# Software Design Specification

## Z-Wave Management Command Class Specification

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|---|---|
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| **Description:** | The document describes the Z-Wave Command Classes and associated Commands used by Z-Wave enabled products at the Operation and Management level. |
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## REVISION RECORD

| Doc. Rev | Date | By | Pages affected | Brief description of changes |
|---|---|---|---|---|
| 1 | 20170102 | NOBRIOT | ALL<br><br>4.6 to 4.8<br>4.14 & 4.15<br>4.19<br>4.22& 4.23<br>4.26 | Transferred content from [2] and [3]<br>Integrated approved content from Open Review 2016C and 2016D<br>-　　AGI Command Class<br>-　　Multi Channel Association Command Class<br>-　　Version Command Class<br>-　　Wake Up Command Class<br>-　　Z-Wave Plus Info Command Class |
| 2 | 20170403 | NOBRIOT | Various<br>4.21 | Integrated approved content from Open Review 2017A<br>Added Version Command Class, version 3 |
| 3 | 20170702 | NOBRIOT | Various<br>4.10 & 4.24 | Integrated approved content from Open Review 2017B<br>Moved IP Association and Z/IP Naming and Location from [17] |
| 4 | 20171002 | NOBRIOT | Various | Integrated approved content from Open Review 2017C |

# Table of Contents

# Table of Figures

# Table of Tables

# 1 ABBREVIATIONS

| Abbreviation | Explanation |
| --- | --- |
| AGI | Association Group Information |
| API | Application Programming Interface |
| ASCII | American Standard Code for Information Interchange. An ASCII code is the numerical representation of a character. |
| CRC | Cyclic Redundancy Check |
| DHCP | Dynamic Host Configuration Protocol. |
| DNS | Dynamic Host Service |
| ID | Identifier |
| IP | Internet Protocol |
| IPV4 | Internet Protocol version 4 |
| IPV6 | Internet Protocol version 6 |
| LF | Linefeed character. |
| LSB | Less Significant Bit |
| MSB | Most Significant Bit |
| NIF | Node Information Frame |
| PIR | Pyroelectric Infrared |
| SUC | Static Update Controller |
| Unicode | Unicode is a standard for encoding of characters. For more information, visit http://www.unicode.org/ |
| Z/IP | Z-Wave for IP |

## 2 INTRODUCTION

Commands classes are divided in four categories:

- Application Command Classes [16]
- Management Command Classes
- Transport-Encapsulation Command Classes [15]
- Network-Protocol Command Classes [17]

The list of defined Command Classes with their associated category is available in [14].

This document describes the Command Classes designed for node management specific purposes. Management command classes are used for service and capabilities discovery, as well as battery management or node associations.

### 2.1 Precedence of definitions

Device Class, Device Type and Command Class Specifications approved as final version during the Device Class, Device Type and Command Class Open Review process have precedence over this document until integrated into this document.

### 2.2 Terms used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document MUST be interpreted as described in IETF RFC 2119 [6].

Statements containing the IETF RFC 2119 [6] key words are at times marked with unique requirement numbers in the margin. The requirements numbers have the following syntax: CC:xxxx.xx.xx.xx.xxx with each x being an hexadecimal digit.

This document defines functionality as deprecated or obsoleted.

The term "obsolete" means that the functionality MUST NOT be supported in new implementations applying for certification.

A controller SHOULD provide controlling capabilities of the actual functionality for backwards compatibility with legacy devices.

The term "deprecated" also indicates an obsolete definition, but it permits new implementations applying for certification.

Thus, the term "deprecated" means that the functionality SHOULD NOT be supported in new implementations applying for certification. Often, another substitute functionality is REQUIRED if the deprecated functionality is implemented.

A controller SHOULD provide controlling capabilities of the actual functionality for backwards compatibility with legacy devices.

# 3   COMMAND CLASS OVERVIEW

General command class overview and rules are described in the Z-Wave Application Command Class Specification [16] and are valid for the Command Classes presented in this document.

No additional considerations apply for the Management Command Classes.

# 4   COMMAND CLASS DEFINITIONS

The following subchapters contain definitions of Management Command Classes.

### 4.1    Application Capability Command Class, version 1

The Application Capability Command Class comprises commands for handling issues related to dynamic support for command classes.
Examples include nodes, which only support certain command classes when included securely, and controllers that only support command classes for primary controllers when they are actually operating as primary controllers.

The intention of the Application Capability Command Class is to provide tools for handling exceptions. Controlling nodes SHOULD maintain a local representation of supported command classes by destination nodes rather than relying on destination nodes returning Application Capability messages.

Destination nodes capable of returning Application Capability messages MUST list Application Capability Command Class as supported only.

### 4.1.1    Not Supported Command Class Command

The Not Supported Command Class Command is used by a node to indicate to a requesting node that the requested command class is not supported. The offending command and command class are encapsulated.

A node SHOULD use this command to indicate to other nodes that a command is not supported.

A node receiving this command SHOULD use the information to clean up internal states by requesting up-to-date information on command class support from the sending node using Node Information frame. This includes adjusting user interface details accordingly.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_APPLICATION_CAPABILITY | | | | | | | |
| Command = COMMAND_COMMAND_CLASS_NOT_SUPPORTED | | | | | | | |
| Dyna-mic | *Reserved* | | | | | | |
| Offending Command Class (0x20 – 0xEE) | | | | | | | |
| Offending Command | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_APPLICATION_CAPABILITY | | | | | | | |
| Command = COMMAND_COMMAND_CLASS_NOT_SUPPORTED | | | | | | | |
| Dyna-mic | *Reserved* | | | | | | |
| Offending Command Class MSB (0xF1 – 0xFF) | | | | | | | |
| Offending Command Class LSB (0x00 – 0xFF) | | | | | | | |
| Offending Command | | | | | | | |

Payload data following the offending command is omitted.

**Dynamic (1 bit)**

If the "Dynamic" flag is set ('1'), the sending node has been designed to support this command class but the current operational conditions prevent the node from supporting this command class.
One example is the AddNode command used for network management. This command is only supported when a controller is operating as primary controller.

| Value | Meaning |
|-------|---------|
| '0' | Command not supported (Permanently) |
| '1' | Dynamic support. (Currently no support) |

**Reserved**

This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Offending Command Class (1 or 2 bytes)**

This field indicates the offending command class received by the destination node. The size of the command class field depends on the value of the first byte.

**Offending Command (1 byte)**

This field indicates the offending command received by the destination node.

### 4.2    Application Status Command Class, version 1

This command class contains commands that are not directly related to a specific functionality in the application, but are useful for maintaining an optimal Z-Wave system.

#### 4.2.1    Compatibility Considerations

##### 4.2.1.1    Node Information Frame (NIF)

A supporting node MUST always advertise the Application Status Command Class in its NIF, regardless of the inclusion status and security bootstrapping outcome.

#### 4.2.2    Application Busy Command

The Application Busy Command used to instruct a node that the node that it is trying to communicate with is busy and is unable to service the request right now.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_APPLICATION_STATUS | | | | | | | |
| Command = APPLICATION_BUSY | | | | | | | |
| Status | | | | | | | |
| Wait Time | | | | | | | |

**Status (8 bits)**

The status field can have the following values

| Status | Description |
|---|---|
| 0 | Try again later |
| 1 | Try again in Wait Time seconds |
| 2 | Request queued, executed later |

**Wait Time (8 bits)**

The wait time field indicates the number of seconds a node should wait before retrying the request.

### 4.2.3   Application Rejected Request Command

All supported commands are typically executed unconditionally and the only handshake is acknowledgement on the protocol level. Some applications can however be in a state where the application rejects to execute a supported command. The Application Rejected Request Command used to instruct a node that the command was rejected by the application in the receiving node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_APPLICATION_STATUS | | | | | | | |
| Command = APPLICATION_REJECTED_REQUEST | | | | | | | |
| Status | | | | | | | |

**Status (8 bits)**

This field MUST be set to 0. The value 0 MUST indicate that the received (supported) command has been rejected by the application at the receiving node

### 4.3    Association Command Class, version 1

The Association Command Class is used to manage associations to NodeID destinations. A NodeID destination may be a simple device or the Root Device of a Multi Channel device.

An association group sends an unsolicited command to the configured destinations when triggered by an event. The parameters of the command may be dynamic, e.g. the temperature of a sensor reading or the light level for a dimmer.

#### 4.3.1    Compatibility considerations

CC:0085.01.00.22.001    The Association Group Information (AGI) Command Class SHOULD be supported to enable automated discovery of association group properties.

CC:0085.01.00.22.002    It is RECOMMENDED that a node which implements the Association Command Class also implements the Multi Channel Association Command Class for compatibility with End Point destinations. For instance, a wall switch may be configured to control one specific outlet of a power strip if the wall switch supports Multi Channel Association.

#### 4.3.2    Z-Wave Plus considerations

CC:0085.01.00.11.001

CC:0085.01.00.13.001

The Z-Wave Plus certification program mandates that association group 1 is reserved for the Lifeline association group. Association group 1 MUST NOT be assigned to any other use than the Lifeline group. The actual Device Type of a given product specifies mandatory commands which the device must be able to send to a lifeline group destination. A manufacturer MAY add additional commands to the Lifeline group.

The Z-Wave Plus certification program mandates support for the Association Group Information (AGI) Command Class if a device supports the Association Command Class.

The Z-Wave Plus certification program recommends that a composite device is designed as a Multi Channel device.

#### 4.3.3    Security considerations

CC:0085.01.00.41.001    A node which has been S0/S2 bootstrapped MUST NOT accept Association commands unless the commands are received via the highest security key granted to the node during bootstrapping.

### 4.3.4 Association Set Command

This command is used to add destinations to a given association group.

CC:0085.01.01.12.001
CC:0085.01.01.13.001
The receiving node SHOULD add the specified NodeID destinations to the specified association group. This command MAY be ignored if the association group is already full.

CC:0085.01.01.11.001
Routing slaves MUST have return routes assigned to all association destinations.

CC:0085.01.01.51.001
Unless the association destination is a gateway, a controlling node MUST NOT create an association if the association destination node does not support the controlling commands (Set/Get types) that the actual association group will be sending. The AGI Command Class MUST be used to probe the

CC:0085.01.01.51.002
commands that a given association group will be sending.

CC:0085.01.01.52.001
A controlling node SHOULD NOT create an association if the source and destination nodes are bootstrapped with different security levels.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_SET | | | | | | | |
| Grouping Identifier | | | | | | | |
| NodeID 1 | | | | | | | |
| .. | | | | | | | |
| NodeID N | | | | | | | |

**Grouping Identifier (8 bits)**

CC:0085.01.01.11.002
This field is used to specify the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

CC:0085.01.01.11.003
A receiving node MUST ignore an unsupported Grouping Identifier.

**NodeID (N bytes)**

This field specifies a list of NodeIDs that are to be added to the specified association group.

### 4.3.5    Association Get Command

This command is used to request the current destinations of a given association group.

CC:0085.01.02.11.001    The Association Report Command MUST be returned in response to this command.

CC:0085.01.02.11.002    This command MUST NOT be issued via multicast addressing.
CC:0085.01.02.11.003    A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_GET | | | | | | | |
| Grouping Identifier | | | | | | | |

**Grouping Identifier (8 bits)**

CC:0085.01.02.11.004    This field is used to specify the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

CC:0085.01.02.12.001    A node that receives an unsupported Grouping Identifier SHOULD return information relating to Grouping Identifier 1.

### 4.3.6    Association Report Command

This command is used to advertise the current destinations of a given association group.

If the node supports the Multi Channel Association Command Class,

CC:0085.01.03.11.001
- the node MUST advertise the same Node ID destinations in this report as in the Multi Channel Association Report Command

CC:0085.01.03.11.002
- the node MUST NOT advertise the NodeID of End Point destinations in this report.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_REPORT | | | | | | | |
| Grouping Identifier | | | | | | | |
| Max Nodes Supported | | | | | | | |
| Reports to Follow | | | | | | | |
| NodeID 1 | | | | | | | |
| … | | | | | | | |
| NodeID N | | | | | | | |

**Grouping Identifier (8 bits)**

CC:0085.01.03.11.003
This field is used to advertise the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

**Max Nodes Supported (8 bits)**

CC:0085.01.03.13.001
The maximum number of destinations supported by the advertised association group. Each destination MAY be a NodeID destination or an End Point destination (if the node supports the Multi Channel Association Command Class).

**Reports to Follow (8 bits)**

CC:0085.01.03.11.004
The entire list destinations of the advertised association group may be too long for one command. This field MUST advertise how many report frames will follow this report.

**NodeID (N bytes)**

CC:0085.01.03.11.005
This field advertises a list of NodeID destinations of the advertised association group. The list of NodeIDs MUST be empty if there are no NodeID destinations configured for the advertised association group.

### 4.3.7 Association Remove Command

This command is used to remove destinations from a given association group.

CC:0085.01.04.11.001 If the node supports the Multi Channel Association Command Class the node MUST NOT remove End Point destinations in response to this command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_REMOVE | | | | | | | |
| Grouping Identifier | | | | | | | |
| NodeID 1 | | | | | | | |
| … | | | | | | | |
| NodeID N | | | | | | | |

**Grouping Identifier (8 bits)**

This field is used to specify from which association group the specified NodeID destinations should be removed.

CC:0085.01.04.11.002 Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

CC:0085.01.04.11.003 This field MUST be interpreted in combination with the NodeID field.

CC:0085.01.04.11.004 A node that receives an unsupported Grouping Identifier MUST ignore this command.

**NodeID (N bytes)**

This field specifies a list of NodeID destinations that are to be removed from the specified association group.

CC:0085.01.04.11.005 The Grouping Identifier and NodeID fields MUST be interpreted as indicated in Table 1.

**Table 1, Association Remove, V1 :: Parameter interpretation**

| Grouping identifier | Number of NodeIDs | Interpretation |
|---|---|---|
| > 0 | > 0 | Remove specified NodeIDs from the specified association group (MANDATORY V1) |
| > 0 | = 0 | Remove all NodeIDs from the specified association group (RECOMMENDED V1) |
| = 0 | $\geq$ 0 | (*Reserved* V1) |

CC:0085.01.04.11.006 A sending node MUST NOT send reserved parameter combinations and a receiving node MUST ignore reserved parameter combinations.

### 4.3.8   Association Supported Groupings Get Command

This command is used to request the number of association groups that this node supports.

CC:0085.01.05.11.001    The Association Supported Groupings Report Command MUST be returned in response to this command.

CC:0085.01.05.11.002    This command MUST NOT be issued via multicast addressing.
CC:0085.01.05.11.003    A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_GROUPINGS_GET | | | | | | | |

### 4.3.9   Association Supported Groupings Report Command

This command is used to advertise the maximum number of association groups implemented by this node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_GROUPINGS_REPORT | | | | | | | |
| Supported Groupings | | | | | | | |

**Supported Groupings (8 bits)**

This field is used to advertise the number of association groups that this node supports.

CC:0085.01.06.11.001    Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

### 4.4 Association Command Class, version 2

The Association Command Class is used to manage associations to NodeID destinations. A NodeID destination may be a simple device or the Root Device of a Multi Channel device.

The following sections specify commands which were extended or added in version 2.

#### 4.4.1 Compatibility considerations

CC:0085.02.00.21.001 A device supporting this command class version MUST also support the Association Command Class, version 1.

This version introduces

- New methods for the removal of associations via the Association Remove Command
- New commands
  - Association Specific Group Get Command
  - Association Specific Group Report Command

The considerations of section 4.3.1 also apply to this version.

#### 4.4.2 Z-Wave Plus considerations

The considerations of section 4.3.2 also apply to this version.

#### 4.4.3 Security considerations

The considerations of section 4.3.3 also apply to this version.

### 4.4.4    Association Remove Command

The Association Remove Command is used to remove NodeID destinations from a given association group.

CC:0085.02.04.11.001

If the node supports the Multi Channel Association Command Class the node MUST NOT remove End Point destinations in response to this command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_REMOVE | | | | | | | |
| Grouping Identifier | | | | | | | |
| NodeID 1 | | | | | | | |
| ... | | | | | | | |
| NodeID N | | | | | | | |

**Grouping identifier (8 bits)**

This field is used to specify from which association group the specified NodeID destinations are to be removed.

CC:0085.02.04.11.002

This field MUST be interpreted in combination with the NodeID field.

CC:0085.02.04.11.003

A node that receives an unsupported Grouping Identifier MUST ignore this command; with the exception of Grouping Identifier 0, which MUST be accepted. Refer to Table 2.

**NodeID (N bytes)**

CC:0085.02.04.11.004

This field specifies a list of NodeID destinations that are to be removed. The Grouping Identifier and NodeID fields MUST be interpreted as indicated in Table 2:

**Table 2, Association Remove, V2 :: Parameter interpretation**

| Grouping identifier | Number of NodeIDs | Interpretation |
|---|---|---|
| > 0 | > 0 | Remove destination NodeIDs from association group (MANDATORY V1, MANDATORY V2) |
| > 0 | = 0 | Remove all destination NodeIDs from association group (RECOMMENDED V1, MANDATORY V2) |
| = 0 | > 0 | Remove destination NodeIDs from all association groups (*Reserved* V1, MANDATORY V2) |
| = 0 | = 0 | Remove all destination NodeIDs from all association groups (*Reserved* V1, MANDATORY V2) |

### 4.4.5    Association Specific Group Get Command

This command allows a portable controller to interactively create associations from a multi-button device to a destination that is out of direct range.

CC:0085.02.0B.12.001
CC:0085.02.0B.11.001
CC:0085.02.0B.12.002

It is OPTIONAL for a device to support this functionality. However, a receiving device MUST always return the Association Specific Group Report Command in response to this command.
If the device does not support this functionality, a Group parameter value of 0 SHOULD be advertised in the Association Specific Group Report Command that is returned in response to this command.

This functionality allows a supporting multi-button device to detect a key press and subsequently advertise the identity of the key. The following sequence of events takes place:

- o    The user activates a special identification sequence and pushes the button to be identified

- o    The device issues a Node Information frame (NIF)

- o    The NIF allows the portable controller to determine the NodeID of the multi-button device

- o    The portable controller issues an Association Specific Group Get Command to the multi-button device

- o    The multi-button device returns an Association Specific Group Report Command that advertises the association group that represents the most recently detected button

CC:0085.02.0B.12.003

The Association Group Information (AGI) Command Class provides a centralised alternative for the discovery of available association groups and the capabilities of these groups. A device supporting this functionality SHOULD also support the Association Group Information (AGI) Command Class.

CC:0085.02.0B.11.002
CC:0085.02.0B.11.003

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_SPECIFIC_GROUP_GET | | | | | | | |

**Clarification:** Previous text revisions of this specification presented conflicting guidelines for the Association Specific Group Get Command when received by non-supporting devices.
The values 0 and 1 were both suggested for the Group field of the Association Specific Group Report

CC:0085.02.0B.12.004   Command. It is RECOMMENDED that the value 0 is returned by non-supporting devices.

### 4.4.6 Association Specific Group Report Command

This command is used to advertise the association group that represents the most recently detected button.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION | | | | | | | |
| Command = ASSOCIATION_SPECIFIC_GROUP_REPORT | | | | | | | |
| Group | | | | | | | |

**Group (8 bits)**

This field is used to advertise the association group that represents the most recently detected button.

CC:0085.02.0C.11.001   The value of this field MUST be in the range 0..255.

CC:0085.02.0C.11.002   If a supporting device implements a multi-button device, the Group field MUST advertise an association group which represents the most recently activated button. The actual association group SHOULD be
CC:0085.02.0C.12.001   able to control an actuator device, e.g. via the Basic Command Class.

CC:0085.02.0C.12.002   This field SHOULD be set to 0 if the functionality is not supported or if the most recent button event does not map to an association group.

**Clarification:** Previous text revisions of this specification presented conflicting guidelines for the Association Specific Group Get Command when received by non-supporting devices.
The values 0 and 1 were both suggested for the Group field of the Association Specific Group Report
CC:0085.02.0C.12.003   Command. It is RECOMMENDED that the value 0 is returned by non-supporting devices.

## 4.5    Association Command Configuration Command Class, version 1

The Association Command Configuration Command Class defines the commands necessary for a 2<sup>nd</sup> node to add and delete commands to NodeIDs in a group as defined in the Association Command Class in a 1<sup>st</sup> node.

