware Sensor Aggregate (see Section 3.9)	C.2	Read, Notify	-	Encryption required

Table 3.1: Characteristics for use with CWS

C.1: Mandatory if the CWD supports execution of the Control Loop, otherwise Excluded.
C.2: Mandatory if there is more than one Cookware Sensor Data characteristic, otherwise Excluded.

CWS shall contain up to one instance of each characteristic defined in Table 3.1, except for the Cookware Sensor Data characteristic.

CWS shall expose at least one Cookware Sensor Data characteristic and should use additional instances of the Cookware Sensor Data characteristic for each additional sensor present in the CWD.

A CWD may keep certain sensors inaccessible to clients by not exposing the corresponding Cookware Sensor Data characteristic.

3.1 Cookware Description characteristic

The Cookware Description characteristic is used by the CWS to provide clients with information about the CWD. Appendix A includes sample data for the different types of CWDs.

3.1.1 Characteristic format

The format of the Cookware Description characteristic is defined in Table 3.2.

Field	Data Type/Characteristic	Size (in octets)	Field Requirement
Cookware Type	uint8	1	M
Cookware Shape	uint8	1	M
Cookware Size	variable	variable	M
Maximum Operating Temperature	sint16	2	M
Cookware Capacity	uint16	2	C.1
Heat Capacity	uint16	2	C.1
Heating Unit Capability	uint16	2	C.1
Maximum Operating Pressure	Pressure	4	C.2

Table 3.2: Cookware Description characteristic format

C.1: Mandatory if the Cookware Type field is Vessel or Pressure Vessel, otherwise Excluded.
C.2: Mandatory if the Cookware Type field is Pressure Vessel, otherwise Excluded.

3.1.1.1 Cookware Type field

The Cookware Type field consists of one octet that specifies the type of CWD. Values of the Cookware Type field are defined in Table 3.3.

Value	Description
0x00	Vessel
0x01	Pressure Vessel
0x02	Probe
0x03	Lid
0x04 to 0xFE	RFU
0xFF	Other/Unknown

Table 3.3: Cookware Type field values

3.1.1.2 Cookware Shape field

The Cookware Shape field is a 1-octet value that identifies the shape of the CWD. Values of the Cookware Shape field are defined in Table 3.4.

Value	Description
0x00	Cylinder
0x01	Wok
0x02	Elliptic cylinder
0x03	Rectangular prism
0x04	Stick, for Cookware Type 0x02 (Probe)
0x05	Round, for Cookware Type 0x03 (Lid)
0x06 to 0xFE	RFU
0xFF	Other/Unknown

Table 3.4: Cookware Shape field values

3.1.1.3 Cookware Size field

The Cookware Size field has a variable length that depends on the Cookware Shape field. The formats of the Cookware Size field are defined in Table 3.5.

Field	Data Type	Description
Length	uint8	Length in octets of the Dimensions field
Dimensions	variable	Dimension structure

Table 3.5: Cookware Size field structure

The format of the Dimensions field depends on the Cookware Shape field.

Cylinder

The Cylinder shape value of 0x00 identifies cylindrical-shaped vessels (see Figure 3.1). The dimension structure consists of the vessel height (h) and base diameter (d) in millimeters (mm) as defined in Table 3.6.

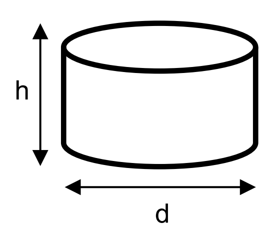

Figure 3.1. Cylindrical vessel

Length (in octets)	Dimension [unit]	
4	Height (h) [mm]	Diameter (d) [mm]
	uint16	uint16

Table 3.6. Cylindrical vessel dimension structure

Wok

For wok-shaped vessels (see Figure 3.2), the dimension structure consists of the height (h), base diameter (d_B),and top diameter (d_T) as defined in Table 3.7.

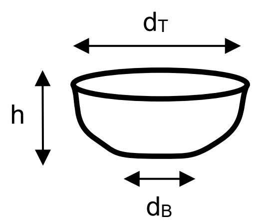

Figure 3.2. Wok-shaped vessel

Length (in octets)	Dimension [unit]		
6	Height (h) [mm]	Base Diameter (d_B) [mm]	Top Diameter (d_T) [mm]
	uint16	uint16	uint16

Table 3.7. Wok-shaped vessel dimension structure

Elliptic Cylinder

For elliptical cylinder vessels or vessels with oblong bases (e.g., Bräter) (see Figure 3.3), the dimension structure is expressed in height (h), major diameter (d_M), and minor diameter (d_m) as defined in Table 3.8.

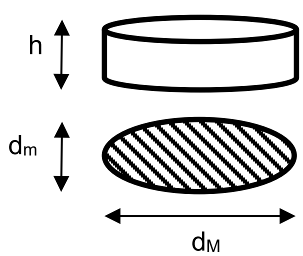

Figure 3.3. Elliptic cylinder vessel

Length (in octets)	Dimension [unit]		
6	Height (h) [mm]	Major Diameter (d_M) [mm]	Minor Diameter (d_m) [mm]
	uint16	uint16	uint16

Table 3.8. Elliptic cylinder vessel dimension structure

Rectangular Prism

For vessels with rectangular prism bases (e.g., grill or teppanyaki) (see Figure 3.4), the dimension structure is expressed in height (h), length (l), and width (w) as defined in Table 3.9.

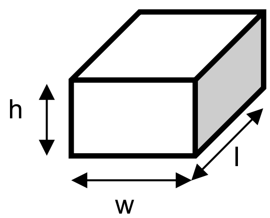

Figure 3.4: Rectangular prism vessel

Length (in octets)	Dimension [unit]		
6	Height (h) [mm]	Length (l) [mm]	Width (w) [mm]
	uint16	uint16	uint16

Table 3.9. Rectangular prism vessel dimension structure

Stick

For stick probes (see Figure 3.5), the dimension structure indicates the total length (l) of the probe as defined in Table 3.10.

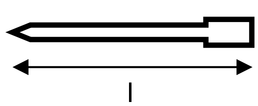

Figure 3.5: Stick probe

Length (in octets)	Dimensions [unit]
2	Length (l) [mm]
	uint16

Table 3.10. Stick probe dimension structure

Round

For round-shaped lids (see Figure 3.6), the dimension structure indicates the diameter (d) of the lid as defined in Table 3.11.

