OCF 2.0 – Z-Wave Translation – Bridging TG CR 2478

Legal Disclaimer

2 Normative references

Z-Wave Application Command Class Specification

http://zwavepublic.com/sites/default/files/command_class_specs_2017A/SDS13781-5%20Z-Wave%20Application%20Command%20Class%20Specification.pdf

Z-Wave Management Command Class Specification

http://zwavepublic.com/sites/default/files/command_class_specs_2017A/SDS13782-5%20Z-Wave%20Management%20Command%20Class%20Specification.pdf

Z-Wave Plus Device Type Specification

http://zwavepublic.com/sites/default/files/sds11847-21_z-wave_plus_device_type_specification.pdf

Z-Wave Plus Role Type Specification

http://zwavepublic.com/sites/default/files/command_class_specs_2017A/SDS11846-20%20Z-Wave%20Plus%20Role%20Type%20Specification.pdf

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

3.1.1 Bridged Protocol

another protocol (e.g., AllJoyn, Zigbee, Z-Wave, BLE) that is being translated to or from OCF protocols

3.1.2 Command Class

a collection of commands used for controlling, querying, and reporting information corresponding to specific function supported by a Z-Wave device

9 Z-Wave Translation

9.1 Operational scenarios

The overall goals are to:

- Make Bridged Z-Wave Servers appear to OCF Clients as if they were native OCF Servers in the local network or cloud environment

"Deep translation" between specific Z-Wave device and OCF Device is specified in a separate document. "on-the-fly" translation is out of scope. (refer to section 5.1 "Deep translation" vs. "on-the-fly" of OCF Bridging Specification).

9.1.1 Overview of OCF-Z-Wave bridging

OCF Z-Wave Bridge provides the bridging function between OCF Client and Bridged Z-Wave Server. The asymmetric bridging is applied to Z-Wave translator. Z-Wave translator is performing the translation to or from a Z-Wave Protocol. Z-Wave Bridge device exposes Bridged Z-Wave Server to OCF Client and OCF Cloud. Bridged Z-Wave Server provides Z-Wave specific data via a Z-Wave protocol for Virtual Bridged Z-Wave Client. Figure 2 presents the overview of OCF Z-Wave Bridge device and its general topology.