The device MUST implement the Association Command Class as 'supported'

The Association Command Class and the Command Configuration Command Class MUST be linked through the following dependencies:

- Nodes added to an association through an Association Set or Association Composite Set MUST be reported in Command Configuration Reports with the Command Class and command identifiers transmitted to the nodes.

- Nodes added to an association through a Command Configuration Set MUST also be reported in an Association Report and Association Composite Report

- All commands associated to a grouping identifier//NodeID pair will be removed as a result of an Association Remove. The related command records will be released

- Command(s) associated to a grouping identifier/NodeID/endpoint pair will be removed as a result of an Association Composite remove. The related command(s) record will be released.

The memory consumption of supporting full command sizes in all combinations of groupings identifiers and Node IDs is very extensive; hence the command class supports a memory flexible implementation.

The Command Class allows a device to support a number of command records. A command record consists of the grouping identifier, the Node ID and the command. The size of the command MAY be restricted by the device through the Max command length field. The command MUST be the complete command needed (I.e. All relevant encapsulations MUST be included in the command).

When no command records are free (all has been used), new commands MUST NOT be allocated to Node IDs before one or more command records have been freed up (through the Association Remove Command)

If the 2<sup>nd</sup> node runs out of free command records before it has finalized its command configurations, it MUST accept that the application on the device has full control of the remaining Node IDs. Alternatively the 2<sup>nd</sup> node can abort the command configuration process. In this case it is RECOMMENDED that the 2<sup>nd</sup> node free up the used command records in the aborted command configuration attempt.

A device can report the maximum number of command records, the number of free command records, and the max command length supported through the Command Records Supported Report.

In order to support sharing knowledge of how a device controls nodes without using extensive memory resources a Configurable Cmd field is supported. When configurable Cmd= 0x0 then a 2<sup>nd</sup> node can only monitor the commands. It cannot control them.

The V/C field allows a device to decrease the memory utilization to a minimum. When a device reports V/C=0x01, then the Command Configuration Set and Command Configuration Report MUST always use command class identifier and command identifier equal to a Basic Set Command Records Supported Get. This allows the device to only store the value field and thereby save memory resources.

### 4.5.1 Command Records Supported Get Command

The Command Records Supported Get Command is used to request the number of free command records available (grouping Identifier, Node ID, command), the maximum command records supported in the device and information regarding the maximum command length supported in the device.

The maximum number of groupings the given node supports is available through the Association Command Class.

The Command Records Supported Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class =<br>COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION | | | | | | | |
| Command = COMMAND_RECORDS_SUPPORTED_GET | | | | | | | |

### 4.5.2 Command Records Supported Report Command

The Command Records Supported Report Command used to report information regarding the Command records.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class =<br>COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION | | | | | | | |
| Command = COMMAND_RECORDS_SUPPORTED_REPORT | | | | | | | |
| Max command length | | | | | | V/C | Conf.<br>Cmd |
| Free Command records 1 | | | | | | | |
| Free Command records 2 | | | | | | | |
| Max Command records 1 | | | | | | | |
| Max Command records 2 | | | | | | | |

**Configurable Cmd (1 bit)**

| Configurable Cmd | Functionality |
|---|---|
| 0 | The local application has full control of the commands associated with the grouping. The commands can be monitored from a 2<sup>nd</sup> network node. |
| 1 | The specific commands associated with the grouping can be controlled and monitored from a 2<sup>nd</sup> network node. This option includes also the level field used by the command *Transfer Scene* in the *Controller Replication Command* Class. In this case the level value is transferred via the command *Basic Set* in the *Basic Command Class*. |

**V/C (1 bit)**

| V/C | Functionality |
|---|---|
| 0 | Command type. A Z-Wave command can be added to the node |
| 1 | Value type. A Value field is specified for a Node ID using the command *Basic Set* in the *Basic Command Class*. Level field originates from the command *Transfer Scene* in the *Controller Replication Command* Class. |

**Max command length (6 bits)**

If Configurable Cmd is equal to 0x0, the field SHOULD return 0x0.

If Configurable Cmd is equal to 0x1 the field SHOULD return the maximum length of a command which can be associated to a node in a grouping. The minimum max command length allowed is 0x03.

Example:

A product reports a Max command length = 0x03. In this case the product can be programmed with a Multilevel Switch Set, but not a Switch Multilevel Start Level Change.

　　Multilevel Switch Set has a command length of 3

　　Multilevel Switch Start Level Change has a command length of 4

**Free Command Records (16 bits)**

The field specifies the current number of free Command Records which can be configured in the device through the Command Configuration Set Command.

**Max Command records (16 bits)**

The field specifies the maximum number of Command Records which can be configured in the device through the Command Configuration Set Command.

### 4.5.3    Command Configuration Set Command

The Command Configuration Set Command used to specify which commands SHOULD be sent to nodes within a given Grouping identifier.

Every Command Configuration Set will utilize one Command record from the pool of free Command records.

If the device has no free command records when receiving the Command Configuration Set, the command will be ignored.

The Application on the node may alter the commands when needed.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION | | | | | | | |
| Command = COMMAND_CONFIGURATION_SET | | | | | | | |
| Grouping identifier | | | | | | | |
| Node ID | | | | | | | |
| Command length | | | | | | | |
| Command Class identifier | | | | | | | |
| Command identifier | | | | | | | |
| Command byte 1 | | | | | | | |
| .. | | | | | | | |
| Command byte n | | | | | | | |

**Grouping identifier (8 bits)**

This grouping identifier used to specify how nodes are grouped together. The grouping identifier values MUST be a sequence starting from 1. This field MAY be ignored in case the node only supports one group.

**Node ID (8 bits)**

This field contains the node ID within the grouping specified, that should receive the command.

**Command length (8 bits)**

This field specifies the complete command length (including command class and command identifiers).

Example: Switch Multilevel Set 0x20. The command length field MUST be equal to 0x03.

**Command Class Identifier (8 bits)**

This field contains the identifier of the command class which should be sent to the Node ID. In case the Configurable Cmd field is equal to 0x0 is this field and the following ignored and can therefore be omitted.

In case the device has reported V/C=0x1, the Command Class and Command Identifiers MUST be equal to Basic Set command.

**Command identifier (8 bits)**

This field contains the identifier of the Command, which should be sent to the specified Node ID. In case the Configurable Cmd field is equal to 0x0 is this field ignored and can therefore be omitted.

In case the device has reported V/C=0x1, the Command Class and Command Identifiers MUST be equal to Basic Set Command.

**Command byte (N bytes)**

These fields contain the command parameters, which should be sent to the Node ID. In case the Configurable Cmd field is equal to 0x0 is these fields ignored and can therefore be omitted.

### 4.5.4 Command Configuration Get Command

The Command Configuration Get Command is used to request the commands specified for to a Node ID within a given Grouping identifier.

The Command Configuration Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION | | | | | | | |
| Command = COMMAND_CONFIGURATION_GET | | | | | | | |
| Grouping identifier | | | | | | | |
| Node ID | | | | | | | |

**Grouping identifier (8 bits)**

This group identifier used to specify how nodes are grouped together. The group identifier values MUST be a sequence starting from 1. This field MUST be ignored in case the node only supports one group.

**Node ID (8 bits)**

This field specifies the node ID within the grouping.

### 4.5.5 Command Configuration Report Command

The Command Configuration Report Command used to report the commands specified for a Node ID within a given Grouping identifier.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_COMMAND_CONFIGURATION ||||||||
| Command = COMMAND_CONFIGURATION_REPORT ||||||||
| Grouping identifier ||||||||
| Node ID ||||||||
| First | Reserved ||| Reports to follow ||||
| Command length ||||||||
| Command Class identifier ||||||||
| Command identifier ||||||||
| Command byte 1 ||||||||
| ... ||||||||
| Command byte N ||||||||

**Grouping identifier (8 bits)**

This group identifier identifies the group. The group identifier values MUST be a sequence starting from 1.

**Node ID (8 bits)**

This field contains the node ID as requested in the Association Command Get.

**Reports to follow (4 bits)**

This value indicates how many report frames left before transferring the entire list of commands.

**First (1 bit)**

This field indicates that this report is the first report relating to a Grouping identifier/Node ID pair

**Command length (8 bits)**

This field specifies the complete command length (including command class and command identifiers).

Example: Multilevel Switch Set 0x20. The command length field MUST be equal to 0x03.

**Command Class Identifier (8 bits)**

This field contains the identifier of the command class which is sent to the Node ID.

In case the device has reported V/C=0x1, the Command Class and Command Identifiers MUST be equal to Basic Set command

**Command identifier (8 bits)**

This field contains the identifier of the Command which is sent to the specified Node ID.

In case the device has reported V/C=0x1, the Command Class and Command Identifiers MUST be equal to Basic Set Command

**Command byte (N bytes)**

These fields contain the command parameter which is sent to the Node ID.

### 4.6 Association Group Information (AGI) command class, version 1

The Association Group Information (AGI) Command Class allows a node to advertise the capabilities of each association group supported by a given application resource.

CC:0059.01.00.12.001 Controllers and installer tools SHOULD use AGI information to support controller-assisted button-to-button association and GUI-based drag-and-drop association in a plug-and-play fashion.

Centralized gateway-based deployments may create a single association from the lifeline association group to a central management application.

#### 4.6.1 Compatibility considerations

CC:0059.01.00.21.001 A node supporting the AGI Command Class MUST support the Association Command Class.

#### 4.6.1.1 Multi Channel considerations

The Association Group Information (AGI) Command Class also applies to Multi Channel devices.

CC:0059.01.00.21.002 If a node implements Multi Channel End Points and supports the AGI Command Class, each individual End Point MUST support the AGI Command Class.

CC:0059.01.00.21.003 Functions such as Device Reset Locally, low battery notification or tamper alarm which do not relate to the actual application functionality of the product MUST reside in the Root Device if the product is implemented as a Multi Channel device.

#### 4.6.2 Association Principles

A light control transmitter may have one or more keys. A key is mapped to one or more association groups.



**Figure 1, Light control transmitter (example)**



**Figure 2, Lamp module (example)**

A light control transmitter key can be configured to control a lamp by adding the NodeID of the lamp to an association group that represents the key.

#### 4.6.3 The Association Group Information

CC:0059.01.00.12.002 A node may implement one or more association groups. If the device implements association groups, the device SHOULD provide an Association Group Information (AGI) table as described in Table 3.

**Table 3, Layout of one line of the Association Group Information table**

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|

An AGI table entry carries a number of fields. The information is typically static and can be defined at compile time. Thus, the AGI table does not need to occupy any RAM or non-volatile storage.

### 4.6.3.1        Group identifier

The Group identifier indicates which association group the actual table entry relates to. As association groups are always numbered in a sequence starting from 1, an actual implementation does not have to store the group identifier in its memory. The number of association groups may be requested via the Association Groupings Get or Multi Channel Association Groupings Get commands.

CC:0059.01.00.11.001

CC:0059.01.00.11.002
CC:0059.01.00.13.001

Association group 1 is reserved for the Z-Wave Plus Lifeline association group. Group 1 MUST NOT be assigned to any other use than the Lifeline group. The actual Device Type specifies a mandatory list of commands which the device MUST send to all targets associated to the Lifeline group. A manufacturer MAY add additional commands to the Lifeline group. Refer to [10].

CC:0059.01.00.11.003
CC:0059.01.00.12.003

The Lifeline group MUST be advertised for the Root Device of a Multi Channel device. A Multi Channel End Point SHOULD advertise commands for association group 1 which End Points can send via the Root Device Lifeline group if a Multi Channel Association is created from the Root Device Lifeline group.

### 4.6.3.2        Profile

CC:0059.01.00.13.002

A device MAY implement one or several AGI profiles. The profile defines the scope of events which triggers the transmission of commands to the actual association group. As an example a temperature sensor may issue different Basic Set Command parameters when the temperature exceeds a threshold and when the temperature drops below a threshold. The actual behavior is application dependent and out of scope of the AGI Command Class.

The profile identifiers are referenced in Table 8. Profiles are divided into categories in the following sections.

#### 4.6.3.2.1        General profiles

CC:0059.01.00.11.004

The "General" category comprises the "Not Applicable" and "Lifeline" profiles. The "Not Applicable" profile identifier MUST be advertised if the actual association group does not match any of the defined profiles.

CC:0059.01.00.11.005

The "Lifeline" profile identifier MUST be advertised for association group 1 of the Root Device.

#### 4.6.3.2.2 Control profiles

"Control" profiles are intended for association groups of which commands are triggered by a user control mechanism, such as keys or buttons. As an example, a light control transmitter may comprise two control keys that can each control a group of lamps.

A control key may control up and down dimming as well as on/off state. Thus, a control key may send more than one command with one specific parameter. A control key may be implemented as a physical key, a group of icons, touch screen gestures or other means. The actual implementation is out of scope of this command class.

CC:0059.01.00.13.003    In case of multiple logical functions in a device, the device MAY implement one Multi Channel End Point for each logical function; e.g. each push button is implemented as a separate End Point.

Table 4 gives an example of a Multi Channel a battery-powered two-button light control device.

Root Device: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | General:Lifeline | Central Scene Notification Notification Report Battery Report Device Reset Locally Notification | Lifeline |
| 2 | Control:Key1 | Basic Set | On/Off control (Button 1) |
| 3 | Control:Key1 | Multilevel Switch Set | Dimmer control (Button 1) |
| 4 | Control:Key2 | Basic Set | On/Off control (Button 2) |
| 5 | Control:Key2 | Multilevel Switch Set | Dimmer control (Button 2) |

End Point 1: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | General:Lifeline | - | Lifeline |
| 2 | Control:Key1 | Basic Set | On/Off control (Button 1) |
| 3 | Control:Key1 | Multilevel Switch Set | Dimmer control (Button 1) |

End Point 2: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | General:Lifeline | - | Lifeline |
| 2 | Control:Key2 | Basic Set | On/Off control (Button 2) |
| 3 | Control:Key2 | Multilevel Switch Set | Dimmer control (Button 2) |

**Table 4, Example: AGI tables for two-button light control transmitter**

The Profile identifiers Control:Key 1 and Control:Key 2 allows an installer tool to determine which Multi Channel End Point and which association group to use in order to configure buttons to control a light dimmer. The Group Name allows a human user to make a qualified decision even if the installer tool is not, e.g. because it is running an older version not updated with newer profile identifiers.

End Points 1 and 2 in the above example do not support any Command Class that must be sent via the Z-Wave Plus Lifeline. Therefore End Points 1 and 2 advertise an empty Command Class list for the Lifeline association group.

CC:0059.01.00.12.004

The Root Device in the above example advertises the Basic Set Command in association group 2. This is a feature of End Point 1. A controlling node SHOULD NOT create associations from other Root Device association groups than the Lifeline group if it supports the Multi Channel Command Class. The purpose of the Root Device Association Groups (with the exception of the Lifeline group) is only to provide backwards compatibility for legacy devices without support for the Multi Channel Command Class.

### 4.6.3.2.3    Sensor profiles

"Sensor" profiles are intended for association groups of which commands are triggered by sensor readings. As an example, a sensor product could comprise two temperature sensors.

Sensor profile identifiers are constructed by prepending the Multilevel Sensor Command Class identifier (referred to with AGI_PROFILE_SENSOR) to a multilevel sensor type defined in the Multilevel Sensor Command Class. The values in Table 8 only serve as examples to illustrate the construction of AGI Sensor Profile Identifiers. For the full list of available sensor types, refer to the "Multilevel Sensor Report Command".

CC:0059.01.00.12.005

In case of multiple logical functions in a device, the device SHOULD implement one Multi Channel End Point for each logical function; e.g. each sensor instance is implemented as a separate End Point. Table 5 gives an example of a Multi Channel battery-powered sensor device with two multilevel sensor functions:

Root Device: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | General:Lifeline | Multilevel Sensor Report<br>Notification Report<br>Battery Report<br>Device Reset Locally Notification | Lifeline |
| 2 | Sensor:Temperature | Basic Set | On/Off control (Indoor temperature) |
| 3 | Sensor:Temperature | Basic Set | On/Off control (Outdoor temperature) |

End Point 1: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | Sensor:Temperature | Multilevel Sensor Report | Indoor temperature via Lifeline |
| 2 | Sensor:Temperature | Basic Set | On/Off control (Indoor temperature) |

End Point 2: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | Sensor:Temperature | Multilevel Sensor Report | Outdoor temperature via Lifeline |
| 2 | Sensor:Temperature | Basic Set | On/Off control (Outdoor temperature) |

**Table 5, Example: AGI tables for two-function sensor**

The Profile identifier is Sensor:Temperature for both End Points but the Group Name allows a user to determine which End Point and which association group to use in order to configure the indoor temperature sensor to control a heating element.

The Root Device in the above example advertises the Multilevel Sensor Report command in the Lifeline group. Residing in a Multi Channel device, the Root Device does not actually implement any application functionality. The Multilevel Sensor Report Command is a feature of the End Points which is advertised for backwards compatibility with legacy devices not supporting the Multi Channel Command Class. Likewise, the Root device advertises the Basic Set Command in association groups 2 and 3. This is also a feature of the End Points. Refer to the Multi Channel Command Class for details on backwards compatibility.

End Point 1 in the above example advertises the Multilevel Sensor Report Command in association group 1. By advertising that zero NodeIDs are supported for association group 1, End Point 1 indicates

that this command is sent via the Root Device Lifeline group if a Multi Channel association is created for the Root Device Lifeline group. The same principle applies to End Point 2.

#### 4.6.3.2.4    Notification profiles

"Notification" profiles are intended for association groups of which commands are triggered by detected events or state changes. As an example, a detector product could comprise one smoke sensor and one CO2 detector.

Notification profile identifiers are constructed by prepending the Notification Command Class identifier (referred to with AGI_PROFILE_NOTIFICATION) to a notification type defined in the Notification Command Class. The values below only serve as an example to illustrate the construction of AGI Notification Profile identifiers. For the full list of available notification types, refer to the Notification Command Class [16].

CC:0059.01.00.12.006

In case of multiple logical functions in a device, the device SHOULD implement one Multi Channel End Point for each logical function.

The following example outlines how a standalone smoke alarm is represented by an AGI table:



Root Device:

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | General:Lifeline | Notification Report Battery Report Device Reset Locally Notification | Lifeline |
| 2 | Notification:SmokeAlarm | Basic Set | On/Off control (Smoke) |

**Table 6, Example: AGI table for one-function alarm device**

The Profile identifier Notification:SmokeAlarm indicates to an installer that the Basic Set Command of association group 2 is issued in response to smoke alarm events.

#### 4.6.3.3    Command Class and Command

CC:0059.01.00.13.004

This field contains the command class and the command that is sent to targets associated with this association group if an event occurs. This field MAY advertise a list of commands and MAY contain a combination of extended and normal command classes. Refer to 4.6.9.

The command list is used by a controlling application to discover what functionality the node provides via a given association group. It also allows the controlling node to ensure that the associated node understands the received commands.

CC:0059.01.00.13.005

A node MAY list only one command if the actual association group sends different commands which actually relate to the same overall functionality and belong to the same Command Class and Commands Class version (e.g. Multilevel Switch Set / Multilevel Switch Start Level Change / Multilevel Stop Level Change)

CC:0059.01.00.12.007

In case Multi Channel End Points are implemented, the Lifeline association group (group 1) of End Points SHOULD be used to advertise commands that will be sent via the Root Device Lifeline group if a Multi Channel association is created from the Root Device Lifeline group.

#### 4.6.3.4 Association group name

This field contains a name reflecting the purpose of the group, e.g. "On/Off control (Smoke)".

CC:0059.01.00.11.006 The Root Device Lifeline group MUST be named "Lifeline".

CC:0059.01.00.11.007 Group names MUST be encoded using UTF-8. The available capacity for characters depends on the actual characters encoded with UTF-8. Plain ASCII characters only occupy one byte while special characters may need two or more bytes for representation.

### 4.6.4 Association Group Name Get

This command is used to query the name of an association group.

CC:0059.01.01.11.001 The Association Group Name Report Command MUST be returned in response to this command.