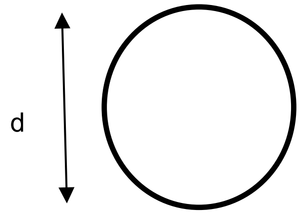

Figure 3.6: Round lid

<table>
<tr><th>Length (in octets)</th><th>Dimensions [unit]</th></tr>
<tr><td rowspan="2">2</td><td>Diameter (d) [mm]</td></tr>
<tr><td>uint16</td></tr>
</table>

Table 3.11. Round lid dimension structure

3.1.1.4 Maximum Operating Temperature field

The Maximum Operating Temperature field is a 2-octet value that represents the maximum operating temperature of the CWD. The Maximum Operating Temperature field is measured in degrees Celsius with resolution of 0.1 degrees Celsius, which matches the format of the Cooking Temperature characteristic defined in GSS [1].

3.1.1.5 Cookware Capacity field

The Cookware Capacity field is a 2-octet value that represents the useful capacity of the CWD in deciliters as described in Table 3.12.

Value	Description
0	Prohibited
1 to 5000	CWD capacity in deciliters
All other values	RFU

Table 3.12. Cookware Capacity field values

3.1.1.6 Heat Capacity field

The Heat Capacity field is a 2-octet value that represents the amount of heat to be supplied to an empty CWD to produce a one-Kelvin increase in the CWD temperature.

The Heat Capacity field value is represented in joules per Kelvin (J/K) as described in Table 3.13.

Value	Description
0x0000	The Heat Capacity value is not available or unknown
0x0001 to 0xFFFE	The Heat Capacity value in J/K
0xFFFF	RFU

Table 3.13. Heat Capacity field values

3.1.1.7 Heating Unit Capability field

The Heating Unit Capability field is a 2-octet bitmask that identifies the type of Cooking Appliance with which the CWD can operate. The possible values are defined in Table 3.14.

Value	Description
Bit 0	Induction
Bit 1	Gas
Bit 2	Radiant
Bit 3	Thick film heating
Bit 4 to 14	RFU
Bit 15	Any

Table 3.14: Heating Unit Capability field values

The bits in the Heating Unit Capability field are not mutually exclusive. For example, value 0x03 indicates that the CWD can operate with both induction and gas Cooking Appliances.

3.1.1.8 Maximum Operating Pressure field

The Maximum Operating Pressure field is a 4-octet value that represents the maximum operating pressure of the CWD in pascals (Pa) with a resolution of 0.1 Pa. The format of the Maximum Operating Pressure field matches the format of the Pressure characteristic as defined in [1].

3.1.2 Characteristic behavior

The client can read the Cookware Description characteristic value at any time. When the characteristic value is read, CWS shall report the description of the CWD.

The Cookware Description characteristic shall be static during the connection.

If the value of the characteristic changes (e.g., because of a firmware upgrade), then CWS shall send the indication of the Cookware Description characteristic to the bonded clients that are registered for the indication through the Client Characteristic Configuration descriptor on reconnection.

3.2 Recipe Parameters characteristic

The Recipe Parameters characteristic allows a client to set the cooking conditions for a cooking step. Appendix C includes examples of the Recipe Parameters characteristic.

3.2.1 Characteristic format

The format of the Recipe Parameters characteristic is defined in GSS [1].

3.2.2 Characteristic behavior

A client can read the Recipe Parameters characteristic at any time. When the characteristic value is read, the CWS shall report the last value written by a client.

If the client attempts to read the Recipe Parameters characteristic before the characteristic has been initialized, or after the cooking step has been completed or deleted, then the Cooking Step Index field in the Recipe Parameters characteristic shall be set to Unknown.

Reading the Recipe Parameters characteristic does not inform the client if the cooking step has been completed or is still in progress. To find out if the cooking step has been completed, the client can read the Cooking Step Status characteristic (see Section 3.4).

The cooking step is started by first writing to the Recipe Parameters characteristic and then writing to the Recipe Control characteristic (see Section 3.3). While the Control Loop executes, the CWD attempts to achieve parameters specified in the Recipe Parameters characteristic (e.g., vessel temperature) by instructing the client to adjust the cooking conditions (e.g., the power emitted by the cooktop induction element), which is done by sending Cooking Zone Desired Cooking Conditions characteristic indications to the client (see Section 3.6).

The CWD shall stop executing the Control Loop after the time indicated in the Duration field expires, or after the condition specified by the Termination Condition field is satisfied.

When written, the field values of the Recipe Parameters characteristic indicate the cooking conditions for the cooking step.

When the Cooking Process Type field is set to 0 (No Cooking), the CWS shall ignore the Flags field and the CWD shall stop execution of the Control Loop by sending a Cooking Zone Desired Cooking Conditions characteristic indication to the client, which sets the Flags field value to 0 (see Section 3.6.2).

3.2.2.1 Cooking Step Index field

CWDs shall only store a single cooking step. If the CWS already has Recipe Parameters characteristic stored for that cooking step and the client attempts to write a new value with a different Cooking Step Index, then the CWS shall reject the write request and respond with the ATT error response with the error code set to «Too Many Recipe Steps» (see Section 2.4).

To allow a client to update the Recipe Parameters characteristic of an existing cooking step, the CWS shall accept the write to the Recipe Parameters characteristic with the same Cooking Step Index as the one stored. If the CWS is executing the cooking step being updated, then the CWS shall restart the execution of that step with the newly specified parameters. The time remaining for executing the cooking step shall be set to the value in the Duration field of the Recipe Parameters characteristic.

3.2.2.2 Flags field

The Flags field specifies the parameters that the client requests to set.

When the Overshoot Prevention flag is set to 1, then the CWD shall prioritize minimizing overshoot while adjusting cooking conditions to match the values specified in the Recipe Parameters characteristic.

When the Overshoot Prevention flag is set to 0, then the CWD shall prioritize speed aiming to reach the values specified in the Recipe Parameters characteristic as quickly as possible, even if overshoot may occur.