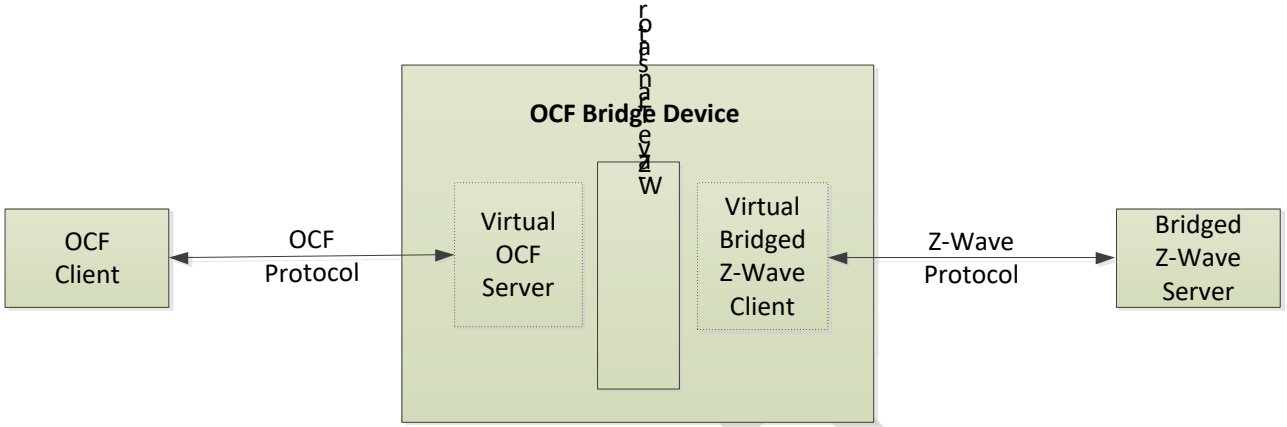

Figure 1 OCF Z-Wave Bridge Device Components

9.1.2 Use case for OCF Client and Z-Wave server

A use case for OCF Client and Z-Wave Server is presented in the Figure 3. A smartphone device acting as OCF Client is allowed to send a command for controlling, querying and reporting the information of Z-Wave devices via OCF Z-Wave Bridge device. For that, Z-Wave Server devices such as door lock with a keypad and light dimmer switch are represented as virtual OCF Z-Wave server devices on OCF Z-Wave Bridge device. Any connectivity that OCF supports is used to communicate between OCF Client and Z-Wave Bridge. Furthermore, OCF Client can also communicate with OCF Z-Wave Bridge via OCF Cloud.

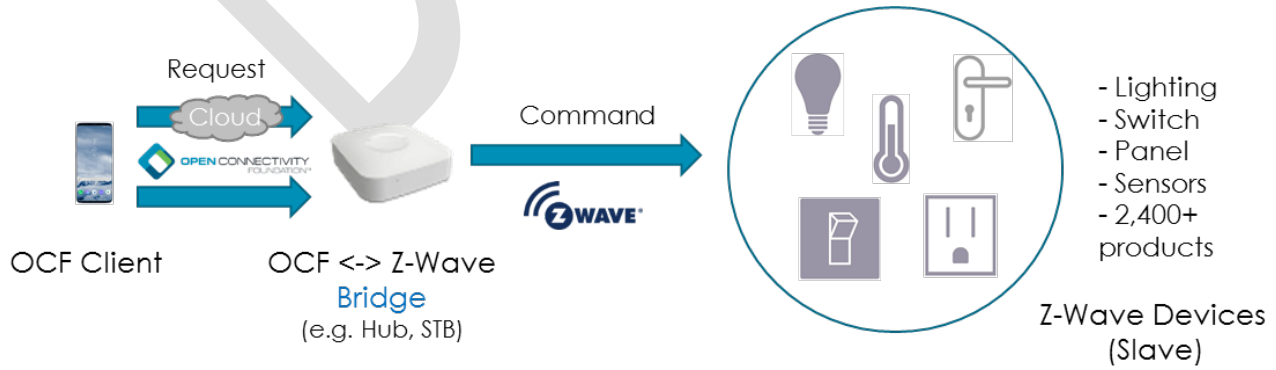

Figure 2 OCF Client and Z-Wave Server

9.2 Requirements specific to Z-Wave Translator

9.2.1 Requirements specific to a Z-Wave

The version of Z-Wave device type for the OCF Z-Wave Bridging is Z-Wave Plus. The Z-Wave Translator shall act as Z-Wave Controller which sets up and performs maintenance operation such as inclusion and exclusion of devices in a Z-Wave network.

The requirements in this section apply when using algorithmic translation, and by default apply to deep translation unless the relevant specification for such deep translation specifies otherwise.

9.2.2 Exposing Z-Wave servers to OCF clients

The translation rule between Z-Wave and OCF data model is described in Table 1. The nature of how Z-Wave devices are structured may be different than how an OCF Device is structured. For example, Light Dimmer Switch is mapped to OCF Light with the device type oic.d.light and a Sensor – Multilevel and a Sensor – Notification is mapped to OCF Sensors with the 'Device Type 'oic.d.sensor'. A Z-Wave Command Class shall be mapped to one more OCF Resources. For instance, Multilevel Switch Command Class is mapped to OCF binary switch and dimming light. Each Command Class parameter is conditionally required to be mapped to a Property of OCF Resource.

Table 1 Translation Rule between Z-Wave and OCF data model

From Z-Wave	Mapping count	To OCF	Mapping count
Z- Wave Plus Device Type	n	OCF Device	1
Command Class	1	OCF Resource	n
Parameter	1	OCF Resource property	1

Table 2 is a mapping example of this rule.