CC:0059.01.01.11.002 This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_GRP_INFO | | | | | | | |
| Command = ASSOCIATION_GROUP_NAME_GET | | | | | | | |
| Grouping Identifier | | | | | | | |

**Grouping Identifier (1 byte)**

This field is used to specify the requested association group identifier.

CC:0059.01.01.12.001 A node receiving this command for an unsupported Grouping Identifier SHOULD return information relating to Grouping Identifier 1.

#### 4.6.5   Association Group Name Report

This command is used to advertise the assigned name of an association group.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_GRP_INFO ||||||||
| Command = ASSOCIATION_GROUP_NAME_REPORT ||||||||
| Grouping Identifier ||||||||
| Name Length ||||||||
| Name 1 ||||||||
| ... ||||||||
| Name N ||||||||

**Grouping Identifier (1 byte)**

This field is used to advertise the actual association group identifier.

**Name Length (1 byte)**

CC:0059.01.02.11.001    This field indicates the length in bytes of the Name field. The value MUST be in the range 0..42.

**Name (N bytes)**

This field is used to indicate the assigned name for the actual Group Identifier.

CC:0059.01.02.11.002    The length of this field in bytes MUST comply with the advertised value in the Name Length field.
CC:0059.01.02.11.003    The string MUST NOT contain any appended termination characters.
CC:0059.01.02.11.004    The characters MUST be encoded in UTF-8 format.

#### 4.6.6   Association Group Info Get

This command is used to request the properties of one or more association group.

CC:0059.01.03.11.001    The Association Group Info Report MUST be returned in response to this command.

CC:0059.01.03.11.002    This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_GRP_INFO ||||||||
| Command = ASSOCIATION_GROUP_INFO_GET ||||||||
| Refresh cache | List Mode | Reserved ||||||
| Grouping Identifier ||||||||

**List Mode (1 bit)**

This field is used to request the properties of the supported association groups of a node.

CC:0059.01.03.11.003
CC:0059.01.03.13.001

If List Mode is set to 1, a receiving node MUST ignore the Grouping Identifier field and return the properties of all its supported associations groups. The receiving node MAY return the response in several Reports, (e.g. due to memory constraints or a high number of association groups).

CC:0059.01.03.11.004

If List Mode is set to 0, a receiving node MUST advertise the properties of the association group identified by the Grouping Identifier.

CC:0059.01.03.11.005

The Association Group Info Report returned in response to this command MUST advertise the same List Mode value as specified by this field.

**Refresh Cache (1 bit)**

CC:0059.01.03.11.006

If AGI information is transferred via a gateway, the gateway MUST cache information for all nodes; also listening nodes.
The AGI Get command flag "Refresh Cache" is used by a management application to instruct a gateway to update its cache on the first chance given. In case of a sleeping device, this may require a user operation to wake up the device. In case of a Wake Up device, the gateway may wait for the next Wake Up Notification from the actual device.

CC:0059.01.03.11.007
CC:0059.01.03.11.008

The "Refresh Cache" value 0 MUST specify that the gateway is to return its cached information.
The "Refresh Cache" value 1 MUST specify that the gateway is to return its cached information and update its cache on the first chance given.

CC:0059.01.03.12.001

The "Refresh Cache" SHOULD be set to 0 by a sending node.
A receiving node may have re-configurable AGI properties, e.g. if it is a configurable multi-purpose

CC:0059.01.03.13.002

remote control. If the "Dynamic Info" flag of the AGI Report command is set to 1, a sending node MAY set the "Refresh Cache" flag in the AGI Get command to force the gateway to update its cache, e.g. after the sending node has re-configured the AGI properties of the receiving node.

**Reserved**

CC:0059.01.03.11.009

This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Grouping Identifier (1 byte)**

CC:0059.01.03.11.00A

This field is used to specify the requested association group identifier. This value MUST be ignored if the List Mode field is set to 1.

CC:0059.01.03.12.002

A node receiving this command for an unsupported Grouping Identifier SHOULD return information relating to Grouping Identifier 1.

### 4.6.7   Association Group Info Report

This command is used to advertise the properties of one or more association groups.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_GRP_INFO ||||||||
| Command = ASSOCIATION_GROUP_INFO_REPORT ||||||||
| List mode | Dynamic Info | Group Count ||||||
| Grouping Identifier ||||||||
| Mode = 0 ||||||||
| Profile MSB ||||||||
| Profile LSB ||||||||
| Reserved = 0 ||||||||
| Event Code MSB = 0 ||||||||
| Event Code LSB = 0 ||||||||
| ... ||||||||
| Grouping Identifier ||||||||
| Mode = 0 ||||||||
| Profile MSB ||||||||
| Profile LSB ||||||||
| Reserved = 0 ||||||||
| Event Code MSB = 0 ||||||||
| Event Code LSB = 0 ||||||||

**List Mode (1 bit)**

CC:0059.01.04.11.001   The List Mode field MUST advertise the same value as specified in the Association Group Info Get command which caused this command to be returned.

CC:0059.01.04.13.001   If List Mode is 1, a sending node is advertising the properties of all association groups. The sending node MAY return several Reports.

CC:0059.01.04.11.002   If List Mode is 0 a sending node MUST advertise the properties of one association group.

**Dynamic Info (1 bit)**

CC:0059.01.04.13.002
CC:0059.01.04.11.003   If the Dynamic Info field is set to 1, the information MAY change and a controlling node SHOULD perform periodic cache refresh for this node. Nodes MUST set this bit if they are able to change the Association Group Information on the fly.

CC:0059.01.04.11.004   If this field is set to 0, a controlling node MUST NOT request this information more than one time.

**Group Count (6 bits)**

CC:0059.01.04.11.005    This field indicates the number of association groups advertised in the command. The Grouping Identifier, Mode, Profile, Reserved and Event Code fields MUST be repeated for each association group.

CC:0059.01.04.11.006    If List Mode is set to 0, the Group Count field MUST be set to 1.
If List Mode is set to 1, the Group Count field MUST advertise the number of association group property blocks following this field.

A node receiving this report may determine the total number of association groups via the Association Supported Groupings Get or Multi Channel Association Supported Groupings Get commands.

**Grouping Identifier (1 byte)**

CC:0059.01.04.11.007    This field MUST advertise the association group identifier of the actual association group property block.

**Mode (1 byte)**

CC:0059.01.04.11.008    This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Profile (2 bytes)**

CC:0059.01.04.11.009    This field is used to advertise the profile of the actual association group. Refer to section 4.6.3.2 and Table 8. This field MUST be encoded according to Table 8.

**Reserved**

CC:0059.01.04.11.00A    This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Event Code (2 bytes)**

CC:0059.01.04.11.00B    This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

#### 4.6.8    Association Group Command List Get

This command is used to request the commands that are sent via a given association group.

CC:0059.01.05.11.001    The Association Group Command List Report MUST be returned in response to this command.

CC:0059.01.05.11.002    This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_GRP_INFO | | | | | | | |
| Command = ASSOCIATION_GROUP_COMMAND_LIST_GET | | | | | | | |
| Allow cache | Reserved | | | | | | |
| Grouping Identifier | | | | | | | |

**Allow Cache (1 bit)**

This field indicates that a Z-Wave Gateway device is allowed to intercept the request and return a
cached response on behalf of the specified target.
CC:0059.01.05.11.003    If this bit is not set to 1, a Z-Wave Gateway device MUST forward the request to the specified target.

CC:0059.01.05.12.001    A requesting node SHOULD allow caching to save network bandwidth.
CC:0059.01.05.11.004    A Z-Wave Gateway device MUST cache information for all nodes; also listening nodes. This will save
network bandwidth.

CC:0059.01.05.11.005    A Z-Wave Gateway device MUST forward the request if it does not hold cached information for the
specified target. The Z-Wave Gateway device MUST cache the data returned.

**Reserved**

CC:0059.01.05.11.006    This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Grouping Identifier (1 byte)**

This field is used to specify the requested association group identifier.

CC:0059.01.05.12.002    A node that receives an unsupported Grouping Identifier SHOULD return information relating to Grouping
Identifier 1.

### 4.6.9   Association Group Command List Report

This command is used to advertise the commands that are sent via an actual association group.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ASSOCIATION_GRP_INFO ||||||||
| Command = ASSOCIATION_GROUP_COMMAND_LIST_REPORT ||||||||
| Grouping Identifier ||||||||
| List Length ||||||||
| Command Class 1 (1 or 2 bytes) ||||||||
| Command 1 ||||||||
| … ||||||||
| Command Class N (1 or 2 bytes) ||||||||
| Command N ||||||||

**Grouping Identifier (1 byte)**

This field is used to advertise the actual association group identifier.

**List Length (1 byte)**

This field advertises the length in bytes of the command list (Command Class and Command fields).

**Command Class and Command**

CC:0059.01.06.13.001

Command Classes MAY be normal or extended Command Classes.
Normal Command Classes are represented as one byte while extended Command Classes are represented as two bytes. Thus, a command list entry (command class + command) is either 2 or 3 bytes long.

The receiving node must parse individual command list entries to determine if the individual Command Class is a normal or an extended Command Class.
The first byte of normal command classes is in the range 0x20 – 0xEE, while the first byte of extended command classes is in the range 0xF1 – 0xFF.

CC:0059.01.06.11.001

A sending node MUST NOT add any command payload in this field.

CC:0059.01.06.11.002

Command Classes already containing destination NodeID such as Wake Up Command Class MUST NOT be listed in the Association Group Command List Report. This also means that the Wake Up Command Class MUST NOT be covered by the Lifeline association group.

### 4.7 Association Group Information (AGI) command class, version 2

The Association Group Information (AGI) Command Class allows a node to advertise the capabilities of each association group supported by a given application resource.

#### 4.7.1 Compatibility considerations

The Association Group Information (AGI) Command Class, version 2 introduces the Profile category "Meter".

The Association Group Information (AGI) Command Class, version 2 defines no new command fields or changes to the interpretation of Association Group Information (AGI) Command Class, version 1.

All sections and commands not described in this version remain unchanged from version 1.

#### 4.7.2 The Association Group Information

CC:0059.02.00.13.001
CC:0059.02.00.12.001

A device MAY implement one or more association groups. If the device implements association groups, the device SHOULD provide an Association Group Information (AGI) table as described in in Table 3

#### 4.7.2.1 Profile

The profile identifiers are referenced in Table 8. The profiles category "Meter" introduced in version 2 is described in 4.7.2.1.1.

##### 4.7.2.1.1 Meter profiles

"Meter" profiles are intended for association groups of which commands are triggered by meter readings. As an example, a two-phase meter product could comprise three electric meters: one for each phase and one for the total consumption.

Meter profile identifiers are constructed by prepending the Meter Command Class identifier (referred to with AGI_PROFILE_METER) to a meter type defined in the Meter Command Class. The values in Table 8 only serve as examples to illustrate the construction of AGI Meter Profile identifiers. For the full list of available meter types, refer to the Meter Command Class.

CC:0059.02.00.12.002

In case of multiple logical functions in a device, the device SHOULD implement one Multi Channel End Point for each logical function; e.g. each meter instance. Table 7 gives an example of a Multi Channel Meter device with two normal and one aggregated meter functions.

Root Device: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | General:Lifeline | Meter Report<br>Device Reset Locally Notification | Lifeline |
| 2 | Meter:Electric | Basic Set | On/Off control (Phase 1) |
| 3 | Meter:Electric | Basic Set | On/Off control (Phase 2) |
| 4 | Meter:Electric | Basic Set | On/Off control (Total consumption) |

End Point 1: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | Meter:Electric | Meter Report | Phase 1 via Lifeline |
| 2 | Meter:Electric | Basic Set | On/Off control (Phase 1) |

End Point 2: 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | Meter:Electric | Meter Report | Phase 2 via Lifeline |
| 2 | Meter:Electric | Basic Set | On/Off control (Phase 2) |

End Point 3 (aggregated): 

| Group identifier | Profile 2 bytes | Command Class & Command (list) N bytes | Group Name (UTF-8) M bytes |
|---|---|---|---|
| 1 | Meter:Electric | Meter Report | Total consumption via Lifeline |
| 2 | Meter:Electric | Basic Set | On/Off control (Total consumption) |

**Table 7, Example: AGI tables for three-function meter**

The Profile identifier is Meter:Electric for all End Points but the Group Name allows a user to determine which End Point and which association group to use in order to configure the phase 2 meter to control an alarm lamp.

The Root Device in the above example advertises the Meter Report Command in the Lifeline group. Residing in a Multi Channel device, the Root Device does not actually implement any application functionality. The Meter Report command is a feature of the End Points which is advertised for backwards compatibility with legacy devices not supporting the Multi Channel Command Class. Likewise, the Root device advertises the Basic Set Command in association groups 2..4. This is also a

feature of the End Points. Refer to the Multi Channel Command Class for details on backwards compatibility.

End Points 1..3 in the above example advertise the Meter Report Command in association group 1. By advertising that zero NodeIDs are supported for association group 1, End Points indicate that this command is sent via the Root Device Lifeline group if a Multi Channel association is created for the Root Device Lifeline group.

### 4.8    Association Group Information (AGI) command class, version 3

The Association Group Information (AGI) Command Class allows a node to advertise the capabilities of each association group supported by a given application resource.

#### 4.8.1    Compatibility considerations

The Association Group Information (AGI) Command Class, version 3 introduces the Profile category "Irrigation".

The Association Group Information (AGI) Command Class, version 3 defines no new command fields or changes to the interpretation of Association Group Information (AGI) Command Class, version 1 and version 2.

All sections and commands not described in this version remain unchanged from version 2.

#### 4.8.2    The Association Group Information

CC:0059.03.00.12.001

A node may implement one or more association groups. If the device implements association groups, the device SHOULD provide an Association Group Information (AGI) table as described in Table 3.

#### 4.8.2.1        Profile

The profile categories are referenced in Table 8. The profiles category "Irrigation" introduced in version 3 is described in 4.8.2.1.1.

##### 4.8.2.1.1         Irrigation Profiles

"Irrigation" profiles are intended for association groups of which commands are triggered by irrigation events. As an example, an irrigation control device may provide 8 channels that can each control an external resource such as a valve or a pump.

**Table 8, AGI Profiles**

| Profile | Explanation | Profile identifier | |
| --- | --- | --- | --- |
| | | MSB | LSB |
| General:NA (v1) | "Not Applicable" There is no specific class of events for this association group | AGI_PROFILE_ GENERAL = 0x00 | AGI_ GENERAL_NA = 0x00 |
| General:Lifeline (v1) | "Lifeline" This association group is intended for all events relevant for the Lifeline group. | AGI_PROFILE_ GENERAL = 0x00 | AGI_ GENERAL_LIFELINE = 0x01 |
| Control:Key01 (v1) | "Control Key 1" Members of this association group are controlled or receive reports in response to user input for key 1 | AGI_PROFILE_ CONTROL = 0x20 | AGI_ CONTROL_KEY01 = 0x01 |
| Control:Key xx (v1) | … | | |
| Control:Key32 (v1) | "Control Key 32" Members of this association group are controlled or receive reports in response to user input for key 32 | AGI_PROFILE_ CONTROL = 0x20 | AGI_ CONTROL_KEY32 = 0x20 |
| Sensor: Air temperature (v1) | "Sensor, Air Temperature" Members of this association group are controlled or receive reports when the sensor value changes. | AGI_PROFILE_ SENSOR = 0x31 | MULTILEVEL_SENSOR_TYPE_ TEMPERATURE = 0x01 |
| Sensor: Humidity (v1) | "Sensor, Humidity" Members of this association group are controlled or receive reports when the sensor value changes. | AGI_PROFILE_ SENSOR = 0x31 | MULTILEVEL_SENSOR_TYPE_ HUMIDITY = 0x05 |
| … | (Only examples above. Sensor profiles are built based on the Sensor Type as described in 4.6.3.2.3) | AGI_PROFILE_ SENSOR = 0x31 | … |
| Notification: Smoke Alarm (v1) | "Notification, Smoke Alarm" Members of this association group are controlled or receive reports when an event or state change is detected.for the given Notification Type | AGI_PROFILE_ NOTIFICATION = 0x71 | NOTIFICATION_TYPE_ SMOKE = 0x01 |
| Notification: $CO_2$ Alarm (v1) | "Notification, $CO_2$ Alarm" Members of this association group are controlled or receive reports when an event or state change is detected.for the given Notification Type | AGI_PROFILE_ NOTIFICATION = 0x71 | NOTIFICATION_TYPE_ CO2 = 0x03 |
| … | (Only examples above. Notification profiles are built based on the Notification Type as described in 4.6.3.2.4) | AGI_PROFILE_ NOTIFICATION = 0x71 | … |

| Profile | Explanation | Profile identifier | |
|---|---|---|---|
| | | MSB | LSB |
| Meter:<br>Electric, kWh<br>(v2) | "Meter, Electric"<br>Members of this association group receive meter reports or are controlled when a metering event is detected. | AGI_PROFILE_<br>METER = 0x32 | METER_TYPE_ELECTRIC = 0x01 |
| Meter:<br>Gas<br>(v2) | "Meter, Gas"<br>Members of this association group receive meter reports or are controlled when a metering event is detected. | AGI_PROFILE_<br>METER = 0x32 | METER_TYPE_GAS = 0x02 |
| Meter:<br>Water<br>(v2) | "Meter, Water"<br>Members of this association group receive meter reports or are controlled when a metering event is detected. | AGI_PROFILE_<br>METER = 0x32 | METER_TYPE_WATER = 0x03 |
| … | (Only examples above.<br>Meter Profiles are built based on the Meter Types as described in 4.7.2.1.1) | AGI_PROFILE_<br>METER = 0x32 | … |
| | | | |
| Irrigation:<br>Channel 01<br>(v3) | "Irrigation Channel 01"<br>Member(s) of this association group are controlled by channel 1 of an irrigation control device | AGI_PROFILE_<br>IRRIGATION = 0x6B | AGI_<br>IRRIGATION_CHANNEL_01 = 0x01 |
| Irrigation:<br>Channel xx<br>(v3) | … | | |
| Irrigation:<br>Channel 32<br>(v3) | "Irrigation Channel 32"<br>Member(s) of this association group are controlled by channel 32 of an irrigation control device | AGI_PROFILE_<br>IRRIGATION = 0x6B | AGI_<br>IRRIGATION_CHANNEL_32 = 0x20 |

### 4.1 Battery Command Class, version 1

The Battery Command Class is used to request and report battery levels for a given device.

#### 4.1.1 Battery Level Get Command

The Battery Level Get Command is used to request the level of a battery.

CC:0080.01.02.11.001 The Battery Level Report Command MUST be returned in response to this command.

CC:0080.01.02.11.002 This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_BATTERY | | | | | | | |
| Command = BATTERY_GET | | | | | | | |

#### 4.1.2 Battery Level Report Command

This command is used to report the battery level of a battery operated device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_BATTERY | | | | | | | |
| Command = BATTERY_REPORT | | | | | | | |
| Battery Level | | | | | | | |

**Battery Level (8 bits)**

This field is used toreport the percentage indicating the battery level.

CC:0080.01.03.11.001 This field MUST be in the range 0x00..0x64 or set to 0xFF.

CC:0080.01.03.11.002
CC:0080.01.03.11.003
Values in the range 0x00..0x64 MUST indicate the battery percentage level from 0 to 100%
The value 0xFF MUST indicate a low-battery warning.

## 4.2 Device Reset Locally Command Class, version 1

The Device Reset Locally Command Class is used to notify central controllers that a Z-Wave device is resetting its network specific parameters.

CC:005A.01.00.12.001  Any device SHOULD implement this Command Class if it can be reset to factory default.

CC:005A.01.00.11.001  Z-Wave Plus compliant devices MUST implement this command class if they can be reset to factory default.

### 4.2.1 Device Reset Locally Notification Command

CC:005A.01.01.11.001  The Device Reset Locally Notification Command is used to advertise that the device will be reset to default. The reset operation MUST reset protocol data (HomeID, NodeID, etc.) as well as all application specific data to factory default values. In case a Lifeline destination is configured in Association Group

CC:005A.01.01.11.002  #1, the device MUST send a Device Reset Locally Notification Command to the Lifeline destination.

CC:005A.01.01.11.004  For Multi Channel devices, the Device Reset Locally Notification Command MUST be issued by the Root Device. If Multi Channel encapsulation is used, the source End Point MUST be set to 0..