The Cookware Device uses the Last Cooking Step flag and User Action Required flag when sending a Cooking Step Status notification (see Section 3.4.2).

The Cooking Step Started flag shall be ignored by the CWS when written.

3.2.2.3 Cooking Process Type field

The Cooking Process Type field allows the CWD executing the Control Loop to select the sensors that need to be considered during the cooking process and to parameterize those sensors for the type of recipe in progress. For example, if the recipe is for frying, the CWD could select the sensors located at the base of the frying pan and set the sensor triggers for quick response.

The Temperature and Humidity fields of the Recipe Parameters characteristic correspond to the condition of the cooking step, which in most cases can be measured by CWD sensors. For example, with an oven or a refrigerator, the Temperature field will correspond to the temperature in the chamber. For a cooktop, the Temperature field will correspond to the temperature inside the vessel (although not the temperature of the food).

If the Temperature Gradient field is not present, then the CWD should make its best effort to adjust cooking conditions to the Recipe Parameters characteristic target values as fast as possible. For example, the CWD should request the client to use nominal power if the temperature reported by the sensors is lower than the Temperature field value requested by the Recipe Parameters characteristic.

If the client specifies an incorrect Flags value of the Termination Condition field, e.g., both Temperature Increase Condition and Temperature Decrease Condition flags are set, then the CWS shall reject the write request by responding with an ATT error response, with the error code set to «Value Not Allowed» (see [3]).

If the CWD cannot execute the specified Recipe Parameters characteristic because the Cooking Zone Capabilities characteristic of the Associated Cooking Zone have not been set, then the CWS shall reject the write request by responding with an ATT error response, with the error code set to «Cooking Zone Capabilities Not Set» (see Section 2.4).

If the CWD cannot execute the specified Recipe Parameters characteristic because of the capabilities of the Associated Cooking Zone (see Section 3.5), then the CWS shall reject the write request by responding with an ATT error response, with the error code set to «Unsupported by Cooking Zone» (see Section 2.4).

3.3 Recipe Control characteristic

The Recipe Control characteristic allows clients to manage the execution of cooking steps.

3.3.1 Characteristic format

The format of the Recipe Control characteristic is defined in [1]. Because the CWD only supports a single cooking step, the value of the Cooking Step Index field in the write requests is optional.

3.3.2 Characteristic behavior

The behavior of the CWS depends on the Op Code written to the Recipe Control characteristic.

Support for Op Codes specified in Sections 3.3.2.1 to 3.3.2.4 is mandatory. If the Recipe Control write indicates an Op Code that is not defined in this specification, then the CWS shall return an error response with the error code set to «Write Request Rejected» (see Part B, Section 2.4 in [3]).

If a client includes the Cooking Step Index field in the write request and if the recipe stored in the CWS does not contain the cooking step with the Cooking Step Index field equal to the Cooking Step Index in the write request, then the CWS shall reject the request by responding with the ATT error response with the error code set to «Invalid Cooking Step Index» (see Section 2.4).

3.3.2.1 Read Op Code

If the Client Characteristic Configuration descriptor of the Recipe Parameters characteristic is not configured for notifications, then the server shall return an error response with the error code set to «Client Characteristic Configuration Descriptor Improperly Configured» (see [2]).

If the Cooking Step Index field in the request is valid, then the CWS shall send notification of the Recipe Parameters characteristic that includes the cooking step equal to the Cooking Step Index in the request.

If the Cooking Step Index is not present in the write request, then the CWS shall send a notification of the Recipe Parameters characteristic that is stored in the CWS.

3.3.2.2 Start Op Code

A client writes to the Recipe Control characteristic with the Op Code set to Start to start executing a cooking step previously stored in the CWS.

To execute the Control Loop, the CWD uses indications to notify the client about the desired cooking conditions (see Section 3.6). If a client attempts to write the Start Op Code to the Recipe Control characteristic while the Cooking Zone Desired Cooking Conditions characteristic is not configured for indications, then the CWS shall return an ATT error response, with the error code set to «Client Characteristic Configuration Descriptor Improperly Configured» (see [2]).

If a client attempts to write the Start Op Code to the Recipe Control characteristic while the Recipe Parameters characteristic has not been written, or if the cooking step specified by the Recipe Parameters characteristic has been completed (i.e., the Cooking Step Index of the Recipe Parameters characteristic is set to 0 (Unknown)), then the CWS shall return an ATT error response, with the error code set to «Invalid Cooking Step Index» (see [2]).

If, at the time of receiving the start command, the CWS is not executing a cooking step, then the CWS shall begin executing the cooking step stored in the Recipe Parameters characteristic.

To start executing the cooking step, the CWD shall start or adjust execution of the Control Loop by sending Cooking Zone Desired Cooking Condition characteristic indication.

When starting a cooking step with the Cooking Process Type field set to 0 (No Cooking), the CWD shall ignore the Flags field of the Recipe Parameters and shall stop executing the Control Loop. To start the new cooking step, a client writes to the Recipe Parameters characteristic and then writes to the Recipe Control characteristic with the Op Code set to Start.

As specified in Section 3.4.2, if the Cooking Step Status characteristic is configured for notifications through the Client Characteristic Configuration Descriptor, then the CWS must send a Cooking Step Status characteristic notification when CWD starts executing the cooking step.

3.3.2.3 Stop Op Code

If the write request with the Stop Op Code is received, then the CWS shall stop the current cooking step if one is being executed. The CWS shall send a Cooking Zone Desired Cooking Conditions characteristic indication to remove power from the Cooking Zone (see Section 3.6). The Recipe Parameters corresponding to the cooking step are preserved, and the cooking step can be restarted by sending the Start Op Code.

As specified in Section 3.4.2, if the Cooking Step Status characteristic is configured for notifications through the Client Characteristic Configuration Descriptor, then the CWS must send Cooking Step Status characteristic notifications for the cooking step that is being stopped.

3.3.2.4 Delete Op Code

The CWD shall support the deletion of the cooking step stored in the CWS.

If the write request is received with the Delete Op Code and the Cooking Step Index field is equal to the Cooking Step Index of the cooking step being executed, then the CWS shall send the Cooking Zone Desired Cooking Conditions characteristic indication to remove power from the Cooking Zone (see Section 3.6) and delete the corresponding Recipe Parameters characteristic value.