Table 2 Z-Wave → OCF mapping example (Light Dimmer Switch)

Z-Wave		OCF	
Z- Wave Plus Device Type	Light Dimmer Switch	**OCF Device**	oic.d.light (Light)
Command Class	Multilevel Switch Command Class (Multilevel Switch Set/Get/Report)	**OCF Resource(s)**	oic.r.switch.binary (Value)
			oic.r.light.dimming (dimmingSetting)
	Manufacturer Specific Command Class (Manufacturer Specific Get/Report) Version Command Class (Version Get/Report)		oic.wk.d (Device) oic.wk.p (Platform)

	Z-Wave Plus Info Command Class (Z-Wave Plus Info Get/Report)		
Z-Wave Command Parameter	Value (255 or 0)	**OCF Resource Property**	Value (True or False)
	Value (1~99)		dimmingSetting (Integer)

If Z-Wave Plus device, Z-Wave Command Class, Z-Wave Command Parameter are enlisted in the well-defined set as specified in OCF Resource to Z-Wave Command Class Mapping Specification, translator shall follow the specification for translating it to OCF device, OCF resource or OCF resource property(i.e., “deep translation”).

A Z-Wave Server device shall be mapped to a single OCF Deice Type. The OCF Device Type shall be provided by using Device identifier of the Z-Wave Server device. Z-Wave translator have a table which includes the mapping information between the Z-Wave Device identifier and the OCF Device Type. Based on the table, Z-Wave Translator finds the Device Type according to the Z-Wave Device identifier.

A Z-Wave device includes one or more Z-Wave Command Class. If a Z-Wave Command Class can be mapped to resource type on a single OCF resource, there should be a single Virtual OCF Resource. Otherwise, a Z-Wave Command Class maps to multiple OCF resource, an OCF resource shall exist with an OCF Resource Type of [“oic.wk.col”] which is a Collection of links. The links in the collection are the Resources with translated Resource Types. The resource mapping between Z-Wave Server and OCF Resources is defined in the OCF Resource to Z-Wave Command Class Mapping specification. The Z-Wave Translator have a table which includes the mapping information between the identifier of Command Class and OCF Resource Type(s). After virtual Bridged Z-Wave Client and Bridged Z-Wave Server device have done the inclusion procedure as specified in the Z-wave Plus Role Type Specification, Z-Wave Translator obtains the list of Command Class identifier. Based upon the table, Z-Wave Translator finds the matched OCF Resource Types(s) according to the identifier of Z-Wave Command Class.

Since OCF Bridge Device knows all relationships between OCF Resources and Z-Wave servers, the path component of URI can be free to choose. To maintain the relationship information and URI definition is implementation specific.

If a Z-Wave operation fails, the translator shall send an appropriate OCF error response to the OCF Client, it shall construct an appropriate OCF error message (e.g., diagnostic payload if using CoAP) from the Z-Wave enumerated status value and Z-Wave error message (if any), using the form "<error name>: <error message>", with the <error name> and <error message> taken from the Z-Wave error message, ,and the error code for the OCF network set to an appropriate value.

9.2.2.1 Translation for well-defined set

Table 5 is the list of Z-Wave Plus device type which have corresponding OCF Recourses. Translation should be done as follows in the table if the Z-Wave Plus device type supports deep translation which is aligned with the OCF Device Specification.

Table 3 Z-Wave Device & Command Class – OCF Device & Resource mapping

Z- Wave Plus Device	Z-Wave Command Class	OCF Resource Type	OCF Device Type	OCF Device Name