CC:005A.01.01.12.001  A controller device receiving the Device Reset Locally Notification Command SHOULD consider the sending node to be a failing node and accordingly perform relevant maintenance operations like removing failing nodes, removing associations to failing nodes, etc.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_DEVICE_RESET_LOCALLY | | | | | | | |
| Command = DEVICE_RESET_LOCALLY_NOTIFICATION | | | | | | | |

### 4.3 Firmware Update Meta Data Command Class, version 1 [DEPRECATED]

<div style="border:1px solid">

**THIS VERSION HAS BEEN DEPRECATED**

CC:007A.01.00.13.001
CC:007A.01.00.12.001

A device MAY implement support for this version of the command class, but it is RECOMMENDED that new implementations implement the Firmware Update Meta Data Command Class, version 3.

If implementing support for this version of the command class, it is RECOMMENDED that support for Firmware Update Meta Data Command Class, version 3 is also implemented.

</div>

The Firmware Update Meta Data Command Class may be used to transfer a firmware image to a Z-Wave device.

CC:007A.01.00.11.001

A device which supports the Firmware Update CC MUST support the Version CC and the Manufacturer Specific CC to enable other devices to select the correct firmware for a specific target. The Version Command Class may be used to verify that the intended firmware version is installed.

CC:007A.01.00.11.002

Devices implementing the Firmware Update CC MUST support a data rate of 40kbit/s or more.

CC:007A.01.00.12.002
CC:007A.01.00.12.003

A checksum SHOULD be appended to the firmware image to ensure the integrity of the image. A receiving device SHOULD verify the integrity of the received firmware image by matching the received firmware image checksum and the firmware image checksum that is indicated by the Firmware Meta Data Report when the firmware update is initiated.

CC:007A.01.00.12.004

It is RECOMMENDED that firmware update is enabled by out-of-band authentication (e.g. physical activation of a pushbutton). If out-of-band authentication is implemented, the device to receive a firmware update must be armed for firmware update before the Firmware Update Meta Data Request Get Command is issued.

#### 4.3.1 Firmware Meta Data Get Command

The Firmware Meta Data Get Command is used to request information on the current firmware in the device.

CC:007A.01.01.11.001

The Firmware Meta Data Report Command MUST be returned in response to this command.

CC:007A.01.01.11.002
CC:007A.01.01.11.003

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing. The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_MD_GET | | | | | | | |

### 4.3.2 Firmware Meta Data Report Command

The Firmware Meta Data Report Command is used to advertise the status of the current firmware in the device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_MD_REPORT | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Checksum 1 | | | | | | | |
| Checksum 2 | | | | | | | |

**Manufacturer ID (16 bits)**

The Manufacturer ID is a unique ID identifying the manufacturer of the device.

Manufacturer identifiers can be found in [12].

CC:007A.01.02.11.001   The first byte MUST be the most significant byte.

**Firmware ID (16 bits)**

CC:007A.01.02.12.001   A manufacturer SHOULD assign a unique Firmware ID to each existing product variant. A product variant may be a particular hardware version for a particular world region. When combined with the Manufacturer ID, the Firmware ID is a unique identification of a firmware image that is guaranteed to work with a particular product among all Z-Wave enabled products in the world.
If the product has no Firmware ID, the value 0x0000 MUST be returned.

CC:007A.01.02.11.002   The first byte MUST be the most significant byte.

A user may request Manufacturer Specific information to get more detailed information on the product.

CC:007A.01.02.12.002   A controlling device SHOULD match the advertised firmware ID for the existing firmware image to the firmware ID provided for a new image. If the firmware IDs do not match, the controlling device SHOULD abort the firmware update operation.

**Checksum (16 bits)**

CC:007A.01.02.13.001   The checksum field is used to report a checksum value of the firmware image currently running in the Z-Wave chip. As an alternative, a value of zero MAY be returned.

CC:007A.01.02.11.003   The first byte MUST be the most significant byte.

CC:007A.01.02.12.003   It is RECOMMENDED to use a checksum algorithm that implements a CRC-CCITT polynomial using initialization value equal to 0x1D0F and 0x1021 (normal representation).

### 4.3.3   Firmware Update Meta Data Request Get Command

The Firmware Update Meta Data Request Get Command is used to request that a firmware update is initiated.

CC:007A.01.03.11.001   The Firmware Update Meta Data Request Report Command MUST be returned in response to this command.

CC:007A.01.03.11.002   The firmware update MUST NOT be initiated if the Manufacturer ID and the Firmware ID do not match the actual firmware image values.

CC:007A.01.03.11.003   The firmware update MUST be aborted if the checksum does not match the calculated checksum after the firmware image has been transferred.

CC:007A.01.03.12.001   It is RECOMMENDED that firmware update is initiated by out-of-band authentication (e.g. physical activation of a pushbutton).

CC:007A.01.03.11.004   This command MUST NOT be issued via multicast addressing.
CC:007A.01.03.11.005   A receiving node MUST NOT return a response if this command is received via multicast addressing. The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD ||||||||
| Command = FIRMWARE_UPDATE_MD_REQUEST_GET ||||||||
| Manufacturer ID 1 ||||||||
| Manufacturer ID 2 ||||||||
| Firmware ID 1 ||||||||
| Firmware ID 2 ||||||||
| Checksum 1 ||||||||
| Checksum 2 ||||||||

**Manufacturer ID (16 bits)**

The Manufacturer ID is a unique ID identifying the manufacturer of the device.

CC:007A.01.03.11.006    Manufacturer identifiers can be found in [12].The first byte MUST be the most significant byte.

**Firmware ID (16 bits)**

CC:007A.01.03.12.002    A manufacturer SHOULD assign a unique Firmware ID to each existing product variant. A product variant may be a particular hardware version for a particular world region. When combined with the Manufacturer ID, the Firmware ID is a unique identification of a firmware image that is guaranteed to work with a particular product among all Z-Wave enabled products in the world.

CC:007A.01.03.11.007    A receiving application MUST check that the Manufacturer ID and Firmware ID fields match the
CC:007A.01.03.12.003    Manufacturer ID and Firmware ID values of the current firmware. While it is NOT RECOMMENDED, one MAY design a the product that has no Firmware ID.
CC:007A.01.03.11.008    A sending node MUST specify the Firmware ID value 0x0000 to indicate an absent Firmware ID.
CC:007A.01.03.11.009    A receiving node MUST interpret the value 0x0000 as "No Firmware ID available".

CC:007A.01.03.11.00A    The first byte MUST be the most significant byte.

**Checksum (16 bits)**

CC:007A.01.03.11.00B    The checksum field MUST carry the checksum of the firmware image about to be transferred.
CC:007A.01.03.11.00C    A receiving node MUST match this value and the checksum calculated from the received firmware image.

CC:007A.01.03.12.004    It is RECOMMENDED to use a checksum algorithm that implements a CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation). Refer to appendices in [2].

### 4.3.4    Firmware Update Meta Data Request Report Command

This command is used to advertise if the firmware update will be initiated.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REQUEST_REPORT | | | | | | | |
| Status | | | | | | | |

**Status (8 bits)**

CC:007A.01.04.11.001    This field MUST comply with Table 9.

### 4.3.5 Firmware Update Meta Data Get Command

The Firmware Update Meta Data Get Command is used to request one or more Firmware Update Meta Data Report Commands.

CC:007A.01.05.11.001 The Firmware Update Meta Data Report Command MUST be returned in response to this command.

CC:007A.01.05.13.001
CC:007A.01.05.13.002
The transmission of the next Firmware Update Meta Data Get Command MAY be delayed if time is required to store the most recent firmware fragment in temporary non-volatile memory. A node MAY request multiple Firmware Update Meta Data Report Commands to improve throughput.

CC:007A.01.05.11.002
CC:007A.01.05.11.003
This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing. The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

Two exceptions may apply: A noise burst may interfere the transmission or the data source may stop returning Firmware Update Meta Data Report Commands.

CC:007A.01.05.12.001 To accommodate for bursts of RF noise, a device receiving data SHOULD repeatedly retransmit the same Firmware Update Meta Data Get Command every 10 seconds in case no Firmware Update Meta Data Report Commands are received.

CC:007A.01.05.12.002 A device receiving data SHOULD stop retransmitting Firmware Update Meta Data Get commands 2 minutes after the last successful reception of a Firmware Update Meta Data Report Command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_GET | | | | | | | |
| Number of Reports | | | | | | | |
| Res | | Report number 1 | | | | | |
| Report number 2 | | | | | | | |

**Res**

CC:007A.01.05.11.004 This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Number of Reports (8 bits)**

Number of Firmware Update Meta Data Report Commands to be received in response to this Firmware Update Meta Data Get Command.

**Report number 1 .. 2 (15 bits)**

CC:007A.01.05.11.005 The Report number field indicates the Firmware Update Meta Data Report Command to be requested. The report number values MUST be a sequence starting from 1. The first byte (Report number 1) is the most significant byte.

### 4.3.6 Firmware Update Meta Data Report Command

The Firmware Update Meta Data Report Command is used to transfer a firmware image fragment.

CC:007A.01.06.11.001

If sending more than a single Firmware Update Meta Data Report Command at a time, a node MUST apply a delay between each transmitted command. The minimum required time delay and number of frames before a delay must be inserted depends on the actual bit rate.

- 40 kbit/s: At least 35 ms if sending more than 1 frame back-to-back
- 100 kbit/s: At least 15 ms if sending more than 2 frames back-to-back

CC:007A.01.06.12.001

If needed, a controlling node SHOULD abort an ongoing transfer by responding to a Firmware Update Meta Data Get Command with a Firmware Update Meta Data Report Command with the Last bit enabled and the Data fields intentionally corrupted.
This will invalidate the calculated firmware checksum, which should eventually cause the receiving device to return a Firmware Update Meta Data Status Report Command with the status code <checksum error>.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REPORT | | | | | | | |
| Last | Report number 1 | | | | | | |
| Report number 2 | | | | | | | |
| Data 1 | | | | | | | |
| … | | | | | | | |
| Data N | | | | | | | |

**Last (1 bit)**

The Last flag indicates if the requested Firmware Update Meta Data Report Command carries the last firmware image fragment.

CC:007A.01.06.11.002

The flag MUST be set to '1' if this is the last fragment. Otherwise the flag MUST be '0'.

**Report number (15 bits)**

CC:007A.01.06.11.003

The Report number field indicates the sequence number of the contained firmware fragment. The first firmware fragment MUST be identified by the Report number value 1. The sequence number of each following firmware fragment MUST be incremented.

Report number 1 is the most significant byte.

The report number may be used to calculate the offset of the data by the formula:

Offset = (Report number – 1) x Number of Data fields (N)

CC:007A.01.06.11.004
CC:007A.01.06.13.001

Except for the last frame, each Report MUST carry the same number of Data bytes as the first fragment. The last frame MAY carry a shorter Data field.

**Data (N bytes)**

The Data field is used to carry one firmware image fragment. Except for the last frame, each Firmware Update Meta Data Report Command MUST carry the same number of Data bytes as the first fragment. The last frame MAY carry a shorter Data field.

CC:007A.01.06.11.005
CC:007A.01.06.13.002

CC:007A.01.06.11.006

A sending device MUST use a fragment size which matches the actual number of available Data bytes. The number of available Data bytes depends on the actual bit rate, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report.

CC:007A.01.06.11.007

A receiving device MUST determine the number of Data bytes from the length of the first received frame.

### 4.3.7 Firmware Update Meta Data Status Report Command

This command is used to advertise the firmware update status.

CC:007A.01.07.11.001

The command MUST be issued when the firmware update is completed or aborted by the device receiving the firmware.

CC:007A.01.07.11.002

A node MUST NOT issue Firmware Update Meta Data Get Command after receiving a Firmware Update Meta Data Status Report.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_STATUS_REPORT | | | | | | | |
| Status | | | | | | | |

**Status (8 bits)**

CC:007A.01.07.11.003

This field MUST comply with Table 10.

### 4.3.8    Examples

Figure 3 shows a controlling node requesting the Manufacturer ID and Firmware ID of another node by issuing the Firmware Meta Data Get Command.
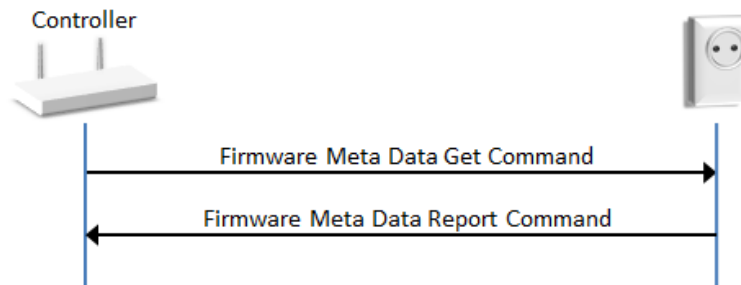


**Figure 3, Requesting Manufacturer ID and Firmware ID of a node**

Figure 4 outlines the actual firmware update message flow. Prior to the firmware update, the supporting node may receive an out-of-band authentication (e.g. physical activation of a pushbutton). The controller sends a Firmware Meta Data Request Get Command to initiate the downloading a new firmware image. The supporting node returns a Firmware Meta Data Request Report Command report to confirm the update request and the supporting node begins pulling firmware image fragments from the controller. Finally a Firmware Update Meta Data Status Report is returned to the controller to indicate the success (or failure) of the update process.
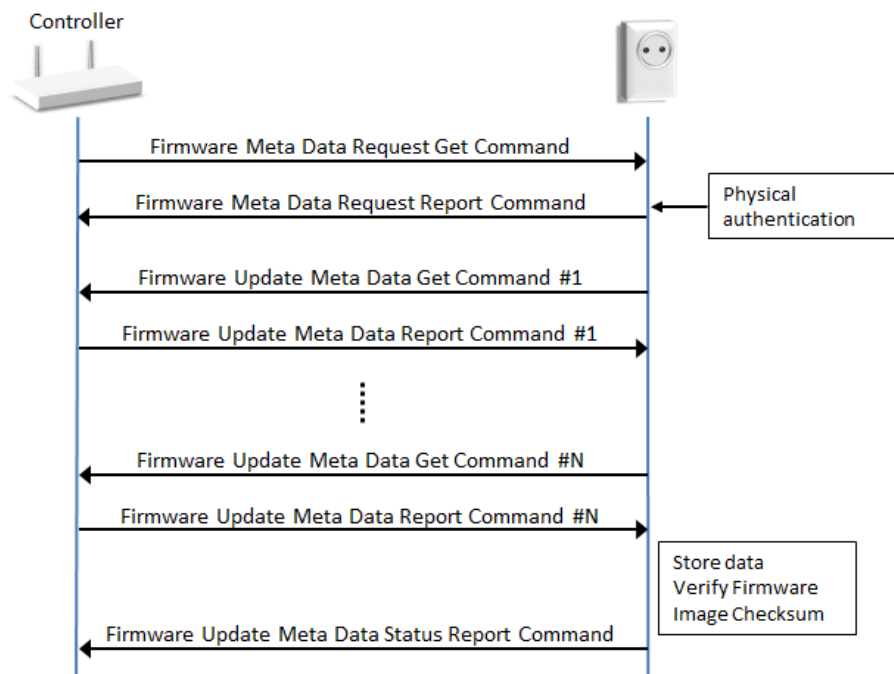


**Figure 4, Transferring a firmware image to a device**

### 4.4    Firmware Update Meta Data Command Class, version 2

Firmware Update Meta Data Command Class, version 2 updates the Firmware Update Meta Data Report Command.

CC:007A.02.00.11.001    While support for version 1 has been deprecated, a controlling device implementing Firmware Update Meta Data Command Class, version 2 MUST also be able to control Firmware Update Meta Data Command Class, version 1 based devices.

#### 4.4.1    Compatibility considerations

CC:007A.02.00.21.001    A node supporting Firmware Update Meta Data Command Class, version 2 MUST also support Firmware Update Meta Data Command Class, version 1.

All commands and fields not described in this version remain unchanged from version 1.

#### 4.4.2    Interoperability considerations

#### 4.4.2.1        Interoperability with v1 devices

Version 2 of the Firmware Update Meta Data Report command introduces a 16-bit Checksum field to follow the variable-length Data field. No fields follow the variable-length Data field in Version 1 of the Firmware Update Meta Data Report command.

At the same time, the specified method for determining the length of the variable-length Data field is that the length must be calculated from the length of the received frame.

The unintended consequence is that a version 1 implementation receiving a Firmware Update Meta Data Report v2 command will consider the 16-bit Checksum field to be the last two bytes of the Data field. Similarly, a version 2 implementation receiving a Firmware Update Meta Data Report v1 command will consider the last two bytes of the Data field to be the 16-bit Checksum field.
In either case, the transfer will fail.

CC:007A.02.00.31.001    Therefore, a controlling device implementing the Firmware Update Meta Data Command Class, version 2 MUST do the following when initiating the transfer of a firmware image:

1.  Request the version of the Firmware Update Meta Data Command Class from the target device
2.  Use the version of the Firmware Update Meta Data Report implemented by the target device
3.  Determine the number of Data bytes that can fit into the Firmware Update Meta Data Report command so that the complete command can still fit into the payload field of the transport frame. The number of available payload bytes in the frame depends on the actual bit rate, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report.

CC:007A.02.00.32.001    The controller SHOULD accept any binary image format and transfer that without any modifications. The image may be encrypted or carry checksums.

**4.4.2.2        Checksum calculation**

Version 1 of the Firmware Update Meta Data Command Class introduced a 16-bit Checksum field used to verify firmware image integrity. It has been a recommendation to use the CRC-CCITT polynomial for calculating checksums. Nodes having implemented another method for calculating the checksum will find a non-matching checksum.

From Version 5 onwards, the checksum calculation method is mandatory. For more details about the checksum calculation, refer to Appendix B

**4.4.3    Firmware Update Meta Data Report Command**

The Firmware Update Meta Data Report command is used to transfer a firmware image fragment.

CC:007A.02.06.11.001   If sending more than a single Firmware Update Meta Data Report Command at a time, a node MUST apply a delay between each transmitted command. The minimum required time delay and number of frames before a delay must be inserted depends on the actual bit rate.

- 40 kbit/s: At least 35 ms if sending more than 1 frame back-to-back
- 100 kbit/s: At least 15 ms if sending more than 2 frames back-to-back

CC:007A.02.06.12.001   If needed, a controlling node SHOULD abort an ongoing transfer by responding to a Firmware Update Meta Data Get Command with a Firmware Update Meta Data Report Command with the Last bit enabled and the Data fields intentionally corrupted while the Checksum field of the Firmware Update Meta Data Report Command is valid, i.e. calculated over the corrupted Data fields.
This will invalidate the calculated firmware checksum, which should eventually cause the receiving device to return a Firmware Update Meta Data Status Report Command with the status code <checksum error>.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD ||||||||
| Command = FIRMWARE_UPDATE_MD_REPORT ||||||||
| Last | Report number 1 |||||||
| Report number 2 ||||||||
| Data 1 ||||||||
| … ||||||||
| Data N ||||||||
| Checksum 1 ||||||||
| Checksum 2 ||||||||

All fields not described below remain unchanged from version 1.

**Checksum (16 bits)**

CC:007A.02.06.11.002   The checksum field MUST be used to ensure the consistency of the entire command; including the
command class and command identifiers.

CC:007A.02.06.12.002   It is RECOMMENDED to use a checksum algorithm that implements the CRC-CCITT polynomium using
initialization value equal to 0x1D0F and 0x1021 (normal representation).

The Checksum field is known to cause compatibility issues with version 1 devices. Refer to 4.4.1.

### 4.5    Firmware Update Meta Data Command Class, version 3

The Firmware Update Meta Data Command Class, version 3 allows a Z-Wave enabled device to receive one out of several firmware images.

As an example, one may construct a product comprising a Z-Wave chip and a secondary host processor that maintains a security certificate. With the capability to handle multiple firmware images enables the Z-Wave chip, the host processor and the security certificate may all be updated via individual firmware IDs.

#### 4.5.1    Compatibility considerations

CC:007A.03.00.21.001

CC:007A.03.00.21.002

A device implementing Firmware Update Meta Data Command Class, version 3 MUST also implement Firmware Update Meta Data Command Class, version 2.
While support for version 1 has been deprecated, a controlling device implementing Firmware Update Meta Data Command Class, version 2 MUST also be able to control Firmware Update Meta Data Command Class, version 1 based devices.