As specified in Section 3.4.2, if the Cooking Step Status characteristic is configured for notifications through the Client Characteristic Configuration Descriptor, then the CWS must send Cooking Step Status characteristic notifications for the cooking step that has been terminated.

3.4 Cooking Step Status characteristic

The Cooking Step Status characteristic provides a way for a client to find the status of the previously started cooking step and to receive a notification when the cooking step is started or completed (e.g., when the Termination Condition specified in the Recipe Parameters characteristic is satisfied).

3.4.1 Characteristic format

The Cooking Step Status characteristic format is defined in GSS [1].

3.4.2 Characteristic behavior

A client can read the Cooking Step Status characteristic at any time. When the Cooking Step Status characteristic is read, the Cooking Step Index field, the Last Cooking Step flag, and the User Action Required flag shall match the corresponding fields of the Recipe Parameters characteristic that was last written to the CWS; the Cooking Step Started flag shall be set to one if the execution of the cooking step has been started; the Remaining Time field shall be set to the CWD's estimation of time until the cooking step is completed.

If the Cooking Step Status characteristic is configured for notifications through the Client Characteristic Configuration descriptor, then the CWS shall notify the connected client when the execution of the cooking step has been started, paused or completed. While the execution of the cooking step is in progress, the CWS may also send notifications to the connected client periodically if the estimation of the remaining time changes. For example, while baking the cake, the estimation can change because of the size of the cake, or the accuracy of the preheating process, or if the actual power supplied by the Cooking Appliance is different than expected.

The value of the Cooking Step Index field in the Cooking Step Status characteristic notification shall match the Cooking Step Index field of the Recipe Parameters characteristic that was last written to the CWS.

When the cooking step is started, the value of the Remaining Time field shall match the value of the Duration field of the Recipe Parameters characteristic that has been last written to the CWS. When the cooking step is completed or terminated, the Remaining Time field shall be set to zero. When the cooking step is paused or is being executed, the Remaining Time field shall include the CWD estimation of the time remaining until the cooking step is completed.

The Cooking Step Started flag shall be set to one if the CWD started execution of the cooking step.

The value of the Last Cooking Step flag in the Cooking Step Status characteristic notification shall match the Last Cooking Step flag of the Recipe Parameters characteristic that has been last written to the CWS.

The value of the User Action Required flag in the Cooking Step Status characteristic notification shall match the User Action Required flag of the Recipe Parameters characteristic that has been last written to the CWS.

If the characteristic value changes while the connection to a bonded client is down, then CWS may send a notification when the connection to the client is reestablished.

3.5 Cooking Zone Capabilities characteristic

The client uses the Cooking Zone Capabilities characteristic to inform the server about the power capabilities that can be applied by the Associated Cooking Zone. Appendix B includes an example for Cooking Zone Capabilities characteristic.

3.5.1 Characteristic format

The Cooking Zone Capabilities characteristic format is defined in GSS [1].

3.5.2 Characteristic behavior

When a CWD is Associated with a Cooking Zone, the Cooking Appliance writes to the Cooking Zone Capabilities characteristic.

Some appliances allow to combine (aggregate) Cooking Zones. For example, an induction cooktop may allow to aggregate two cooking zones to apply power evenly to a large CWD. When aggregation or disaggregation of the Cooking Zones is performed while the CWD is Associated with the Cooking Zone, the Cooking Appliance writes new values to the Cooking Zone Capabilities characteristic of the CWS.

When a new value of the Cooking Zone Capabilities characteristic is written, the CWD shall use the new values to verify that the appropriate type of power source will be applied by the Cooking Zone. The CWD may also use the Cooking Zone Capabilities characteristic to detect if the Recipe Parameters characteristic (see Section 3.2) is acceptable, and to optimize the Control Loop.

3.6 Cooking Zone Desired Cooking Conditions characteristic

The Cooking Zone Desired Cooking Conditions characteristic is used by the CWD that is executing the Control Loop to request the client set the desired conditions to be applied by the Cooking Zone.

3.6.1 Characteristic format

The format of the Cooking Zone Desired Cooking Conditions characteristic matches the format of the Cooking Conditions characteristic defined in GSS [1].

3.6.2 Characteristic behavior

After a client sets or adjusts the parameters of the cooking step by writing to the Recipe Parameters characteristic, the CWD should indicate the Cooking Zone Desired Cooking Conditions characteristic to the client. The values of the fields shall be set to the values for the Cooking Zone to apply. The CWD may send as many indications as needed while executing the cooking step.

The Cooking Zone Desired Cooking Conditions characteristic allows a CWD to indicate the cooking conditions to the client, such as power level, humidity level (i.e., the amount of steam in an oven), or fan speed (for convection ovens).

The Power Level field, if present, represents the power level for the Cooking Zone to apply.

The Desired Temperature field, if present, represents the temperature level for the Cooking Zone to apply.

The Humidity field, if present, represents the relative humidity for the Cooking Zone to apply.

The Blower Fan Airflow field, if present, represents the speed for the Cooking Zone intake or recirculation blower fan relative to the maximum fan speed.

If all bits in the Flags field are set to the value of 0, then the client shall stop the cooking process.

The Manufacturer Specific Data field may be used by the client to exchange manufacturer-specific information with the CWS.

3.7 Cooking Zone Actual Cooking Conditions characteristic

The Cooking Zone Actual Cooking Conditions characteristic is used by a client (e.g., a Cooking Zone) to inform the CWD about the actual parameters that the Cooking Zone applied. The actual parameters may be different from the desired parameters requested by the CWD because of the cooking appliance load, CWD position within the cooking zone, and other factors. The actual parameters may also indicate to the CWD that the user adjusted cooking conditions manually (e.g., the power is turned off).

3.7.1 Characteristic format

The format of the Cooking Zone Actual Cooking Conditions characteristic matches the Cooking Conditions characteristic defined in GSS [1].

3.7.2 Characteristic behavior

When a client writes to the Cooking Zone Actual Cooking Conditions characteristic, the CWD may adjust its estimation of the Cooking Step Status (see Section 3.4). The CWD may also terminate execution of the Control Loop if the value of the Cooking Zone Actual Cooking Conditions characteristic is different from the requested Cooking Zone Desired Cooking Conditions.