Light Dimmer Switch	Multilevel Switch Command Class	oic.r.switch.binary	oic.d.light	Light
	Multilevel Switch Command Class	oic.r.light.dimming		
	Manufacturer Specific Command Class	oic.wk.d		
	Version Command Class Z-Wave Plus Info Command Class	oic.wk.p		
Door Lock – Keypad	Door Lock Command Class	oic.r.lock.status	oic.d.smartlock	Smart Lock
	Battery Command Class	oic.r.energy.battery.		
	Manufacturer Specific Command Class	oic.wk.d		
	Version Command Class Z-Wave Plus Info Command Class	oic.wk.p		
On/Off Power Switch	Binary Switch Command Class	oic.r.switch.binary	oic.d.switch	Switch
	Battery Command Class	oic.r.energy.battery.		
	Manufacturer Specific Command Class	oic.wk.d		
	Version Command Class Z-Wave Plus Info Command Class	oic.wk.p		
Sensor - Multilevel	Multilevel Sensor Command Class	oic.r.sensor	oic.d.sensor	Generic Sensor
	Battery Command Class	oic.r.energy.battery.		
	Manufacturer Specific Command Class	oic.wk.d		
	Version Command Class Z-Wave Plus Info Command Class	oic.wk.p		
Sensor - Notification	Notification Command Class	oic.r.sensor	oic.d.sensor	Generic Sensor
	Battery Command Class	oic.r.energy.battery.		
	Manufacturer Specific Command Class	oic.wk.d		
	Version Command Class Z-Wave Plus Info Command Class	oic.wk.p		

9.2.2.1.1 Exposing a Z-Wave Server as a Virtual OCF Server

Table 4 shows how OCF Device properties, as specified in Table 20 in the OCF Core Specification, shall be derived, typically from fields of Command Parameter of Z-Wave Command Classes specified in the Z-Wave Command Class specifications

The value of the “di” property of OCF Devices (including Virtual OCF Devices) shall be established as part of Onboarding of that Virtual OCF Device.

Table 4 oic.wk.d Resource Type definition

To OCF Property title	OCF Property name	OCF Description	OCF Mandatory	From Z-Wave Field name	Z-Wave Description	Z-Wave Mandatory*
(Device) Name	n	Human friendly name For example, “Bob’s Thermostat”	Y	Translate Product ID to Human friendly name based upon the Product ID/product name table within Z-Wave Controller	Product ID: a unique ID identifying the actual product. A specific Product ID MUST be defined by the manufacturer for each product of a given product type Defined in Manufacturer Specific Command Class	Product ID: Y
Spec Version	icv	Spec version of the core specification this device is implemented to, The syntax is "core.major.minor”]	Y	(none)	Translator should return its own value	
Device ID	di	Unique identifier for Device. This value shall be as defined in OCF Security Specification for DeviceID.	Y	(none)	Use as defined in the OCF Security Specification	:
Protocol-Independent ID	piid	Unique identifier for OCF Device (UUID)	Y	(none)	Translator should return a random-generated UUID as specified in the section 4.4 of IETF RFC 4122	
Data Model Version	dmv	Spec version(s) of the vertical specifications this device data model is implemented to. The syntax is a comma separated list of "<vertical>.major.minor”]. <vertical> is the name of the vertical (i.e. sh for Smart Home)	Y	(none)	Translator should return its own value	
Localized Descriptions	ld	Detailed description of the Device, in one or more languages. This property is an array of objects where each object has a ‘language’ field (containing an RFC 5646 language tag) and a ‘value’ field containing the device description in the indicated language.	N	(none)		
Software Version	sv	Version of the device software.	N	Firmware 0 Version	Dedicated to the Z-Wave chip firmware. The manufacturer MUST assign a version	N

					number Defined in Version Command Class	
Manufacturer Name	dmn	Name of manufacturer of the Device, in one or more languages. This property is an array of objects where each object has a 'language' field (containing an RFC 5646 language tag) and a 'value' field containing the manufacturer name in the indicated language.	N	Translate Manufacturer ID to Human friendly name based upon the Manufacturer ID/Manufacturer name table within Z-Wave Controller	Manufacturer ID: the unique ID identifying the manufacturer of the device. Defined in Manufacturer Specific Command Class	Y
Model Number	dmno	Model number as designated by manufacturer.	N	Product ID	A unique ID identifying the actual product. A specific Product ID MUST be defined by the manufacturer for each product of a given product type Defined in Manufacturer Specific Command Class	Y

Table 5 shows how OCF Device Configuration properties, as specified in Table 15 in OCF Core Specification, shall be derived:

Table 5 oic.wk.con Resource Type definition

To OCF Property title	OCF Property name	OCF Description	OCF Mandatory	From Z-Wave Field name	Z-Wave Description	Z-Wave Mandatory*
(Device) Name	n	Human friendly name For example, "Bob's Thermostat"	Y	Translate Product ID to Human friendly name based upon the Product ID/product name table within Z-Wave Controller	Product ID: a unique ID identifying the actual product. A specific Product ID MUST be defined by the manufacturer for each product of a given product type Defined in Manufaturer Specific Command Class	Product ID: Y
Location	loc	Provides location information where available.	N	(none)		
Location Name	locn	Human friendly name for location For example, "Living Room".	N	(none)		
Currency	c	Indicates the currency that is used for any monetary transactions	N	(none)		
Region	r	Free form text Indicating the current region in which the device is located geographically. The free form text shall not start with a quote (").	N	(none)		

Localized Names	ln	Human-friendly name of the Device, in one or more languages. This property is an array of objects where each object has a 'language' field (containing an RFC 5646 language tag) and a 'value' field containing the device name in the indicated language. If this property and the Device Name (n) property are both supported, the Device Name (n) value shall be included in this array.	N	Translate Product ID to Human friendly name based upon the Product ID/product name table within Z-Wave Controller	Product ID: a unique ID identifying the actual product. A specific Product ID MUST be defined by the manufacturer for each product of a given product type Defined in Manufacturer Specific Command Class	Product ID: Y
Default Language	dl	The default language supported by the Device, specified as an RFC 5646 language tag. By default, clients can treat any string property as being in this language unless the property specifies otherwise.	N	Language	Specify the language settings on a device Defined in Language Command Class	N

Table 6 shows how OCF Platform properties, as specified in Table 21 in the OCF Core Specification, shall be derived, typically from fields of Command Parameter of Z-Wave Command Class specified in the Z-Wave Command Class specifications.

Table 6 oic.wk.p Resource Type definition

To OCF Property title	OCF Property name	OCF Description	OCF Mandatory	From Z-Wave Field name	Z-Wave Description	Z-Wave Mandatory *
Platform ID	pi	Unique identifier for the physical platform (UIUID); this shall be a UUID in accordance with IETF RFC 4122. It is recommended that the UUID be created using the random generation scheme (version 4 UUID) specific in the RFC.	Y	(none)	Translator should return a random-generated UUID as specified in the section 4.4 of IETF RFC 4122.	
Manufacturer Name	mnmn	Name of manufacturer (not to exceed 16 characters)	Y	Translate Manufacturer ID to Human friendly name based upon the Manufacturer ID/Manufacturer name table within Z-Wave Controller	Manufacturer ID: the unique ID identifying the manufacturer of the device. Defined in Manufacturer Specific Command Class	Y
Manufacturer Details Link (URL)	mnml	URL to manufacturer (not to exceed 32 characters)	N	(none)		
Model Number	mnmo	Model number as designated by manufacturer	N	Product ID	A unique ID identifying the actual product.	Y

					A specific Product ID MUST be defined by the manufacturer for each product of a given product type Defined in Manufacturer Specific Command Class	
Date of Manufacture	mndt	Manufacturing date of device	N	(none)		
Platform Version	mnpv	Version of platform – string (defined by manufacturer)	N	(none)		
OS Version	mnos	Version of platform resident OS – string (defined by manufacturer)	N	(none)		
Hardware Version	mnhw	Version of platform hardware	N	Hardware Version	A value which is unique to this particular version of the product Defined in Version Command Class	Y
Firmware version	mnfv	Version of device firmware	N	Firmware 0 Version	Dedicated to the Z-Wave chip firmware. The manufacturer MUST assign a version number Defined in Version Command Class	N
Support link	mnsl	URI that points to support information from manufacturer	N	(none)		
SystemTime	st	Reference time for the device	N	(none)		
Vendor ID	vid	Vendor defined string for the platform. The string is freeform and up to the vendor on what text to populate it.	N	(none)		

9.2.2.2 On-the-fly Translation

If a Z-Wave Plus device type is not in a well-defined set, a Z-Wave Translator SHALL NOT translate it.