All commands and fields not described in this version remain unchanged from version 2.

#### 4.5.1.1        New fields and values

The Firmware Update Command Class, Version 3, introduces WaitTime parameter and a new Status code 0xFE for the Firmware Update Meta Data Status Report Command.

CC:007A.03.00.21.003

The status code 0xFE is intended for confirming the successful transfer of images which do not necessitate a restart, e.g. security certificates. If this code was returned to a controller implementing a previous version, the controller would report that an error had occurred. Therefore, a supporting node MUST NOT return this code after having updated the firmware image for the Z-Wave chip image, i.e. the Firmware ID 0 target.

#### 4.5.2    Interoperability considerations

CC:007A.03.00.32.001

Unintended modification of a firmware image SHOULD be prevented. It is RECOMMENDED that firmware update is enabled by out-of-band authentication (e.g. physical activation of a pushbutton).

CC:007A.03.00.31.001
CC:007A.03.00.32.002

A checksum MUST be appended to the Firmware 0 image to ensure the integrity of the image. A receiving device SHOULD verify the integrity of the received Firmware 0 image by matching the received Firmware 0 image checksum and the Firmware 0 image checksum that is indicated by the Firmware Meta Data Report when the firmware update is initiated.

CC:007A.03.00.32.003

CC:007A.03.00.31.002

Any image transferred via the Firmware Update Meta Data Command Class SHOULD include a fingerprint value for validation of the integrity of the entire image after the transfer. The image and the fingerprint value MUST be packed in one entity which can be stored in one file and transferred as one entity.

CC:007A.03.00.31.003

A manufacturer MUST assign a unique Firmware ID to each existing product variant. A product variant may be a particular hardware version for a particular world region. The combination of Manufacturer ID and Firmware ID provides unique identification of a firmware image that is guaranteed to work with a particular component of a particular product.

#### 4.5.2.1          Interoperability with v1 devices

Version 2 of the Firmware Update Meta Data Report command introduces a 16-bit Checksum field to follow the variable-length Data field. No fields follow the variable-length Data field in Version 1 of the Firmware Update Meta Data Report command. Version 3 of the Firmware Update Meta Data Report command uses the v2 format.

At the same time, the specified method for determining the length of the variable-length Data field is that the length must be calculated from the length of the received frame.

The unintended consequence is that a version 1 implementation receiving a Firmware Update Meta Data Report v2 command will consider the 16-bit Checksum field to be the last two bytes of the Data field. Similarly, a version 2 implementation receiving a Firmware Update Meta Data Report v1 command will consider the last two bytes of the Data field to be the 16-bit Checksum field.
In either case, the transfer will fail.

CC:007A.03.00.31.004    Therefore, a node controlling the Firmware Update Meta Data Command Class, version 3 MUST do the following when initiating the transfer of a firmware image:

1. Request the version of the Firmware Update Meta Data Command Class from the target device
2. Use the version of the Firmware Update Meta Data Report implemented by the target device
3. Determine the number of Data bytes that can fit into the Firmware Update Meta Data Report command so that the complete command can still fit into the payload field of the transport frame. The number of available payload bytes in the frame depends on the actual bit rate, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report

#### 4.5.2.2          Checksum calculation

Version 1 of the Firmware Update Meta Data Command Class introduced a 16-bit Checksum field used to verify firmware image integrity. It has been a recommendation to use the CRC-CCITT polynomial for calculating checksums. Nodes having implemented another method for calculating the checksum will find a non-matching checksum.

From Version 5 onwards, the checksum calculation method is mandatory.

For more details about the checksum calculation, refer to Appendix B

### 4.5.3 Firmware Meta Data Report Command

This command is used to advertise the status of the current firmware in the device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD ||||||||
| Command = FIRMWARE_MD_REPORT ||||||||
| Manufacturer ID 1 ||||||||
| Manufacturer ID 2 ||||||||
| Firmware 0 ID 1 ||||||||
| Firmware 0 ID 2 ||||||||
| Firmware 0 Checksum 1 ||||||||
| Firmware 0 Checksum 2 ||||||||
| Firmware Upgradable ||||||||
| Number of Firmware Targets ||||||||
| Max Fragment Size 1 ||||||||
| Max Fragment Size 2 ||||||||
| Firmware 1 ID 1 ||||||||
| Firmware 1 ID 2 ||||||||
| … ||||||||
| Firmware N ID 1 ||||||||
| Firmware N ID 2 ||||||||

Fields not described below remain unchanged from version 2

**Firmware 0 ID (16 bits)**

The Firmware 0 ID field is dedicated to target 0, i.e. the Z-Wave chip.

CC:007A.03.02.11.001 A manufacturer MUST assign a unique Firmware ID to each existing product variant. A product variant may be a particular hardware version for a particular world region. The combination of Manufacturer ID and Firmware ID provides unique identification of a firmware image that is guaranteed to work with a particular component of a particular product.

CC:007A.03.02.11.002 The first byte MUST be the most significant byte.

A user may request Manufacturer Specific information to get more detailed information on the product.

CC:007A.03.02.12.001 A controlling node SHOULD match the advertised firmware ID for the existing firmware image to the firmware ID provided for a new image. If the firmware IDs do not match, the controlling device SHOULD abort the firmware update operation.

**Firmware 0 Checksum (16 bits)**

CC:007A.03.02.11.003 The checksum field MUST be used to ensure consistency of the Firmware 0 image currently in the device.

CC:007A.03.02.11.004    The first byte MUST be the most significant byte.

CC:007A.03.02.12.002    It is RECOMMENDED to use a checksum algorithm that implements a CRC-CCITT polynomial using initialization value equal to 0x1D0F and 0x1021 (normal representation).

### Firmware Upgradable (8 bits)

This field defines whether the Z-Wave chip is firmware upgradable.

CC:007A.03.02.11.005    The value 0x00 MUST indicate that the firmware 0 image is not upgradable.
The value 0xFF MUST indicate that the firmware 0 image is upgradable.

### Number of Firmware Targets (8 bits)

CC:007A.03.02.11.006    The Number of Firmware Targets field MUST report the number of firmware IDs following this field.

CC:007A.03.02.11.007    The Firmware 0 ID field is not included. The field MUST be zero if the device only implements a Firmware 0 target, i.e. the Z-Wave chip.

### Max Fragment Size (16 bits)

CC:007A.03.02.11.008
CC:007A.03.02.13.001    The Max Fragment Size field MUST report the maximum number of Data bytes that a device is able to receive at a time. A sending node MAY send shorter fragments. The fragment size actually used is indicated in the Firmware Update Meta Data Request Get Command and confirmed in the Firmware Update Meta Data Request Report Command.

CC:007A.03.02.11.009    The Max Fragment Size may be longer than the supported frame length of Z-Wave if the image is to be transferred over e.g. IP. If the image is to be transferred over Z-Wave, the sending node MUST use a fragment size which matches the actual number of available Data bytes. The number of available Data bytes depends on the actual bit rate, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report.

### Firmware n ID (16 bits)

CC:007A.03.02.11.00A    The Firmware 1 ID field indicates the Firmware ID that MUST be used for target 1. The Firmware 2 ID field represents target 2. And so on.

CC:007A.03.02.11.00B    The first byte MUST be the most significant byte.

CC:007A.03.02.12.003    A controlling device SHOULD match the advertised firmware ID for the existing firmware image to the firmware ID provided for a new image. If the firmware IDs do not match, the controlling device SHOULD abort the firmware update operation.

### 4.5.4    Firmware Update Meta Data Request Get Command

The Firmware Update Meta Data Request Get Command is used to request that a firmware update is initiated by the node receiving this command.

CC:007A.03.03.11.001    The Firmware Update Meta Data Request Report Command MUST be returned in response to this command.

CC:007A.03.03.11.002
CC:007A.03.03.11.003
This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

CC:007A.03.03.11.004
The firmware update MUST NOT be initiated if the Manufacturer ID and the Firmware ID do not match the actual firmware image values for the specified Firmware Target.

CC:007A.03.03.11.005
The firmware update MUST be aborted if the checksum does not match the calculated checksum after the firmware image has been transferred.

CC:007A.03.03.12.001
It is RECOMMENDED that firmware update is enabled by out-of-band authentication (e.g. physical activation of a pushbutton) prior to the transmission of this command.

CC:007A.03.03.12.002

CC:007A.03.03.11.006
Any image transferred via the Firmware Update Meta Data Command Class SHOULD include a fingerprint value to enable the validation of the integrity of the entire image after the transfer. The image and the fingerprint value MUST be packed in one entity which can be stored in one file and transferred as one entity.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REQUEST_GET | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Checksum 1 | | | | | | | |
| Checksum 2 | | | | | | | |
| Firmware Target | | | | | | | |
| Fragment Size 1 | | | | | | | |
| Fragment Size 2 | | | | | | | |

All fields not described below remain unchanged from version 2.

**Firmware ID (16 bits)**

CC:007A.03.03.11.007
The Firmware ID MUST match the specified target of the actual device.

CC:007A.03.03.11.008
The firmware update MUST NOT be initiated if the Firmware ID does not match the specified target of the actual device.

CC:007A.03.03.11.009
The first byte MUST be the most significant byte.

**Firmware Target (8 bits)**

CC:007A.03.03.11.00A This field MUST be used to identify the firmware image to be updated. The firmware images MUST be identified as follows:

| Firmware Target | Description |
| --- | --- |
| 0x00 | Firmware image targeted for the Z-Wave chip. |
| 0x01 | Firmware image intended for target 1 defined by the manufacturer. |
| … | |
| 0xFF | Firmware image intended for target 255 defined by the manufacturer. |

**Fragment Size (16 bits)**

CC:007A.03.03.11.00B The Fragment Size field MUST report the fragment size that is to be used for firmware fragments. A receiving device MUST use this fragment size for the firmware update. The fragment size is not exchanged during the actual firmware update.

CC:007A.03.03.11.00C The Fragment Size MUST NOT exceed the Max Fragment Size value of the Firmware Meta Data Report.

CC:007A.03.03.11.00D A version 1 Firmware Update Meta Data Request Get Command does not carry a Fragment Size field. A receiving node MUST determine the number of Data bytes from the length of the first received frame, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report.

### 4.5.5 Firmware Update Meta Data Request Report Command

This command is used to advertise if the firmware update will be initiated.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REQUEST_REPORT | | | | | | | |
| Status | | | | | | | |

**Status (8 bits)**

CC:007A.03.04.11.001 This field MUST comply with Table 9.

### 4.5.6    Firmware Update Meta Data Get Command

The Firmware Update Meta Data Get Command is used to request one or more Firmware Update Meta Data Report Commands.

CC:007A.03.05.11.001    One or more Firmware Update Meta Data Report Commands MUST be returned in response to this command.

CC:007A.03.05.11.002    This command MUST NOT be issued via multicast addressing.
CC:007A.03.05.11.003    A receiving node MUST NOT return a response if this command is received via multicast addressing. The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

CC:007A.03.05.11.004    A node MUST verify the Manufacturer ID and Firmware ID fields received in a Firmware Update Meta Data Request Get Command before sending any Firmware Update Meta Data Get Commands.
CC:007A.03.05.11.005    A controlling node receiving a Firmware Update Meta Data Get Command MUST return fragments of the firmware image that was previously identified by the Manufacturer ID and Firmware ID fields received in a Firmware Update Meta Data Request Get Command.

CC:007A.03.05.13.001    The transmission of the next Firmware Update Meta Data Get Command MAY be delayed if time is required to store the most recent firmware fragment in temporary non-volatile memory. A node MAY
CC:007A.03.05.13.002    request multiple Firmware Update Meta Data Report Commands to improve throughput.

CC:007A.03.05.13.003    RAM may be a limited resource. A node MAY adjust the size of incoming Firmware Update Meta Data Report Commands to the available first level RAM receive buffer by reporting the desired Max Fragment Size when returning a Firmware Meta Data Report Command in response to a Firmware Update Meta Data Get Command.

Two exceptions may apply: A noise burst may interfere the transmission or the data source may stop returning Firmware Update Meta Data Report Commands.

CC:007A.03.05.12.001    To accommodate for bursts of RF noise, a device receiving data SHOULD repeatedly retransmit the same Firmware Update Meta Data Get Command every 10 seconds in case no Firmware Update Meta Data Report Commands are received.
CC:007A.03.05.12.002    A device receiving data SHOULD stop retransmitting Firmware Update Meta Data Get commands 2 minutes after the last successful reception of a Firmware Update Meta Data Report Command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_GET | | | | | | | |
| Number of Reports | | | | | | | |
| Res | | Report Number 1 | | | | | |
| Report Number 2 | | | | | | | |

**Res**

CC:007A.03.05.11.006    This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Number of Reports (8 bits)**

Number of Firmware Update Meta Data Report Commands to be received in response to a single Firmware Update Meta Data Get Command.

CC:007A.03.05.11.007   The requesting node MUST keep track of missing Firmware Update Meta Data Report Commands.

**Report Number (15 bits)**

CC:007A.03.05.11.008   The Report number field indicates the sequence number of the requested firmware fragment. The first firmware fragment MUST be identified by the Report Number value 1.

CC:007A.03.05.11.009   Report number 1 MUST be the most significant byte.

CC:007A.03.05.11.00A   If the Number of Reports field is larger than 1, the Report Number MUST identify the first firmware fragment in the requested sequence of firmware fragments.

### 4.5.7    Firmware Update Meta Data Report Command

The Firmware Update Meta Data Report command is used to transfer a firmware image fragment.

CC:007A.03.06.11.001    If sending more than a single Firmware Update Meta Data Report Command at a time, a node MUST apply a delay between each transmitted command. The minimum required time delay and number of frames before a delay must be inserted depends on the actual bit rate.

- 40 kbit/s: At least 35 ms if sending more than 1 frame back-to-back
- 100 kbit/s: At least 15 ms if sending more than 2 frames back-to-back

After receiving all Firmware Update Meta Data Report Commands required for a complete firmware image, a receiving node MUST store the firmware image in the Firmware Target specified in a previously received Firmware Update Meta Data Request Get Command.

CC:007A.03.06.12.001    If needed, a controlling node SHOULD abort an ongoing transfer by responding to a Firmware Update Meta Data Get Command with a Firmware Update Meta Data Report Command with the Last bit enabled and the Data fields intentionally corrupted while the Checksum field of the Firmware Update Meta Data Report Command is valid, i.e. calculated over the corrupted Data fields.
This will invalidate the calculated firmware checksum, which should eventually cause the receiving device to return a Firmware Update Meta Data Status Report Command with the status code <checksum error>.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REPORT | | | | | | | |
| Last | Report number 1 | | | | | | |
| Report number 2 | | | | | | | |
| Data 1 | | | | | | | |
| … | | | | | | | |
| Data N | | | | | | | |
| Checksum 1 | | | | | | | |
| Checksum 2 | | | | | | | |

All fields not described below remain unchanged from version 2.

**Last (1 bit)**

This field indicates if the Firmware Update Meta Data Report Command is the last one.

CC:007A.03.06.11.002    The value 1 MUST indicate that this is the last report. Otherwise the field MUST be set to 0.

CC:007A.03.06.11.003    On the reception of the last image fragment, the receiving node MUST verify that the transferred image does match the indicated Manufacturer ID, Firmware ID and Firmware Target values.

**Checksum (16 bits)**

CC:007A.03.06.11.004    The checksum field MUST be used to ensure the consistency of the entire command; including the command class and command identifiers.

CC:007A.03.06.12.002 It is RECOMMENDED to use a checksum algorithm that implements the CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation).

CC:007A.03.06.11.005 The checksum algorithm used for the Firmware Update Meta Data Command Class, version 3 MUST be the same as the algorithm used for the Firmware Update Meta Data Command Class, version 2 in the actual product.

The Checksum field is known to cause compatibility issues with version 1 devices. Refer to 4.4.1.

### 4.5.8    Firmware Update Meta Data Status Report Command

This command is used to advertise the firmware update status.

CC:007A.03.07.11.001 The command MUST be issued when the firmware update is completed or aborted by the device receiving the firmware.

CC:007A.03.07.11.002 A node MUST NOT issue the Firmware Update Meta Data Get Command after receiving a Firmware Update Meta Data Status Report.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_STATUS_REPORT | | | | | | | |
| Status | | | | | | | |
| WaitTime MSB | | | | | | | |
| WaitTime LSB | | | | | | | |

**Status (8 bits)**

CC:007A.03.07.11.003 This field MUST comply with Table 10.

CC:007A.03.07.13.001 The status code 0xFE MAY be used for confirming the successful transfer of images which do not necessitate a restart, e.g. security certificates.

CC:007A.03.07.11.004 The status code 0xFE MUST NOT be advertised after the transfer of an image for the Firmware ID 0 target (the "Z-Wave chip" image).

CC:007A.03.07.11.005 Controlling nodes implementing earlier versions of the Firmware Update Meta Data CC do not support status codes defined for newer versions. Therefore, a node returning the Firmware Update Meta Data Status Report Command MUST comply with the version implemented on the controlling device (device sending the image). The device returning the Firmware Update Meta Data Status Report can identify the version of the controlling device based on the Firmware Update Meta Data Request Get. This may be done as follows:

- If the Firmware Update Meta Data Request Get does not include Firmware Target and Fragment Size (8 bytes), the controller is version 1 or 2
- If the Firmware Update Meta Data Request Get includes Firmware Target and Fragment Size but not Activation (11 bytes), the controller is version 3

**WaitTime (16 bits)**

CC:007A.03.07.11.006    The WaitTime field MUST report the time that is needed before the receiving node again becomes available for communication after the transfer of an image. The unit is the second.

CC:007A.03.07.11.007    The value 0 (zero) MUST indicate that the node is ready.
The value 0xFFFF is reserved and MUST NOT be returned.

CC:007A.03.07.12.001    A controlling node receiving this command SHOULD wait for the number of seconds specified in this field before trying to resume communication. When resuming communication, the controlling application
CC:007A.03.07.12.002    SHOULD issue a NOP command and wait for acknowledgement.
CC:007A.03.07.13.002    The controlling application MAY attempt resuming communication repeatedly. In that case, the NOP
CC:007A.03.07.11.008    interval SHOULD be five seconds and MUST be at least one second.

### 4.6    Firmware Update Meta Data Command Class, version 4

The Firmware Update Meta Data Command Class may be used to transfer a firmware image to a
Z-Wave device.

#### 4.6.1    Compatibility considerations

All commands and fields not described in this version remain unchanged from version 3.

CC:007A.04.00.21.001

CC:007A.04.00.21.002

A device implementing Firmware Update Meta Data Command Class, version 4 MUST also implement
Firmware Update Meta Data Command Class, versions 3.
While support for version 1 has been deprecated, a controlling device implementing Firmware Update
Meta Data Command Class, version 2 MUST also be able to control Firmware Update Meta Data
Command Class, version 1 based devices.

#### 4.6.1.1       New commands, fields and values

The Firmware Update Meta Data Command Class version 4 supports delaying and scheduling a
firmware update after downloading the image.

Version 4 updates the Firmware Update Meta Data Request Get Command and introduces the following
commands:

- New Firmware Update Activation Set Command
- New Firmware Update Activation Status Report

After downloading an image, a device may use the Firmware Update Meta Data Status Report
Command to indicate to the controlling device that the device is waiting for an activation command.

#### 4.6.2    Interoperability considerations

#### 4.6.2.1       Interoperability with v1 devices

Version 2 of the Firmware Update Meta Data Report command introduces a 16-bit Checksum field to
follow the variable-length Data field. No fields follow the variable-length Data field in Version 1 of the
Firmware Update Meta Data Report command. Version 4 of the Firmware Update Meta Data Report
command uses the v2 format.

At the same time, the specified method for determining the length of the variable-length Data field is that
the length must be calculated from the length of the received frame.

The unintended consequence is that a version 1 implementation receiving a Firmware Update Meta Data
Report v2 command will consider the 16-bit Checksum field to be the last two bytes of the Data field.
Similarly, a version 2 implementation receiving a Firmware Update Meta Data Report v1 command will
consider the last two bytes of the Data field to be the 16-bit Checksum field.
In either case, the transfer will fail.