If a Cooking Controller acts as a client for the CWS, then the user may enter the values of the actual parameters being delivered to the CWD manually and the value may not be accurate.

If present, the Power Level field represents the Cooking Appliance’s estimation of the power level that the Cooking Zone applies to the Associated CWD. The value of the Power Level field of the Cooking Zone Actual Cooking Conditions may differ from the value of the Power Level field of the Cooking Zone Desired Cooking Conditions characteristic because of the Cooking Zone Capabilities characteristic, position of the CWD within the Cooking Zone, and other factors.

If present, the Temperature field represents the Cooking Appliance’s measured temperature in the Cooking Zone.

If present, the Humidity field represents the Cooking Appliance’s estimation of the relative humidity level that the Cooking Zone applies to the Associated CWD.

If present, the Blower Fan Airflow field represents the airflow of the Cooking Zone intake or recirculation blower fan relative to the maximum fan speed.

The Manufacturer Specific Data field may be used by the Cookware Server to exchange manufacturer-specific information with a client.

3.8 Cookware Sensor Data characteristic

The Cookware Sensor Data characteristic allows a client to read or receive notifications about measured value and operational status of a particular CWD sensor.

The type of data presented by the sensor (e.g., temperature or pressure) is defined by the UUID field of the Sensor Info descriptor (see Section 3.8.3.1). The list of the sensor types permitted to be present in the CWS is defined in the Cookware Service section in [4].

3.8.1 Characteristic format

The format of the Cookware Sensor Data characteristic is defined in Table 3.15.

Field	Data Type	Size (in octets)	Field Requirement
Sensor Status	uint8	1	M
Sensor Data	variable	variable	M

Table 3.15: Cookware Sensor Data characteristic format

3.8.1.1 Sensor Status field

The Sensor Status field is a 1-octet bit field that identifies the sensor status and errors.

The value of the Sensor Status field is used to indicate to a client if there is an error in the sensor and the error type. The zero value of the Sensor Status field (i.e., when all bits are cleared) indicates that there are no errors and that the Sensor Data field value is correct. If any of the bits specified in Table 3.16 are set, then the Sensor Data field value may not be accurate.

Bit field	Description
Bit 0	Measured value is out of range
Bit 1	Sensor detected internal error
Bit 2 to 7	RFU

Table 3.16: Sensor Status field format

3.8.1.2 Sensor Data field

The Sensor Data field value identifies the value as measured by the CWD’s sensor. The type of the sensor is defined by the UUID field of the Cooking Sensor Info descriptor (see Section 3.8.3.1). The format and size of the Sensor Data field is defined in [1].

3.8.2 Characteristic behavior

The client can read the Cookware Sensor Data characteristic value at any time. When the characteristic value is read, the CWS shall report the most recent measurement value and sensor status.

If notifications are supported, and if the Cookware Sensor Data characteristic is configured for notifications through the Client Characteristic Configuration descriptor, and if a measurement is available, then the Cookware Sensor Data characteristic shall be notified according to the Cooking Trigger Settings descriptor (see Section 3.8.3.2) while in a connection with the client.

If the characteristic value changes while the connection to a client is down, then the CWS may send a notification when the connection to the bonded client is reestablished.

3.8.3 Characteristic descriptors

This section defines the requirements for the descriptors associated with the Cookware Sensor Data characteristic. Mandatory and optional descriptors of the Cookware Sensor Data characteristic are defined in Table 3.17. The CWS may include descriptors that are not present in Table 3.17.

Descriptor	Requirement	Mandatory Properties	Optional Properties
Cooking Sensor Info	M	Read	-
Cooking Trigger Settings	M	Read	Write
Client Characteristic Configuration	M	Read, Write	-
Valid Range	O	Read	-

Table 3.17: Cookware Sensor Data characteristic descriptors

3.8.3.1 Cooking Sensor Info descriptor

The Cooking Sensor Info descriptor is a mandatory read-only descriptor used to provide clients with details about a sensor's properties and its location. Only one Cooking Sensor Info descriptor declaration shall exist in a characteristic definition. The format of the Cooking Sensor Info descriptor is defined in Table 3.18. Appendix A includes sample data for the several types of CWDs.

Field	Data Type	Size (in octets)	Field Requirement
UUID	uint16	2	M
Measurement Uncertainty	uint8	1	M
Sensor Location	struct	Variable	M
Aggregate Offset	uint16	2	C.1

Table 3.18: Cookware Sensor Info descriptor

C.1: Mandatory if the Cookware Sensor Aggregate characteristic is present, otherwise Excluded.

3.8.3.1.1 UUID field

The UUID field of the Sensor Info descriptor identifies the type and the format of the data included in the Sensor Data field of the Cookware Sensor Data characteristic.

Permitted Sensor Data field types are defined in the Cookware Service section in [4]. For example, for the temperature sensor, the UUID field of the Cookware Sensor Info descriptor will contain the UUID of the Cooking Temperature characteristic (see [1]) and the Sensor Data field of the Cookware Sensor Data characteristic will represent the temperature measured by the sensor. Similarly, for the pressure sensor, the UUID field will contain the UUID of the Pressure characteristic. For the humidity sensor, the UUID field will contain the UUID of the Humidity characteristic.

3.8.3.1.2 Measurement Uncertainty field

The Measurement Uncertainly field value represents the sensor uncertainty from the actual value in percentage increments of 0.1%. The values range from 0% (0x00) to 25.4% (0xFE). 0xFF indicates unknown or N/A.

3.8.3.1.3 Sensor Location field

The Sensor Location field describes the location where the sensor is installed on the cookware. The format of the field is defined in Table 3.19.

Field	Size (in octets)
Location Type	1
Location Data Size	1
Location Data	variable

Table 3.19: Sensor Location field format

The first octet of the Sensor Location field defines the type of location (see Table 3.20), for example, on the lid or on the side of the vessel. The Location Type field defines whether the Location Data field is present and how the Location Data field is interpreted. For example, if the Location Type field is set to 0x01 (Vessel side), then the Location Data Size field is set to 2, and the Location Data field contains a 2-octet value that identifies the distance from the bottom of the vessel.