9.2.3 Security

OCF Z-Wave Bridge device inherits section 5.2 for general security requirements.

9.2.3.1 Blocking communication of Bridged Z-Wave Devices with the OCF ecosystem

A Bridge shall be able to block the communication of all OCF Devices with all Bridged Z-Wave Devices that don't communicate securely with the Bridge

Z-Wave currently supports two kinds of security class which are S0 Security Class and S2 Security Class. While OCF allows OCF clients to securely communicate with Bridged Z-Wave Servers, Bridged Z-Wave Servers which the inclusion by the Virtual Z-Wave Client were processed should be set to S2 Security Class to have a corresponding Virtual OCF Server.

Figure 3 presents how OCF Client and Bridged Z-Wave Server communicate based upon their own security.

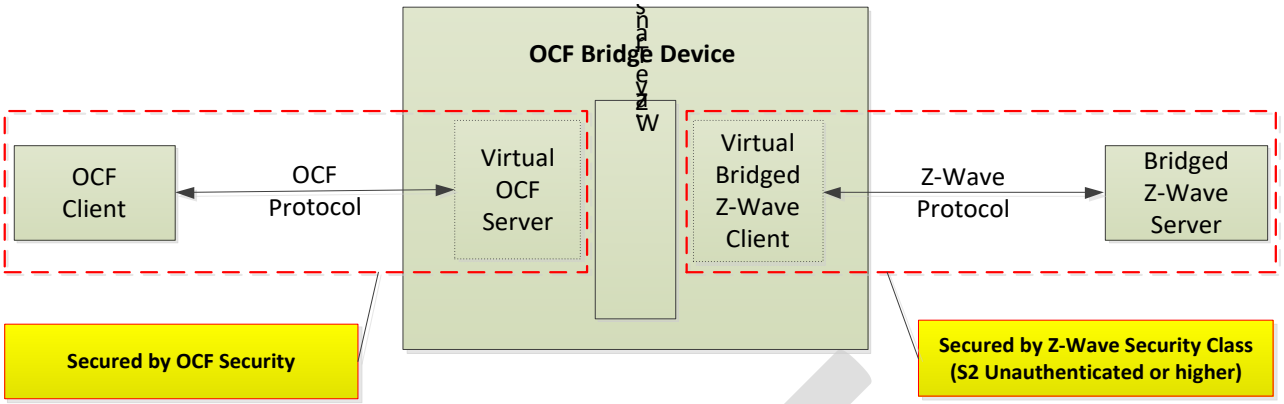

Figure 3 Security between OCF Client and Bridged Z-Wave Server

All 3 types of S2 Security Class such as S2 Access Control, S2 Authenticated and S2 Unauthenticated provides the following advantages from the security perspective;

- The unique device specific key for every secure device enables validation of device identity and prevents man-in-the-middle compromises to security
- The Secure cryptographic key exchange methods during inclusion achieves high level of security between the Virtual Z-Wave Client and the Bridged Z-Wave Server.
- Out of band key exchange for product authentication which is combined with device specific key prevents eavesdropping and man-in-the-middle attack vectors.

Table 7 Z-Wave Security Class

Security Class	Class Name	Validation of device identity	Key Exchange	Message Encapsulation
S2	S2 Access Control	Device Specific key	Out-of-band inclusion	Encrypted command transmission
	S2 Authenticated	Device Specific key	Out-of-band inclusion	Encrypted command transmission
	S2 Unauthenticated	Device Specific key	Z-wave RF band used for inclusion	Encrypted command transmission
S0	S0 Authenticated	N/A	Z-wave RF band used for inclusion	Encrypted command transmission

On the other hand, S0 Security Class has the vulnerability of security during inclusion by exchanging of temporary ‘well-known key’ (e.g. 1234). As a result of that, it may lead the disclosure of the network key if the log of key exchange methods is captured, so Z-Wave devices might be no longer secure in that case.

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