Therefore, a controlling device implementing the Firmware Update Meta Data Command Class, version 2 MUST do the following when initiating the transfer of a firmware image:

1. Request the version of the Firmware Update Meta Data Command Class from the target device
2. Use the version of the Firmware Update Meta Data Report implemented by the target device
3. Determine the number of Data bytes that can fit into the Firmware Update Meta Data Report command so that the complete command can still fit into the payload field of the transport frame. The number of available payload bytes in the frame depends on the actual bit rate, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report

### 4.6.2.2 Checksum calculation

Version 1 of the Firmware Update Meta Data Command Class introduced a 16-bit Checksum field used to verify firmware image integrity. It has been a recommendation to use the CRC-CCITT polynomial for calculating checksums. Nodes having implemented another method for calculating the checksum will find a non-matching checksum.

From Version 5 onwards, the checksum calculation method is mandatory.

For more details about the checksum calculation, refer to Appendix B

### 4.6.3 Firmware Update Meta Data Request Get Command

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REQUEST_GET | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Checksum 1 | | | | | | | |
| Checksum 2 | | | | | | | |
| Firmware Target | | | | | | | |
| Fragment Size 1 | | | | | | | |
| Fragment Size 2 | | | | | | | |
| Reserved | | | | | | | Activation |

All fields not described below remain unchanged from version 3.

**Activation (1 bit)**

The Activation field is used to advertise if the receiving node may delay the actual firmware update.

CC:007A.04.03.11.001

The field MUST be interpreted as:

CC:007A.04.03.13.001
CC:007A.04.03.11.002

- '1': The receiving device MAY delay the actual firmware update.
  If the receiving node delays the firmware update, the delay MUST be advertised via the Status code 0xFD in the Firmware Update Meta data Status Report Command.

CC:007A.04.03.11.003

- '0': The receiving device MUST NOT delay the firmware update.

### 4.6.4   Firmware Update Meta Data Status Report Command

This command is used to advertise the firmware update status.

CC:007A.04.07.11.001   The command MUST be issued when the firmware update is completed or aborted by the device receiving the firmware.

CC:007A.04.07.11.002   A node MUST NOT issue the Firmware Update Meta Data Get Command after receiving a Firmware Update Meta Data Status Report.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_STATUS_REPORT | | | | | | | |
| Status | | | | | | | |
| WaitTime MSB | | | | | | | |
| WaitTime LSB | | | | | | | |

All fields not described below remain unchanged from version 3.

**Status (8 bits)**

CC:007A.04.07.11.003   This field MUST comply with Table 10.

CC:007A.04.07.13.001   The status code 0xFD MAY be used by a version 4 device for confirming that an image has been successfully transferred but that the actual firmware update will not be performed until a Firmware Update Activation Set Command is received.

CC:007A.04.07.13.002   The Firmware Update Activation Set Command MAY be delayed for any period of time. The delay may be controlled via the Schedule Command Class.

CC:007A.04.07.13.003   The status code 0xFE MAY be used for confirming the successful transfer of an image which does not necessitate a restart, e.g. security a certificate.

CC:007A.04.07.11.004   The status code 0xFE MUST NOT be advertised after the transfer of an image for the Firmware ID 0 target (the "Z-Wave chip" image).

CC:007A.04.07.11.005   Controlling nodes implementing earlier versions of the Firmware Update Meta Data CC do not support status codes defined for newer versions. Therefore, a node returning the Firmware Update Meta Data Status Report Command MUST comply with the version implemented on the controlling device (device sending the image). The device returning the Firmware Update Meta Data Status Report can identify the version of the controlling device based on the Firmware Update Meta Data Request Get. This may be done as follows:

- If the Firmware Update Meta Data Request Get does not include Firmware Target and Fragment Size (8 bytes), the controller is version 1 or 2
- If the Firmware Update Meta Data Request Get includes Firmware Target and Fragment Size but not Activation (11 bytes), the controller is version 3
- If the Firmware Update Meta Data Request Get includes Activation (12 bytes), the controller is version 4

### 4.6.5    Firmware Update Activation Set Command

This command is used to initiate the programming of a previously transferred firmware image.
Refer to the Firmware Update Meta Data Status Report Command Status code 0xFD.

CC:007A.04.08.13.001   This command MAY be issued directly by a controlling node or MAY be scheduled for later execution via the Schedule Command Class.

CC:007A.04.08.11.001   The Firmware Update Activation Status Report Command MUST be returned in response to this command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_ACTIVATION_SET | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Checksum 1 | | | | | | | |
| Checksum 2 | | | | | | | |
| Firmware Target | | | | | | | |

For fields' description, refer to the Firmware Update Meta Data Request Get Command.

### 4.6.6    Firmware Update Activation Status Report

This command is used to advertise the result of a firmware update operation initiated by the Firmware Update Activation Set Command.

CC:007A.04.09.11.001

The Firmware Update Activation Status Report fields MUST reflect the values specified in the Firmware Update Activation Set Command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_ACTIVATION_STATUS_REPORT | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Checksum 1 | | | | | | | |
| Checksum 2 | | | | | | | |
| Firmware Target | | | | | | | |
| Firmware Update Status | | | | | | | |

For fields not described below, refer to the Firmware Update Meta Data Request Get Command.

**Firmware Update Status (8 bits)**

CC:007A.04.09.11.002

This field MUST comply with Table 11.

### 4.7    Firmware Update Meta Data Command Class, version 5

The Firmware Update Meta Data Command Class may be used to transfer a firmware image to or from a Z-Wave node.

#### 4.7.1    Compatibility considerations

CC:007A.05.00.21.001    A device implementing Firmware Update Meta Data Command Class, version 5 MUST also implement Firmware Update Meta Data Command Class, version 4.

Firmware Update Meta Data Command Class, version 5 is backwards compatible with Firmware Update Meta Data Command Class, version 4.

All commands and fields not mentioned in this version remain unchanged from version 4.

#### 4.7.1.1    New commands, fields and values

The Firmware Update Meta Data Command Class, version 5 introduces the support of a hardware identifier to uniquely identify firmware images that can be loaded on devices. This allows devices running identical software version on different hardware revisions to receive the correct firmware image.

The following commands are extended from version 4:

- Firmware Meta Data Report Command
- Firmware Update Meta Data Request Get Command
- Firmware Update Meta Data Request Report Command
- Firmware Update Meta Data Status Report Command
- Firmware Update Activation Set Command
- Firmware Update Activation Status Report Command

The Firmware Update Meta Data Command Class, version 5 also introduces the support firmware download from the Z-Wave node to the controller.

The following commands are introduced:

- Firmware Update Meta Data Prepare Get Command
- Firmware Update Meta Data Prepare Report Command

### 4.7.2    Interoperability Considerations

#### 4.7.2.1          Interoperability with v1 devices

Version 2 of the Firmware Update Meta Data Report command introduces a 16-bit Checksum field to follow the variable-length Data field. No fields follow the variable-length Data field in Version 1 of the Firmware Update Meta Data Report command. Version 5 of the Firmware Update Meta Data Report command uses the version 2 format.

At the same time, the specified method for determining the length of the variable-length Data field is that the length must be calculated from the length of the received frame.

The unintended consequence is that a version 1 implementation receiving a Firmware Update Meta Data Report version 2 Command will consider the 16-bit Checksum field to be the last two bytes of the Data field.
Similarly, a version 2 implementation receiving a Firmware Update Meta Data Report version 1 Command will consider the last two bytes of the Data field to be the 16-bit Checksum field.
In either case, the transfer will fail.

CC:007A.05.00.31.001

Therefore, a controlling device implementing the Firmware Update Meta Data Command Class, version 2 MUST do the following when initiating the transfer of a firmware image:

1. Request the version of the Firmware Update Meta Data Command Class from the target device
2. Use the version of the Firmware Update Meta Data Report implemented by the target device
3. Determine the number of Data bytes that can fit into the Firmware Update Meta Data Report command so that the complete command can still fit into the payload field of the transport frame. The number of available payload bytes in the frame depends on the actual bit rate, the use of security encapsulation as well as the presence of Checksum bytes in the Firmware Update Meta Data Report

#### 4.7.2.2          Checksum calculation

Version 1 of the Firmware Update Meta Data Command Class introduced a 16-bit Checksum field used to verify firmware image integrity. It has been a recommendation to use the CRC-CCITT polynomial for calculating checksums. There is no way to identify what method has been used for calculating the checksum for nodes implementing version 1 to version 4. Nodes having implemented another method for calculating the checksum will find a non-matching checksum.

From Version 5 onwards, the checksum calculation method is mandatory.

For more details about the checksum calculation, refer to Appendix B

### 4.7.3 Firmware Meta Data Report Command

This command is used to advertise the status of the current firmware in the device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_MD_REPORT | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware 0 ID 1 | | | | | | | |
| Firmware 0 ID 2 | | | | | | | |
| Firmware 0 Checksum 1 | | | | | | | |
| Firmware 0 Checksum 2 | | | | | | | |
| Firmware Upgradable | | | | | | | |
| Number of Firmware Targets | | | | | | | |
| Max Fragment Size 1 | | | | | | | |
| Max Fragment Size 2 | | | | | | | |
| Firmware 1 ID 1 | | | | | | | |
| Firmware 1 ID 2 | | | | | | | |
| … | | | | | | | |
| Firmware N ID 1 | | | | | | | |
| Firmware N ID 2 | | | | | | | |
| Hardware Version | | | | | | | |

All fields not described below remain unchanged from version 4.

**Firmware 0 Checksum (16 bits)**

The checksum field MUST carry the checksum of the Firmware 0 Image.

CC:007A.05.02.11.001 The checksum MUST be calculated using the CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation).

For more details, refer to Appendix B

**Hardware Version (8 bits)**

CC:007A.05.02.11.002
CC:007A.05.02.11.003
This field MUST report a value which is unique to this particular version of the product.
It MUST be possible to uniquely identify applicable firmware images via the Manufacturer ID, Firmware ID and the Hardware Version fields. This information allows selecting a firmware image that is guaranteed to work with this particular version of the product.

CC:007A.05.02.11.004
The Hardware Version field MUST apply to the entire product and not only to the version of the Z-Wave radio chip.

CC:007A.05.02.11.005
This field MUST report the same value as the Version CC Version Report Command: Hardware Version field.

### 4.7.4    Firmware Update Meta Data Request Get Command

This command is used to request that a firmware update is initiated by the node receiving this command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REQUEST_GET | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Firmware Checksum 1 | | | | | | | |
| Firmware Checksum 2 | | | | | | | |
| Firmware Target | | | | | | | |
| Fragment Size 1 | | | | | | | |
| Fragment Size 2 | | | | | | | |
| Reserved | | | | | | | Activation |
| Hardware Version | | | | | | | |

All fields not described below remain unchanged from version 4.

**Firmware Checksum (16 bits)**

CC:007A.05.03.11.001
The checksum field MUST carry the checksum of the firmware image about to be transferred.

CC:007A.05.03.11.002
The checksum MUST be calculated using the CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation).

For more details, refer to Appendix B

**Hardware Version (8 bits)**

Refer to 4.7.3 Firmware Meta Data Report Command.

### 4.7.5 Firmware Update Meta Data Request Report Command

This command is used to advertise if the firmware update will be initiated.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_REQUEST_REPORT | | | | | | | |
| Status | | | | | | | |

**Status (8 bits)**

CC:007A.05.04.11.001   The Status field MUST comply with Table 9.

**Table 9, Firmware Update Meta Data Request Report::Status encoding**

| Status | Description | Version |
|--------|-------------|---------|
| 0x00 | ERROR. Invalid combination of Manufacturer ID and Firmware ID. The device will not initiate the firmware update. | 1 |
| 0x01 | ERROR. Device expected an authentication event to enable firmware update. The device will not initiate the firmware update. | 1 |
| 0x02 | ERROR. The requested Fragment Size exceeds the Max Fragment Size. The device will not initiate the firmware update. | 3 |
| 0x03 | ERROR. This firmware target is not upgradable. The device will not initiate the firmware update. | 3 |
| 0x04 | ERROR. Invalid Hardware Version. The device will not initiate the firmware update. | 5 |
| 0xFF | OK. The device will initiate the firmware update of the target specified in the Firmware Update Meta Data Request Get Command. | 1 |

CC:007A.05.04.11.002   All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

### 4.7.6    Firmware Update Meta Data Status Report Command

This command is used to advertise the firmware update status.

CC:007A.05.07.11.001    The command MUST be issued when the firmware update is completed or aborted by the device receiving the firmware.

CC:007A.05.07.11.002    A device MUST NOT issue the Firmware Update Meta Data Get Command after receiving a Firmware Update Meta Data Status Report.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_STATUS_REPORT | | | | | | | |
| Status | | | | | | | |
| WaitTime MSB | | | | | | | |
| WaitTime LSB | | | | | | | |

All fields not described below are the same as in version 4.

**Status (8 bits)**

CC:007A.05.07.11.003    This field MUST comply with Table 10.

CC:007A.05.07.13.001    The status code 0xFD MAY be used by a version 4 device for confirming that an image has been successfully transferred but that the actual firmware update will not be performed until a Firmware Update Activation Set Command is received.

CC:007A.05.07.13.002    The Firmware Update Activation Set Command MAY be delayed for any period of time. The delay may be controlled via the Schedule Command Class.

CC:007A.05.07.13.003    The status code 0xFE MAY be used for confirming the successful transfer of an image which does not necessitate a restart, e.g. security a certificate.

CC:007A.05.07.11.004    The status code 0xFE MUST NOT be advertised after the transfer of an image for the Firmware ID 0 target (the "Z-Wave chip" image).

CC:007A.05.07.11.005    Controlling nodes implementing earlier versions of the Firmware Update Meta Data CC do not support status codes defined for newer versions. Therefore, a device returning the Firmware Update Meta Data Status Report Command MUST comply with the version implemented on the controlling device (device sending the image). The device returning the Firmware Update Meta Data Status Report can identify the version of the controlling device based on the Firmware Update Meta Data Request Get. This may be done as follows:

- If the Firmware Update Meta Data Request Get does not include Firmware Target and Fragment Size (8 bytes), the controller is version 1 or 2
- If the Firmware Update Meta Data Request Get includes Firmware Target and Fragment Size but not Activation (11 bytes), the controller is version 3
- If the Firmware Update Meta Data Request Get includes Activation but not Hardware Version (12 bytes), the controller is version 4
- If the Firmware Update Meta Data Request Get includes Hardware Version (13 bytes), the controller is version 5.

**Table 10, Firmware Update Meta Data Status Report::Status encoding**

| Status | Description | Version |
|--------|-------------|---------|
| 0x00 | The device was unable to receive the requested firmware data without checksum error.<br>Number of retries and request sequence of missing frames are implementation specific. The image is not stored. | 1 |
| 0x01 | The device was unable to receive the requested firmware data.<br>Number of retries and request sequence of missing frames are implementation specific. The image is not stored. | 1 |
| 0x02 | The transferred image does not match the Manufacturer ID.<br>The image is not stored. | 4 |
| 0x03 | The transferred image does not match the Firmware ID.<br>The image is not stored. | 4 |
| 0x04 | The transferred image does not match the Firmware Target.<br>The image is not stored. | 4 |
| 0x05 | Invalid file header information.<br>The image is not stored. | 4 |
| 0x06 | Invalid file header format.<br>The image is not stored. | 4 |
| 0x07 | Insufficient memory.<br>The image is not stored. | 4 |
| 0x08 | The transferred image does not match the Hardware version<br>The image is not stored | 5 |
| … | *Reserved* | - |
| 0xFD | Firmware image downloaded successfully, waiting for activation command. | 4 |
| 0xFE | New image was successfully stored in temporary non-volatile memory.<br>The device does not restart itself.<br>This Status code MUST NOT be used when updating the Z-Wave chip image | 3 |
| 0xFF | New image was successfully stored in temporary non-volatile memory.<br>The device will now start storing the new image in primary non-volatile memory dedicated to executable code. Then the device will restart itself. | 1 |

CC:007A.05.07.11.006 All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

### 4.7.7 Firmware Update Activation Set Command

This command is used to initiate the programming of a previously transferred firmware image.
Refer to the Firmware Update Meta Data Status Report Command Status code 0xFD.

CC:007A.05.08.13.001 This command MAY be issued directly by a controlling node or MAY be scheduled for later execution via the Schedule Command Class.

CC:007A.05.08.11.001 The Firmware Update Activation Status Report Command MUST be returned in response to this command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD ||||||||
| Command = FIRMWARE_UPDATE_ACTIVATION_SET ||||||||
| Manufacturer ID 1 ||||||||
| Manufacturer ID 2 ||||||||
| Firmware ID 1 ||||||||
| Firmware ID 2 ||||||||
| Firmware Checksum 1 ||||||||
| Firmware Checksum 2 ||||||||
| Firmware Target ||||||||
| Hardware Version ||||||||

All fields not described below remain unchanged from version 4.

**Firmware Checksum (16 bits)**

CC:007A.05.08.11.002 The checksum field MUST carry the checksum of the firmware image about to be activated.

CC:007A.05.08.11.003 The checksum MUST be calculated using the CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation).

For more details, refer to Appendix B

**Hardware Version (8 bits)**

Refer to 4.7.3 Firmware Meta Data Report Command.

### 4.7.8 Firmware Update Activation Status Report Command

This command is used to advertise the result of a firmware update operation initiated by the Firmware Update Activation Set Command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_ACTIVATION_STATUS_REPORT | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Firmware Checksum 1 | | | | | | | |
| Firmware Checksum 2 | | | | | | | |
| Firmware Target | | | | | | | |
| Firmware Update Status | | | | | | | |
| Hardware Version | | | | | | | |

All fields not described below remain unchanged from version 4.

**Firmware Checksum (16 bits)**

CC:007A.05.09.11.001 The checksum field MUST carry the checksum of the firmware image activated by the Firmware Update Activation Set Command.

CC:007A.05.09.11.002 The checksum MUST be calculated using the CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation).

For more details, refer to Appendix B

**Hardware Version (8 bits)**

Refer to 4.7.3 Firmware Meta Data Report Command.

**Firmware Update Status (8 bits)**

CC:007A.05.09.11.003 The Firmware Update Status field MUST comply with Table 11.

**Table 11, Firmware Update Activation Status Report::Firmware Update Status encoding**

| Status | Description | Version |
|--------|-------------|---------|
| 0x00 | Invalid combination of manufacturer ID, firmware ID and Hardware Version or Firmware Target. The received image will not be stored. | 4 |
| 0x01 | Error activating the firmware. Last known firmware image has been restored. | 4 |
| … | *Reserved* | - |
| 0xFF | Firmware update completed successfully. | 4 |

All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

### 4.7.9    Firmware Update Meta Data Prepare Get Command

This command is used to request that a firmware download is initiated by the node sending this command.

CC:007A.05.0A.11.001    The Firmware Update Meta Data Prepare Report Command MUST be returned in response to this command when the receiving node is ready to send the requested firmware image.

CC:007A.05.0A.11.002
CC:007A.05.0A.11.003    This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

CC:007A.05.0A.12.001    Any image transferred via the Firmware Update Meta Data Command Class SHOULD include a fingerprint value to enable the validation of the integrity of the entire image after the transfer. The image
CC:007A.05.0A.11.004    and the fingerprint value MUST be packed in one entity which can be stored in one file and transferred as one entity.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_PREPARE_GET | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Firmware ID 1 | | | | | | | |
| Firmware ID 2 | | | | | | | |
| Firmware Target | | | | | | | |
| Fragment Size 1 | | | | | | | |
| Fragment Size 2 | | | | | | | |
| Hardware Version | | | | | | | |

Refer to 4.7.4 Firmware Update Meta Data Request Get Command for field description.

### 4.7.10 Firmware Update Meta Data Prepare Report Command

This command is used to advertise if the firmware image has been prepared and is ready to be transferred.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_FIRMWARE_UPDATE_MD | | | | | | | |
| Command = FIRMWARE_UPDATE_MD_PREPARE_REPORT | | | | | | | |
| Status | | | | | | | |
| Firmware Checksum 1 | | | | | | | |
| Firmware Checksum 2 | | | | | | | |

**Status (8 bits)**

CC:007A.05.0B.11.001 The Status field MUST comply with Table 12.