Location Type	Description	Location Data Size (in octets)	Location Data
0x00	RFU	N/A	N/A
0x01	Vessel side	2	uint16 – distance from the bottom in mm
0x02	Vessel bottom	2	uint16 – distance from the center in mm
0x03	Grill plate	2	uint16 – distance from the center in mm
0x04	Lid	2	uint16 – distance from the center in mm
0x05	Probe food core	2	uint16 – mm from the tip
0x06	Probe ambient	2	uint16 – mm from the tip
0x07	Handle	0	N/A
0x08	Electronics/Battery	0	N/A
0x09 to 0xFE	RFU	variable	N/A
0xFF	Other/Unknown	N/A	N/A

Table 3.20: Sensor Location location type and location data

3.8.3.1.4 Aggregate Offset field

The Cookware Sensor Aggregate characteristic value (see Section 3.9) is a byte array that represents concatenation of Cookware Sensor Data characteristics from the CWD sensors. The Aggregate Offset field of the Cooking Sensor Info descriptor is a uint16 value that identifies the offset in octets where the Cookware Sensor Data characteristic value will be present in the Cookware Sensor Aggregate characteristic value byte array.

The Aggregate Offset field should increment in a way that the order of values in the Cookware Sensor Data characteristic matches the order in which the corresponding Cookware Sensor Data characteristics appear in the CWD GATT database. For example, if a CWD includes two temperature sensors (with a Sensor Data field size of 2 octets), the value of the Aggregate Offset field of the sensor that appears in the GATT database first will be set to 0. The value of the Aggregate Offset field of the sensor that appears in the GATT database second will be set to 3.

Special value 0xFFFF indicates that the Cookware Sensor Data characteristic value for this sensor is not included in the Cookware Sensor Aggregate characteristic value.

The Aggregate Offset field is present only if the Cookware Sensor Aggregate characteristic is present.

3.8.3.2 Cooking Trigger Settings descriptor

The Cooking Trigger Settings descriptor value indicates to the client the rules that the Cookware Server uses to send the Cookware Sensor Data characteristic notifications. The Cookware Server may also allow the client to control the timing when the Server sends the sensor notifications by writing to the Cooking Trigger Settings descriptor.

The Cooking Trigger Settings configuration allows a periodic transmission interval, a transmission based on the value changes of the sensor data, or a combination of the two.

When a combination of periodic transmission interval and value change is selected, the Cookware Server sends a notification when the interval expires, or when the measured value has changed more than the specified delta threshold. Either of the notifications causes the reset of the time counter of the periodic notifications.

Figure 3.7 shows an example of a time diagram of the CWS sending notifications based on the Cooking Trigger Settings with Interval (T) and Delta (D). The notifications are shown on the figure as dots, and they are numbered 1-9. The notifications 1, 2, 3, 7, 8, and 9 are caused by the Interval expiry. Notifications 4, 5, and 6 are caused by the difference in the measured value being more than the Delta.

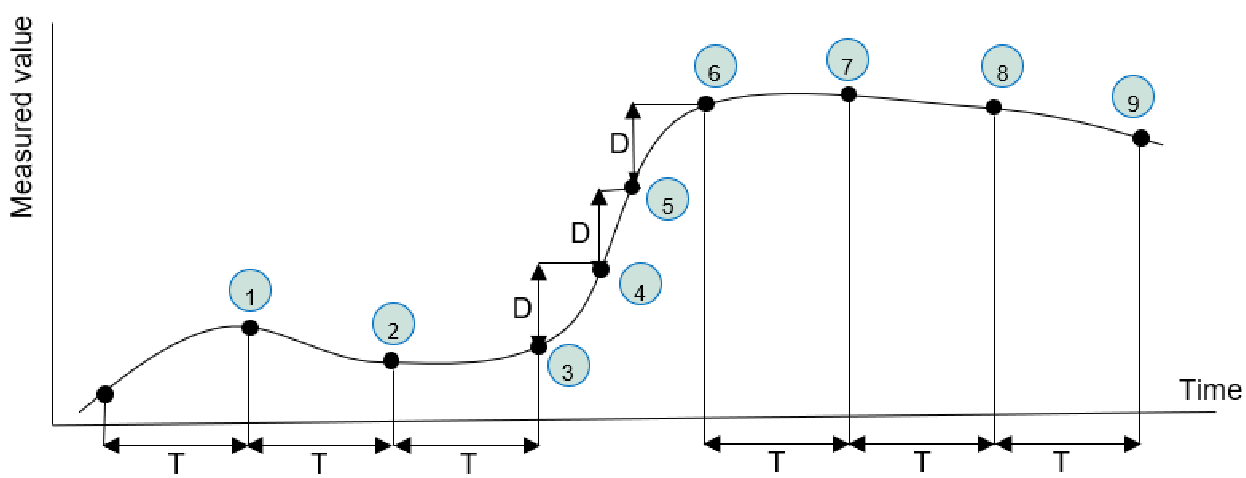

Figure 3.7: Cooking Trigger Settings example

One instance of the Cooking Trigger Settings descriptor shall be defined for each Cookware Sensor Data characteristic.

Table 3.21 defines the format for the Cooking Trigger Settings fields.

Field	Data Type	Size (in octets)	Field Requirement
Interval	uint16	2	M
Delta	variable	variable	M

Table 3.21: Cooking Trigger Settings descriptor format

3.8.3.2.1 Interval field

Setting the Interval field to a non-zero value will cause the Cookware Server to periodically send a notification for the corresponding Cookware Sensor Data characteristic.

The time interval is expressed in multiples of 100 milliseconds (ms). The Interval field may be set from 100 ms to 6553.5 seconds.

A value of 0 disables periodic notifications for this sensor.

The default value for the Interval field shall be zero.

3.8.3.2.2 Delta field

CWS notifies the Cookware Sensor Data characteristic when the absolute value changes by greater than or equal to a specified threshold since the previous notification to the same characteristic.

The format of the field is the same as the format of the Sensor Data field of the Cookware Sensor Data characteristic of this descriptor.

A value of 0 disables notifications on value change. Only positive values are allowed.

The default value for the Delta field shall be zero.