**Table 12, Firmware Update Meta Data Prepare Report::Status encoding**

| Status | Description | Version |
|--------|-------------|---------|
| 0x00 | ERROR. Invalid combination of Manufacturer ID and Firmware ID. The receiving node MUST NOT initiate the firmware download. | 5 |
| 0x01 | ERROR. Device expected an authentication event to enable firmware update. The receiving node MUST NOT initiate the firmware download. | 5 |
| 0x02 | ERROR. The requested Fragment Size exceeds the Max Fragment Size. The receiving node MUST NOT initiate the firmware download. | 5 |
| 0x03 | ERROR. This firmware target is not downloadable. The receiving node MUST NOT initiate the firmware download. | 5 |
| 0x04 | ERROR. Invalid Hardware Version. The receiving node MUST NOT initiate the firmware download. | 5 |
| 0xFF | OK. The receiving node can initiate the firmware download of the target specified in the Firmware Update Meta Data Prepare Get Command. | 5 |

CC:007A.05.0B.11.002 All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

**Firmware Checksum (16 bits)**

CC:007A.05.0B.11.003 The checksum field MUST carry the checksum of the firmware image about to be transferred.

CC:007A.05.0B.11.004 The checksum MUST be calculated using the CRC-CCITT polynomium using initialization value equal to 0x1D0F and 0x1021 (normal representation).

For more details, refer to Appendix B

### 4.7.11  Examples

#### 4.7.11.1  Identifying firmware revisions

The different fields Manufacturer ID, Firmware ID and Hardware version are used to identify compatible firmware image with the product.

The Version Command Class is also used for identifying the Firmware version/subversion

An example of the different fields' usage for a wall outlet is shown in Table 13

**Table 13, Labelling different Firmware revisions**

| Product | Firmware identification | | | |
|---|---|---|---|---|
| | Manufacturer ID | Hardware Version | Firmware ID | Firmware version /sub-version |
| Initial Wall Outlet | 0x0001 | 0x01 | 0x0001 | 0x01 / 0x01 |
| New revision | | | | |
| Fixing previous bugs | 0x0001 | 0x01 | 0x0001 | 0x01 / 0x02 |
| New revision | | | | |
| Introducing new features (e.g. multiple press) | 0x0001 | 0x01 | 0x0001 | 0x02 / 0x01 |
| New revision | | | | |
| US version (initial version) | 0x0001 | 0x01 | 0x0001 | 0x02 / 0x01 |
| China version (matching local requirements) | 0x0001 | 0x01 | 0x0002 | 0x02 / 0x01 |
| New revision | | | | |
| Proximity Sensor added (US) | 0x0001 | 0x02 | 0x0001 | 0x02 / 0x01 |
| Proximity Sensor added (China) | 0x0001 | 0x02 | 0x0002 | 0x02 / 0x01 |
| New revision | | | | |
| Adding S2 Capability (without proximity sensor, US) | 0x0001 | 0x01 | 0x0001 | 0x03 / 0x01 |
| Adding S2 Capability (without proximity sensor, China) | 0x0001 | 0x01 | 0x0002 | 0x03 / 0x01 |
| Adding S2 Capability (with proximity sensor, US) | 0x0001 | 0x02 | 0x0001 | 0x03 / 0x01 |
| Adding S2 Capability (with proximity sensor, US) | 0x0001 | 0x02 | 0x0002 | 0x03 / 0x01 |

An illustration of a controller retrieving the firmware information is given in Figure 5

**In the Report Command, the controller finds :**

Manufacturer ID: Which identifies the product manufacturer

Firmware n ID: Which identifies whether the firmware implements a particular variant, feature, or is matched to a given world region for example.

Hardware Version: Which tells what chips, optional buttons or LEDs the product hardware implements. The same information can be retrieved thanks to Version CC.

**In the Report Command, the controller finds :**

Firmware n Version / Subversion: Which identifies the each firmware ID application version and subversion

Hardware Version: Which MUST be the same as in Firmware Update Meta Data CC

**Figure 5, Identifying compatible firmware images**

### 4.7.11.2 Firmware download

The use of the Firmware Update Meta Data Prepare Get and Firmware Update Meta Data Prepare Report commands is illustrated in Figure 6.
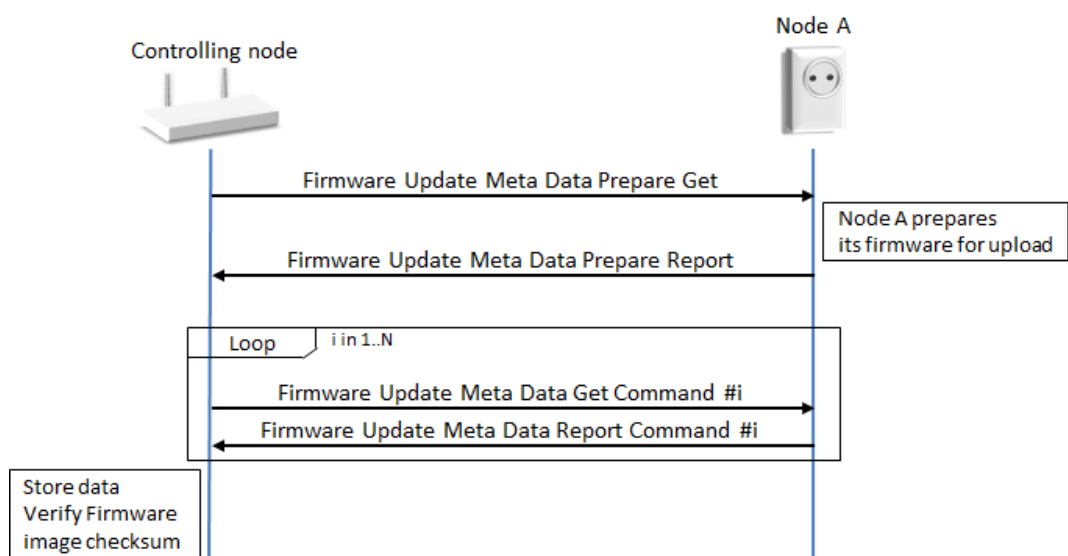


**Figure 6, Firmware download flow diagram**

### 4.8 Grouping Name Command Class, version 1 [DEPRECATED]

**THIS COMMAND CLASS HAS BEEN DEPRECATED**

A device MAY implement this command class, but it is RECOMMENDED that new implementations use the Association Group Information (AGI) Command Class for naming association groups.
If implementing this command class, it is RECOMMENDED that the Association Group Information (AGI) Command Class is also implemented.

The Grouping Name Command Class is used to transfer name of groupings (as defined by the grouping identifier in the Association Command Class).

#### 4.8.1 Grouping Name Set Command

The Grouping Name Set Command used to set a grouping Identifier name.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_GROUPING_NAME | | | | | | | |
| Command = GROUPING_NAME_SET | | | | | | | |
| Grouping identifier | | | | | | | |
| Reserved | | | | | Char. Presentation | | |
| Grouping Name 1 | | | | | | | |
| … | | | | | | | |
| Grouping Name N | | | | | | | |

**Grouping Identifier (8 bits)**

The field specifies the Grouping ID.

**Reserved**

This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Char. Presentation (3 bits)**

The char presentation identifier MAY be set to the following values:

| Char. Presentation | Description |
|---|---|
| 0 | Using standard ASCII codes, see appendices in [2] (values 128-255 are ignored) |
| 1 | Using standard and OEM Extended ASCII codes, see appendices in [2] |
| 2 | Unicode UTF-16 |

**Note:** Devices supporting Unicode UTF-16 characters can have strings of a maximum of 8 characters because each character is described by a 2 byte long decimal representation. The first byte is the most significant byte. I.e. if there is one Unicode character in the set frame the char 1 will be MSB and char 2 will be LSB of the Unicode character.

All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

**Grouping Name (N bytes)**

Grouping name using specified character representation.

The Grouping name MAY have a maximum of 16 characters and a minimum of 0 characters. The number of character fields transmitted MUST be determined from the frame length. If a frame with more than 16 characters is received, the receiving node MUST ignore any characters following the 16<sup>th</sup> character.

### 4.8.2 Grouping Name Get Command

The Grouping Name Get Command is used to request a grouping Identifier name.

The Grouping Name Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_GROUPING_NAME | | | | | | | |
| Command = GROUPING_NAME_GET | | | | | | | |
| Grouping identifier | | | | | | | |

**Grouping Identifier (8 bits)**

The field specifies the grouping identifier.

### 4.8.3    Group Name Report Command

The Grouping Name Report Command is used to report the grouping Identifier name.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_GROUPING_NAME | | | | | | | |
| Command = GROUPING_NAME_REPORT | | | | | | | |
| Grouping identifier | | | | | | | |
| Reserved | | | | | Char. Presentation | | |
| Grouping Name 1 | | | | | | | |
| … | | | | | | | |
| Grouping Name N | | | | | | | |

**Grouping Identifier (8 bits)**

The field specifies the grouping identifier.

**Reserved**

This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Char. Presentation (3 bits)**

Refer to description under the Grouping Name Set Command

**Grouping Name (N bytes)**

The Grouping Name fields contain the assigned group name. The Group Name can have a maximum of 16 characters and a minimum of 0 characters.

### 4.9    Hail Command Class, version 1 [OBSOLETED]

**THIS COMMAND CLASS HAS BEEN OBSOLETED**

New implementations MUST report local state updates via the Lifeline Association Group or use dedicated Command Classes for application specific purposes. Refer to [10]

The Hail Command Class used by applications to hail other devices in the Z-Wave network. The usage of the Hail Command Class is application specific.

### 4.9.1    Hail Command

Application can send unsolicited Hail Command to other devices in a Z-Wave network.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_HAIL | | | | | | | |
| Command = HAIL | | | | | | | |

### 4.10   IP Association Command Class, version 1

The IP Association Command Class is used to create and maintain Z-Wave application bindings between IPv6 hosts. An association group sends a predefined command to the configured destinations when triggered by an event.

IP Association identifies nodes via IPv6 addresses.
IP Association is natively Z-Wave Multi Channel End Point aware.
IP Association groups are specific to a particular End Point or Root Device.

#### 4.10.1   Compatibility considerations

The IP Association Command Class extends the functionality of the Z-Wave Multi Channel Association Command Class. Z-Wave nodes may be represented as Z/IP nodes in an IP subnet. IP Associations may be mapped to classic Z-Wave Multi Channel associations.

The IP Association Remove Command extends the Multi Channel Association Remove Command by adding the ability to clear all groups in all End Points of a node. Only one IP association can be created or maintained with a single command.

In order to respond quickly and to conserve battery, it is RECOMMENDED that a Z/IP Gateway caches IP associations and corresponding Z-Wave associations and only looks up all associations when explicitly instructed to do so.

#### 4.10.2   Terminology

The IP Association Command Class operates on IP primitives but works for all generations of Z-Wave technology. In the following, the term "Classic Z-Wave" refers to operations that are possible with Z-Wave-only releases.

The term "Z-Wave node" is used to identify a Z-Wave node as used in Classic Z-Wave while the term "Z/IP node" denotes an IP enabled Z-Wave node that implements the ICMP echo service and the Z-Wave UDP service. A Z/IP node may implement other IP services. Such IP services are out of scope of this document.

An IP association is created by sending an IP Association Set command from a configuration tool to the association source, instructing the association source to add an association destination to an association group maintained in the association source. The association destination has no knowledge that an association is created.

A Z/IP Gateway represents classic Z-Wave nodes as Z/IP nodes in an IP environment. The Z/IP Gateway therefore maps IP association commands from Z/IP clients to relevant Association and Multi Channel Association commands for Z-Wave nodes.
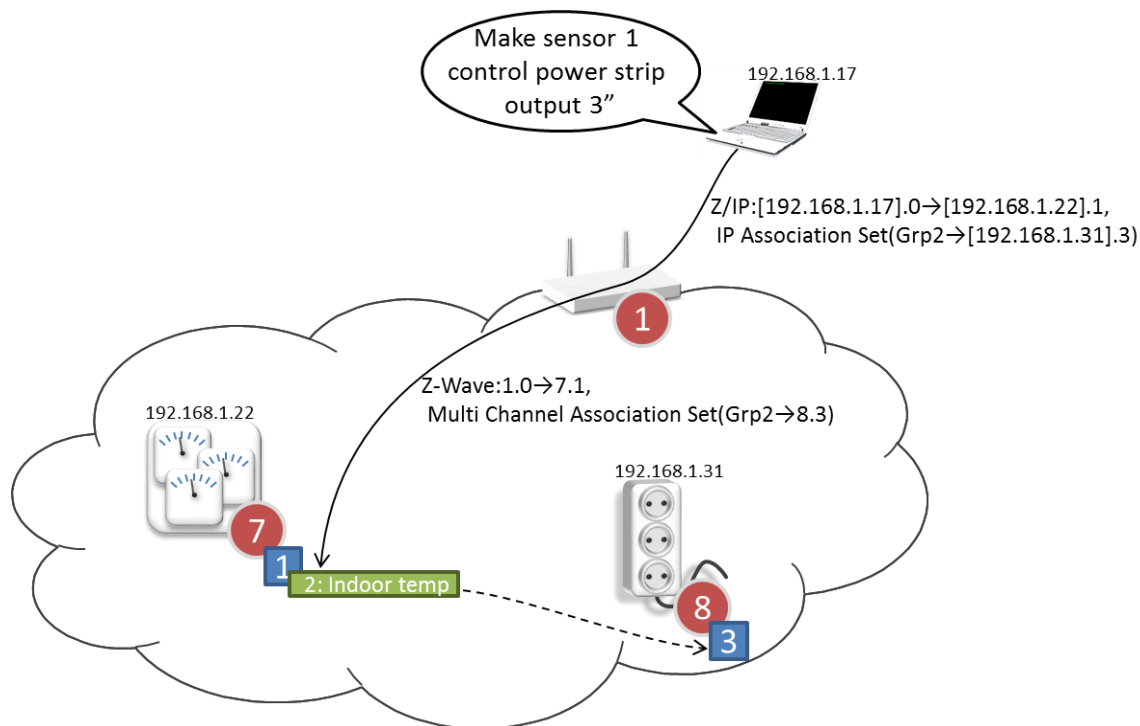


**Figure 7, IP Association example**

### 4.10.3 Z-Wave Multi Channel compatibility considerations

IP Association is natively Multi Channel aware. The same message format is used to create an association to a logical End Point as to the Root Device.

In the Z/IP framework, End Point 0 represents the physical entity.

IP Associations are conceptually created between two Z/IP resources identified by an IPv6 address and an End Point. In case one or both parties are Z-Wave nodes represented as Z/IP nodes, the Z/IP Gateway MUST create Z-Wave associations in the following way, based on the Resource Directory information pertaining to the actual nodes.

A Z/IP gateway MUST map IP associations to Z-Wave associations according to Table 14.

**Table 14, IP association mapping to Z Wave association**

| Association source Multi Channel Capability | Association destination Multi Channel Capability | Association type | Creating the association |
|---|---|---|---|
| - | - | Root Device → Root Device | An Association Set Command MUST be sent un-encapsulated to the association source node |
| ✓ | ✓ | End Point m → End Point n<br><br>m, n MAY be 0 | A Multi Channel Association Set Command MUST be sent Multi Channel encapsulated to the association source End Point.<br><br>A Multi Channel Association from the Lifeline association group of a sensor Root Device enables the transmission of sensor reports with different Source End Points to the Lifeline destination. |
| ✓ | - | End Point m → Root Device | An Association Set Command MUST be sent Multi Channel encapsulated to the association source End Point. |
| - | ✓ | Root Device → End Point n | An Association Set Command MUST be sent un-encapsulated to the association source node. This first association MUST target a NodeID owned by the Z/IP Gateway.<br><br>A second association MUST be created from the abovementioned Z/IP Gateway to the Multi Channel End Point specified in the IP Association Set Command. |

### 4.10.4 Advertising the IP Association Command Class

The Node Information Frame emitted by Classic Z-Wave nodes does not include IP Association. To allow IP clients to issue IP Association commands, the Z/IP Gateway MUST rewrite the list of supported command classes from the node, replacing the Association and Multi Channel Association Command Classes with the IP Association Command Class in the following situations:

- When a Node Info Cached Report is sent to an IP client.
- When a Node Add Status is being sent to an IP client.

In both cases, rewriting MUST NOT be performed if the report is being sent to a native Z-Wave node.

Furthermore, mDNS responses to queries for nodes supporting the IP Association Command Class MUST also advertise nodes supporting the Association and Multi Channel Association Command Classes (but the command classes must be replaced with COMMAND_CLASS_IP_ASSOCIATION before advertised via mDNS).

**4.10.5  IP Association Set Command**

This command is used to add one resource to a given association group.

The receiving IPv6 host SHOULD add the specified destination resource to the specified association group.
This command MAY be ignored if the association group is already full.

Unless the association destination is a gateway, a controlling node SHOULD NOT create an association if the association destination node does not support the controlling commands (Set/Get type) that the actual association group will be sending. The AGI Command Class SHOULD be used to probe the commands that a given association group will be sending.
A controlling node SHOULD NOT create an association if the source and destination nodes are bootstrapped with different security levels.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_IP_ASSOCIATION ||||||||
| Command = IP_ASSOCIATION_SET ||||||||
| Grouping identifier ||||||||
| IPv6 Address 1 ||||||||
| .. ||||||||
| IPv6 Address 16 ||||||||
| End Point ||||||||

**Grouping identifier (8 bits)**

This field is used to specify the actual association group.
Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

**IPv6 Address (16 bytes)**

This field specifies the full IPv6 address for the association destination.
The IPv6 address MUST NOT be compressed.
The IPv6 address SHOULD be in the ULA IPv6 prefix or in a globally routable IPv6 prefix.
The IPv6 address MAY be an IPv4-mapped IPv6 address.
The field MUST NOT carry a link-local IPv6 address.

**End Point (8 bits)**

This field is used in combination with the IPv6 Address to identify the actual resource.

The field represents the Z/IP Bit Address flag (bit 7) as well as the Z/IP 7-bit End Point identifier (bits 6..0).

The receiving node MUST treat this field as one scalar value when adding or removing associations; i.e. any 8-bit End Point value causes one association to be added.

### 4.10.6 IP Association Get Command

This command is used to request active associations for a given association group.The IP Association Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_IP_ASSOCIATION | | | | | | | |
| Command = IP_ASSOCIATION_GET | | | | | | | |
| Grouping identifier | | | | | | | |
| Index | | | | | | | |

**Grouping identifier (8 bits)**

This field is used to specify the actual association group.
Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

If an unsupported Grouping Identifier is specified, the IP Association Report Command returned in response to this command MUST carry IPv6 address and End Point fields which are set to all-zeros.

**Index (8 bits)**

This field is used to specify an entry in the association table for the group identified by the Grouping Identifier.

A requesting host SHOULD start specifying the index value 1.
The actual number of nodes in the association group may be determined from the Actual Nodes field of the IP Association Report.

**4.10.7   IP Association Report Command**

This command is used to advertise one association group entry.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_IP_ASSOCIATION | | | | | | | |
| Command = IP_ASSOCIATION_REPORT | | | | | | | |
| Grouping identifier | | | | | | | |
| Index | | | | | | | |
| Actual Nodes | | | | | | | |
| IPv6 Address 1 | | | | | | | |
| .. | | | | | | | |
| IPv6 Address 16 | | | | | | | |
| End Point | | | | | | | |

**Grouping identifier (8 bits)**

This field is used to identify the actual group of nodes.

**Index (8 bits)**

This field is used to advertise the actual entry in the association group identified by the Grouping Identifier.

**Actual Nodes (8 bits)**

This value indicates the number of nodes in the association group advertised by the Grouping identifier field.

**IPv6 Address (16 bytes)**

This field carries a full IPv6 address with no compression. The address SHOULD be in the ULA IPv6 prefix or in a globally routable IPv6 prefix. The address MAY be an IPv4-mapped IPv6 address. The field MUST NOT carry a link-local IPv6 address.

If the Actual Nodes value is zero, the IPv6 Address field MUST be all zeros.

**End Point (8 bits)**

This field is used in combination with the IPv6 Address to identify the actual resource

If the Actual Nodes value is zero, the End Point field MUST be all zeros.