3.8.3.3 Valid Range descriptor

The Valid Range descriptor is a pair of values representing the minimum and maximum values within which the CWD’s sensor can operate. The format of each of the values in the Valid Range descriptor field depends on the sensor type (see Section 3.8.3.1.1) and is defined in [1].

For example, if the sensor is a temperature sensor with the Cooking Temperature characteristic value expressed in sint16, the Range for each sensor will be 2 sint16s (i.e., 4 octets).

3.9 Cookware Sensor Aggregate characteristic

The Cookware Sensor Aggregate characteristic provides a method for a client to read or be notified about a batch of all sensor measurement data at once.

3.9.1 Characteristic format

The format of the Cookware Sensor Aggregate characteristic is shown in Table 3.22. The ellipses (…) in Table 3.22 indicate that there may be multiple rows depending on the value of N.

Field	Data Type	Size (in octets)	Description
Cookware Sensor Data 1	struct	variable	Value of the Cookware Sensor Data characteristic corresponding to the first sensor. Structure of the field matches the Cookware Sensor Data characteristic defined in Section 3.8.1.
…	…	…	…
Cookware Sensor Data N	struct	variable	Value of the Cookware Sensor Data characteristic corresponding to the Nth sensor. Structure of the field matches the Cookware Sensor Data characteristic defined in Section 3.8.1.

Table 3.22: Cookware Sensor Aggregate characteristic format

3.9.1.1 Cookware Sensor Data field

Each Cookware Sensor Data field of the Cookware Sensor Aggregate characteristic exactly matches the value of the corresponding Cookware Sensor Data characteristic (see Section 3.8).

3.9.2 Characteristic behavior

The client can read the Cookware Sensor Aggregate characteristic value at any time. When the characteristic value is read, the Cookware Server shall report the value corresponding to the most recent values of each of the Cookware Sensor Data characteristics.

If the Cookware Sensor Aggregate characteristic is configured for notification through the Client Characteristic Configuration descriptor, then the characteristic shall be notified while in a connection with the client. The timing of the notifications is set by the Cooking Trigger Settings descriptor of each Cookware Sensor Data characteristic participating in the aggregation. Therefore, if the condition of any CWD sensor requires notification, the whole Cookware Sensor Aggregate characteristic is notified.

4 SDP interoperability

If the Cookware Service is exposed over Basic Rate/Enhanced Data Rate (BR/EDR), then it shall have the Service Discovery Protocol (SDP) record defined in Table 4.1:

Item	Definition	Type	Value	Status
Service Class ID List	-	-	-	M
Service Class #0	-	UUID	«Cookware Service»	M
Protocol Descriptor List	-	-	-	M
Protocol #0	-	UUID	L2CAP	M
Parameter #0 for Protocol #0	Protocol/Service Multiplexer (PSM)	Uint16	PSM = ATT	M
Protocol #1	-	UUID	ATT	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

Acronym/Abbreviation	**Meaning**
ATT	Attribute Protocol
BR/EDR	Basic Rate/Enhanced Data Rate
CSS	Core Specification Supplement
CWD	Cookware Device
CWS	Cookware Service
GATT	Generic Attribute Profile
GSS	GATT Specification Supplement
J/K	joules per Kelvin
LSO	least significant octet
MSO	most significant octet
PDU	Protocol Data Unit
PSM	Protocol/Service Multiplexer
RFU	Reserved for Future Use
SDP	Service Discovery Protocol
UUID	Universally Unique Identifier

Table 5.1: Acronyms and abbreviations

6 References

[1] GATT Specification Supplement, https://www.bluetooth.com/specifications/gss/

[2] Core Specification Supplement, Version 13 or later

[3] Bluetooth Core Specification, Version 6.1 or later

[4] Bluetooth Assigned Numbers, https://www.bluetooth.com/specifications/assigned-numbers

Appendix A Cookware device parameters example

This appendix provides sample data for Cookware Description characteristics and Cookware Sensor Info descriptors of the Cookware Sensor Data characteristics. When the Cooking Client executes the control loop, it uses these values to understand the sensor data received from the CWD.

A.1 Frying Pan

Table A.1 shows sample data for a cylindrical frying pan with a diameter of 280 mm and a height of 60 mm, and with a total capacity of 2.2 liters. The frying pan can only be used with induction cooktops and can operate with a maximum operating temperature of 350°C.

Field	Value	Description
Cookware Type	0x00	Vessel
Cookware Shape	0x00	Cylinder
Cookware Size	0x04 0x3C 0x00 0x18 0x01	Length 4 bytes Height 60 mm Diameter 280 mm
Maximum Operating Temperature	0xAC 0x0D	350.0°C
Cookware Capacity	0x16	2.2 liters
Heat Capacity	0x00	Unknown
Heating Unit Capability	0x01	Induction

Table A.1: Sample data for the Cookware Description characteristic for a frying pan

Table A.2 shows sample data for a Cookware Sensor Info descriptor for a temperature sensor located in the center of the frying pan.

Field	Value	Description
UUID	0x2C2E	Cooking Temperature characteristic
Measurement Uncertainty	0xFF	Unknown
Sensor Location	0x02 0x02 0x00 0x00	Location Type: Vessel bottom Location Size: 2 Distance from the center: 0

Table A.2: Sample data for the Cookware Sensor Info descriptor for a temperature sensor

A.2 Food Temperature Probe

This section shows sample data for a 120 mm long food temperature probe. The probe has two temperature sensors located at 5 mm and at 30 mm from the tip of the probe and can operate at a maximum temperature of 400°C. Table A.3 shows sample data for a Cookware Description characteristic for a food probe.

Field	Value	Description
Cookware Type	0x02	Probe
Cookware Shape	0x04	Stick
Cookware Size	0x02 0x78 0x00	Length 2 bytes Height 120 mm
Maximum Operating Temperature	0xA0 0x0F	400.0°C

Table A.3: Sample data for the Cookware Description characteristic for a food probe

Table A.4 shows sample data for a Cookware Sensor Info descriptor for the temperature sensor located 5 mm away from the tip of the probe.

Field	Value	Description
UUID	0x2C2E	Cooking Temperature characteristic
Measurement Uncertainty	0x32	5.0%
Sensor Location	0x05 0x02 0x05 0x00	Location Type: Probe food core Location Size: 2 Distance from the tip: 5 mm
Aggregate Offset	0x00	Offset 0 for the first sensor in the aggregate characteristic

Table A.4: Sample data for the Cookware Sensor Info descriptor for the first temperature sensor

The second sensor measures ambient temperature. It is located 30 mm from the tip of the probe. Table A.5 shows the sample data for the Cookware Sensor Info descriptor for the second temperature sensor is almost the same. The size of the Cookware Sensor Data characteristic is 3 bytes: 1 byte for the Sensor Status, and 2 bytes for the Cooking Temperature characteristic. The Aggregate Offset field is set to 3.

Field	Value	Description
UUID	0x2C2E	Cooking Temperature characteristic
Measurement Uncertainty	0x32	5.0%
Sensor Location	0x06 0x02 0x1E 0x00	Location Type: Probe ambient Location Size: 2 Distance from the tip: 30 mm
Aggregate Offset	0x03	Sensor data for this sensor is at offset 3 in the aggregate characteristic notifications

Table A.5: Sample data for Cookware Sensor Info descriptor for the second temperature sensor

Appendix B Cooking Zone Capabilities characteristics example

This appendix provides sample data for a Cooking Zone Capabilities characteristic. When CWD executes the control loop, the CWD needs to know the characteristics of the cooking zone to be able to control the appliance.

Table B.1 shows sample data for one of the cooking zones of an induction cooktop that can deliver up to 1800 W of power and up to 80% of the nominal power, regardless of other conditions in the appliance.

Field	Value	Description
Flags	0x02	The cooking zone can be controlled by setting a power level
Power Technology	0x02	Heating Induction
Number of Cooking Steps	0x01 0x00	Cooking Zone supports execution of the control loop, only one recipe step can be programmed.
Nominal Power	0x50 0x46 0x00	1800.0 W
Boost Level	0x00	Cooking zone has no boost capability
Minimum Available Power	0x20 0x03	80.0%

Table B.1: Sample data for the Cooking Zone Capabilities characteristic

Appendix C Recipe example

This section provides sample data for a recipe for frying a beef steak. The recipe consists of four steps:

1. Preheating: Heat pan to 180°C.
2. Searing: High-temperature cooking at 220°C for the first side.
3. Searing: High-temperature cooking at 220°C for the second side.
4. Final Cooking: Reduce temperature to 160°C for desired doneness.

Step 1. Preheat the pan to 180°C

The Flags field indicates that this step is not the last cooking step, and that additional user action is required when the step is completed, (i.e., the user must put the steak in the pan when the step is completed). The step is completed when the Termination Condition is satisfied. The single Termination Condition is for the Temperature to increase to a specified level.

Field	Value	Description
Flags	0x4C 0x00	Overshoot Prevention flag: 0 (fast heating) Last Cooking Step flag: 0 (not the last step) User Action Required flag: 1 (user action required) Temperature Field Present flag: 1 (present) Temperature Gradient Field Present flag: 0 (not present) Humidity Field Present flag: 0 (not present) Termination Condition Field Present flag: 1 (present)
Cooking Step Index	0x01 0x00	Step 1
Cooking Process Type	0x07	Frying
Duration	0x2C 0x01	300 seconds (5 minutes maximum)
Temperature	0x08 0x07	180.0°C
Termination Condition	0x01	Temperature Increase Condition. The cooking step is completed when the temperature is above, or increases to, the value specified in the Temperature field.

Table C.1: Step 1 of the sample recipe

Step 2. First Side Searing (220°C, 2 minutes)

The Flags field indicates that this step is not the last cooking step, and that additional user action is required when the step is completed, (i.e., the user must flip the steak when the step is completed). There is no Termination Condition field, and the step is completed after the Duration time expires.

Field	Value	Description
Flags	0x0C 0x00	Overshoot Prevention flag: 0 (fast heating) Last Cooking Step flag: 0 (not the last step) User Action Required flag: 1 (user action required) Temperature Field Present flag: 1 (present) Temperature Gradient Field Present flag: 0 (not present) Humidity Field Present flag: 0 (not present) Termination Condition Field Present flag: 0 (present)
Cooking Step Index	0x02 0x00	Step 2
Cooking Process Type	0x07	Frying
Duration	0x78 0x00	120 seconds (2 minutes)
Temperature	0x98 0x08	220.0°C

Table C.2: Step 2 of the sample recipe

Step 3. Second Side Searing (220°C, 2 minutes)

The Recipe Parameters for this step are the same as for Step 2, except that that the User Action Required flag is not set because the cooking process may continue to Step 4 without user intervention. Note that if the user wants to verify proper browning and crust, or to add herbs, butter, or garlic before Step 4, then the User Action Required flag can also be added to this step.

Field	Value	Description
Flags	0x08 0x00	Overshoot Prevention flag: 0 (fast heating) Last Cooking Step flag: 0 (not the last step) User Action Required flag: 0 (no user action required) Temperature Field Present flag: 1 (present) Temperature Gradient Field Present flag: 0 (not present) Humidity Field Present flag: 0 (not present) Termination Condition Field Present flag: 0 (not present)
Cooking Step Index	0x03 0x00	Step 3
Cooking Process Type	0x07	Frying
Duration	0x78 0x00	120 seconds (2 minutes)
Temperature	0x98 0x08	220.0°C

Table C.3: Step 3 of the sample recipe

Step 4: Final Cooking (160°C, 5 minutes)

The Flags field indicates that this is the last cooking step. There is no Termination Condition field, and the step is completed after the Duration time expires.

Field	Value	Description
Flags	0x0B 0x00	Overshoot Prevention flag: 1 (controlled heating) Last Cooking Step flag: 1 (last step) User Action Required flag: 0 (no user action required) Temperature Field resent flag: 1 (present) Temperature Gradient Field Present flag: 0 (not present) Humidity Field Present flag: 0 (not present): Termination Condition Field Present flag: 0 (not present)
Cooking Step Index	0x04 0x00	Step 4
Cooking Process Type	0x03	Braising (slow cooking)
Duration	0x2C 0x01	300 seconds (5 minutes)
Temperature	0xA0 0x00	160.0°C

Table C.4: Step 4 of the sample recipe