The field represents the Z/IP Bit Address flag (bit 7) as well as the Z/IP 7-bit End Point identifier (bits 6..0).

### 4.10.8  IP Association Remove Command

This command is used to remove one resource from a given association group.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_IP_ASSOCIATION ||||||||
| Command = IP_ASSOCIATION_REMOVE ||||||||
| Grouping identifier ||||||||
| IPv6 Address 1 ||||||||
| .. ||||||||
| IPv6 Address 16 ||||||||
| End Point ||||||||

**Grouping identifier (8 bits)**

This field is used to specify the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

A receiving node MUST ignore an unsupported Grouping Identifier.

This field MUST be interpreted in combination with the IPv6 Address and End Point fields.

**IPv6 Address    (16 bytes)**
**End Point       (1 byte)**

These fields specify the resources that are to be removed.
The Grouping identifier and these fields MUST be interpreted as follows.

**Table 15, IP Association Remove, V1 :: Parameter interpretation**

| Command parameters | | | |
| --- | --- | --- | --- |
| **Grouping identifier** | **IPv6 Address** | **End Point ID** | **Removal operation** |
| > 0 | <> 0 | = 0 (Root Device) | Remove destination from association group in the association source Root Device |
| > 0 | <> 0 | > 0 (End Point) | Remove destination from association group in the specified association source End Point |
| > 0 | = 0 | = 0 (Root Device) | Remove all destinations from association group in the association source Root Device |
| > 0 | = 0 | > 0 (End Point) | Remove all destinations from association group in the specified association source End Point |
| = 0 | = 0 | = 0 (Root Device) | Remove all destinations from all association groups in the association source Root Device and in all association source End Points |
| = 0 | = 0 | > 0 (End Point) | Remove all destinations from all groups in the specified association source End Point |
| = 0 | <> 0 | >= 0 | *Reserved* |

*) The End Point field represents the Z/IP Bit Address flag (bit 7) as well as the Z/IP 7-bit End Point identifier (bits 6..0).
The receiving node MUST treat the End Point field as one scalar value when removing associations; i.e. any 8-bit End Point value causes one association to be removed.

### 4.11  Manufacturer Specific Command Class, version 1

The Manufacturer Specific Command Class is used to advertise manufacturer specific information.
Version 2 of this command class further allows device specific information to be advertised.

#### 4.11.1  Security Considerations

This Command Class provides information about the device implementation. This information can
potentially be used by an attacker to find vulnerabilities.

CC:0072.01.00.41.001    A supporting node MUST comply with Table 16.

**Table 16, Manufacturer Specific Command Class support**

|  | After Non-Secure inclusion | After Secure inclusion |
|---|---|---|
| **Non-Secure or Less-Secure communication** | The node MUST support the Manufacturer Specific Command Class and advertise it in the NIF. | The node MUST NOT support the Manufacturer Specific Command Class and MUST NOT advertise it in the NIF or Security Command Class Supported Capabilities commands. |
| **Secure communication at the highest Security Class** | N/A. | The node MUST support the Manufacturer Specific Command Class and advertise it in the Security Command Supported Capabilities commands. |

#### 4.11.2  Manufacturer Specific Get Command

This command is used to request manufacturer specific information from another node.

CC:0072.01.04.11.001    The Manufacturer Specific Report Command MUST be returned in response to this command.

CC:0072.01.04.11.002    This command MUST NOT be issued via multicast addressing.
CC:0072.01.04.11.003    A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MANUFACTURER_SPECIFIC ||||||||
| Command = MANUFACTURER_SPECIFIC_GET ||||||||

### 4.11.3  Manufacturer Specific Report Command

This command is used to advertise manufacturer specific device information.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MANUFACTURER_SPECIFIC | | | | | | | |
| Command = MANUFACTURER_SPECIFIC_REPORT | | | | | | | |
| Manufacturer ID 1 | | | | | | | |
| Manufacturer ID 2 | | | | | | | |
| Product Type ID 1 | | | | | | | |
| Product Type ID 2 | | | | | | | |
| Product ID 1 | | | | | | | |
| Product ID 2 | | | | | | | |

**Manufacturer ID (16 bits)**

CC:0072.01.05.11.001   The Manufacturer ID field MUST carry the unique ID identifying the manufacturer of the device.

Manufacturer identifiers can be found in [12].The first byte is the most significant byte.

**Product Type ID (16 bits)**

CC:0072.01.05.11.002   The Product Type ID field MUST carry a unique ID identifying the actual product type.

The first byte is the most significant byte.

CC:0072.01.05.11.003   A specific Product Type ID MUST be defined by the manufacturer for each type of product.

**Product ID (16 bits)**

CC:0072.01.05.11.004   The Product ID field MUST carry a unique ID identifying the actual product.

The first byte is the most significant byte.

CC:0072.01.05.11.005   A specific Product ID MUST be defined by the manufacturer for each product of a given product type. Thus, the same Product ID value may appear for different Product Type ID values.

### 4.12 Manufacturer Specific Command Class, version 2

Manufacturer Specific Command Class, version 2 adds a set of commands to communicate unique identification, e.g. the serial number, of the product.

Commands not mentioned here remains unchanged as specified for Manufacturer Specific Command Class, Version 1.

#### 4.12.1 Security Considerations

The Manufacturer Specific Command Class provides information about the device implementation. This information can potentially be used by an attacker to find vulnerabilities.

CC:0072.02.00.41.001  A supporting node MUST comply with Table 16.

#### 4.12.2 Device Specific Get Command

This command is used to request device specific information.

CC:0072.02.06.11.001  The Device Specific Report Command MUST be returned in response to this command.

CC:0072.02.06.11.002
CC:0072.02.06.11.003
This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MANUFACTURER_SPECIFIC | | | | | | | |
| Command = DEVICE_SPECIFIC_GET | | | | | | | |
| Reserved | | | | | Device ID Type | | |

**Device ID Type (3 bits)**

This field contains values for the Device ID Type.

| Device ID Type | Value |
|---|---|
| Return OEM <u>factory default</u> Device ID Type | 0 |
| Serial Number | 1 |
| Pseudo Random | 2 |
| Reserved | 3-7 |

CC:0072.02.06.12.001  A sending node SHOULD specify a value of zero when issuing the Device Specific Get command since the responding node may only be able to return one Device ID Type.

### 4.12.3 Device Specific Report Command

This command is used to advertise device specific information.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MANUFACTURER_SPECIFIC ||||||||
| Command = DEVICE_SPECIFIC_REPORT ||||||||
| Reserved ||||| Device ID Type |||
| Device ID Data Format ||| Device ID Data Length |||||
| Device ID Data 1 ||||||||
| ... ||||||||
| Device ID Data N ||||||||

**Device ID Data Format (3 bits)**

This command field defines the format used for Device ID Data.

| Device ID Data Format | Value | Description |
|---|---|---|
| UTF-8 | 0x00 | The Device ID Data MUST be in UTF-8 format. |
| Binary | 0x01 | The Device ID Data is in plain binary format and MUST be displayed as hexadecimal values e.g. 0x30, 0x31, 0x32, 0x33 MUST be displayed as h'30313233. |

CC:0072.02.07.11.001

CC:0072.02.07.11.002

CC:0072.02.07.11.003 All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

**Device ID Type (3 bits)**

This field contains values for the Device ID Type. See Device Specific Get Command for details.

CC:0072.02.07.13.001 In case the Device ID Type specified in a Device Specific Get command is not supported by the responding node, the responding node MAY return the factory default Device ID Type (as if receiving the value 0 in the Device Specific Get command).

**Device ID Data Length(5 bits)**

CC:0072.02.07.11.004 This field contains the length of the Device ID Data field. The field MUST NOT carry the value zero.

**Device ID Data (N bytes)**

Data fields for Device ID. "Device ID Data Format" defines data format and "Device ID Data Length Indicator" defines length.

CC:0072.02.07.11.005 The Manufacturer ID and Device ID combination MUST be globally unique.

### 4.13   Multi Channel Association Command Class, version 1 [OBSOLETED]

CC:008E.01.00.11.001

**THIS VERSION HAS BEEN OBSOLETED**

New implementations MUST use the Multi Channel Association Command Class, version 2 or newer.

### 4.14  Multi Channel Association Command Class, version 2

The Multi Channel Association Command Class is used to manage associations to Multi Channel End Point destinations as well as to NodeID destinations.

An association group sends an unsolicited command to the configured destinations when triggered by an event. The parameters of the command may be dynamic, e.g. the temperature of a sensor reading or the light level for a dimmer.

A NodeID association identifies its destination by a NodeID.
An End Point association identifies its destination by a combination of a NodeID and an End Point.

Refer to [15] for an introduction to the Multi Channel concept.

#### 4.14.1  Compatibility considerations

CC:008E.02.00.21.001    The Multi Channel Association Command Class extends the functionality of the Association command class. A device supporting this Command Class version MUST also support the (non-Multi Channel) Association Command Class, version 2.

CC:008E.02.00.22.001    A controlling device SHOULD NOT create End Point associations to dynamic Multi Channel End Points.

CC:008E.02.00.22.002    The Association Group Information (AGI) Command Class SHOULD be supported to enable automated discovery of association group properties.

CC:008E.02.00.21.002    The Association and Multi Channel Association Command Classes MUST access the same collection of association groups. Further, the following applies:
CC:008E.02.00.21.003    The two command classes MUST advertise the total number of association groups.
CC:008E.02.00.21.004    The two command classes MUST advertise the total number of supported nodes for a given association group.
CC:008E.02.00.21.005    Any advertised association group MUST support NodeID destinations as well as End Point destinations.

CC:008E.02.00.21.006    NodeID associations maintained via the Multi Channel Association Command Class MUST be identical to NodeID associations maintained via the Association Command Class.

CC:008E.02.00.21.007    The Multi Channel Command Class specifies that, for backwards compatibility with non-Multi Channel
CC:008E.02.00.23.001    devices, the Root Device of a Multi Channel device MUST mirror the functionality of End Point 1 and it MAY mirror the functionality of more End Points. This principle also applies to association groups advertised by the Root Device.
CC:008E.02.00.22.003    Each association group advertised by the Root Device, except for association group 1, SHOULD mirror an association group of an End Point.
CC:008E.02.00.22.004    If a Root Device association group mirrors an End Point association group, the Root Device SHOULD map all Association commands for that group to the mirrored End Point association group.

CC:008E.02.00.22.005    Except for association group 1 (the Z-Wave Plus Lifeline), a Multi Channel aware controlling device SHOULD ignore all Root Device association groups since they are just mirrored End Point association groups.

CC:008E.02.00.21.008    The use of encapsulation MUST comply with Table 17.

**Table 17, V2 Associations and the transmissions they may trigger**

| Source → Destination | | Association type | Allowed transmissions |
|---|---|---|---|
| NodeID → NodeID | (V2) | NodeID | Non-encapsulated |
| End Point → NodeID | (V2) | NodeID | Non-encapsulated |
| NodeID → End Point | (V2) | End Point | Encapsulated *) (src≥0, dst>0) |
| End Point → End Point | (V2) | End Point | Encapsulated (src>0, dst>0) |
| ~~NodeID → Root Device~~ | | ~~End Point~~ | *None **)* |

*) The source End Point MAY be different than 0 if the associated group is an End Point group mapped to the Root Device
**) Version 2 of this command class does not allow the destination End Point to be zero.

### 4.14.2  Z-Wave Plus considerations

The Z-Wave Plus certification program mandates that Association group 1 is reserved for the Lifeline association group. Group 1 MUST NOT be assigned to any other use than the Lifeline group. The actual Device Type specifies a mandatory list of commands which the device must be able to send to all lifeline group destinations. A manufacturer MAY add additional commands to the lifeline group.

End Points SHOULD NOT implement the Lifeline Association Group. End Points SHOULD report that zero NodeIDs are supported for association group 1.

The Z-Wave Plus certification program mandates support for the Association Group Information (AGI) Command Class if a device supports the Multi Channel Association Command Class.

### 4.14.3  Security considerations

A device which is included securely MUST NOT accept Association commands unless the commands are received via the highest security key assigned to the device.

### 4.14.4  Multi Channel Association Set Command

This command is used to request that one or more destinations are added to a given association group.

CC:008E.02.01.13.001 The destinations MAY be a mix of NodeID destinations and End Point destinations.

CC:008E.02.01.12.001 The receiving node SHOULD add the specified destinations to the specified association group.
CC:008E.02.01.13.002 This command MAY be ignored if the association group is already full.

CC:008E.02.01.11.001 Routing slaves MUST have return routes assigned to all association destinations.

CC:008E.02.01.11.008 Unless the association destination is a gateway, a controlling node MUST NOT create an association if the association destination node does not support the controlling commands (Set/Get types) that the
CC:008E.02.01.11.009 actual association group will be sending. The AGI Command Class  MUST be used to probe the commands that a given association group will be sending.
CC:008E.02.01.12.004 A controlling node SHOULD NOT create an association if the source and destination nodes are bootstrapped with different security levels.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION | | | | | | | |
| Command = MULTI_CHANNEL_ASSOCIATION_SET | | | | | | | |
| Grouping Identifier | | | | | | | |
| NodeID 1 | | | | | | | |
| ... | | | | | | | |
| NodeID M | | | | | | | |
| Marker = MULTI_CHANNEL_ASSOCIATION_SET_MARKER | | | | | | | |
| Multi Channel NodeID 1 | | | | | | | |
| Bit Address 1 | End Point 1 | | | | | | |
| … | | | | | | | |
| Multi Channel NodeID N | | | | | | | |
| Bit Address N | End Point N | | | | | | |

**Grouping Identifier (8 bits)**

CC:008E.02.01.11.002 This field is used to specify the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

CC:008E.02.01.11.003 A node that receives an unsupported Grouping Identifier MUST ignore this command

**NodeID (M bytes)**

This field specifies a list of NodeID destinations that are to be added to the specified association group as a NodeID association.

CC:008E.02.01.11.004 A NodeID association created via this field MUST be identical to a NodeID association created with the (non-Multi Channel) Association Set command.

**Marker (8 bits)**

This field is used to indicate the end of NodeID destinations and the start of End Point destinations. The Marker field MUST be set to the value MULTI_CHANNEL_ASSOCIATION_SET_MARKER. The field MAY be omitted if no End Point destinations are specified.

CC:008E.02.01.11.005
CC:008E.02.01.13.003

**Multi Channel NodeID (N bytes)**

The Multi Channel NodeID, Bit Address and End Point fields specify a list of End Points which are to be added to the specified association group as an End Point association.

CC:008E.02.01.13.004

The complete identification of an End Point destination requires a NodeID as well as an End Point identifier. This command MAY carry multiple copies of the same Multi Channel NodeID in combination with different End Point identifiers.

**Bit Address + End Point (N bytes)**

CC:008E.02.01.11.006

These fields MUST be processed in combination with the Multi Channel NodeID field.

CC:008E.02.01.12.005

The receiving node SHOULD treat the Bit Address flag and the End Point identifier as one scalar value; thus creating only one association group entry. Using a single scalar value enables:

- Better utilization of association group capacity
- Simple transmission of command for a multi-End Point destination
- Well-defined removal of bit addressed End Points

Refer to the Multi Channel Command Class for the actual encoding of bit addressed End Points.

CC:008E.02.01.11.007

The 7-bit End Point value MUST be in the range 1..127.

### 4.14.5 Multi Channel Association Get Command

This command is used to request the current destinations of a given association group.

CC:008E.02.02.11.001 The Multi Channel Association Report Command MUST be returned in response to this command.

CC:008E.02.02.11.002
CC:008E.02.02.11.003

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION | | | | | | | |
| Command = MULTI_CHANNEL_ASSOCIATION_GET | | | | | | | |
| Grouping Identifier | | | | | | | |

**Grouping Identifier (8 bits)**

CC:008E.02.02.11.004 This field is used to specify the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

CC:008E.02.02.12.001 A node that receives an unsupported Grouping Identifier SHOULD return information relating to Grouping Identifier 1.

### 4.14.6 Multi Channel Association Report Command

This command is used to advertise the current destinations for a given association group.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION ||||||||
| Command = MULTI_CHANNEL_ASSOCIATION_REPORT ||||||||
| Grouping Identifier ||||||||
| Max Nodes Supported ||||||||
| Reports to Follow ||||||||
| NodeID 1 ||||||||
| … ||||||||
| NodeID M ||||||||
| Marker = MULTI_CHANNEL_ASSOCIATION_REPORT_MARKER ||||||||
| Multi Channel NodeID 1 ||||||||
| Bit address 1 | End Point 1 |||||||
| … ||||||||
| Multi Channel NodeID N ||||||||
| Bit address N | End Point N |||||||

**Grouping Identifier (8 bits)**

CC:008E.02.03.11.001

This field is used to advertise the actual association group. Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

**Max Nodes Supported (8 bits)**

CC:008E.02.03.13.001

The maximum number of destinations supported by the advertised association group. Each destination MAY be a NodeID destination or an End Point destination.

**Reports to Follow (8 bits)**

CC:008E.02.03.11.002

The entire list destinations of the advertised association group may be too long for one command. This field MUST advertise how many report frames will follow this report.

**NodeID (M bytes)**

CC:008E.02.03.11.003

This field advertises a list of NodeID destinations of the advertised association group. The list of NodeIDs MUST be empty if there are no NodeID destinations configured for the advertised association group.

**Marker (8 bits)**

Refer to description under the Multi Channel Association Set command.

**Multi Channel NodeID (N bytes)**

The Multi Channel NodeID, Bit Address and End Point fields specify a list of End Points which are currently in the advertised association group.

CC:008E.02.03.13.002

The complete identification of an End Point requires a NodeID as well as an End Point identifier. The Multi Channel Association Report command MAY carry multiple copies of the same Multi Channel NodeID in combination with different End Point identifiers.

CC:008E.02.03.11.004

The list of Multi Channel NodeID and End Point identifiers MUST be empty if there are no End Point destinations configured for the advertised association group.

**Bit address + End Point (N bytes)**

CC:008E.02.03.11.005

These fields MUST be processed in combination with the Multi Channel NodeID field.

Refer to the Multi Channel Command Class for the actual encoding of bit addressed End Points.

### 4.14.7  Multi Channel Association Remove Command

This command is used to remove NodeID and End Point destinations from a given association group.

CC:008E.02.04.11.001

This command MUST manipulate the same list of NodeID destinations as the Association Remove Command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION ||||||||
| Command = MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||
| Grouping Identifier ||||||||
| NodeID 1 ||||||||
| … ||||||||
| NodeID M ||||||||
| Marker = MULTI_CHANNEL_ASSOCIATION_REMOVE_MARKER ||||||||
| Multi Channel NodeID 1 ||||||||
| Bit address 1 | End Point 1 |||||||
| … ||||||||
| Multi Channel NodeID N ||||||||
| Bit address N | End Point N |||||||

**Grouping Identifier (8 bits)**

This field is used to specify from which association group the specified destinations should be removed.

CC:008E.02.04.11.002
CC:008E.02.04.11.003

Grouping Identifiers MUST be assigned in a consecutive range starting from 1.
A receiving node MUST ignore an unsupported Grouping Identifier; except for the value 0.

CC:008E.02.04.11.004    This field MUST be interpreted in combination with the NodeID and End Point fields.

| | | |
|---|---|---|
| **(NodeID Destination)** | **NodeID** | **(M bytes)** |
| **(End Point Destination)** | **Multi Channel NodeID** | **(N bytes)** |
| **(End Point Destination)** | **End Point** | **(N bytes)** |

CC:008E.02.04.11.005    These fields specify the destinations that are to be removed.
The Grouping Identifier and these fields MUST be interpreted as follows.

"NodeID Destinations" denote the NodeID fields.
"End Point destinations" denote the combined Multi Channel NodeID and End Point fields found after the marker.

CC:008E.02.04.13.001    A receiving node MAY interpret the empty command (only Command Class and Command fields) as an instruction to Remove all NodeID destinations and End Point destinations from all association groups.

CC:008E.02.04.11.006    This field MUST be interpreted according to Table 18

**Table 18, Multi Channel Association Remove, V2 :: Parameter interpretation**

| Grouping identifier | Number of NodeID Destinations | Number of End Point Destinations | Interpretation |
|---|---|---|---|
| > 0 | > 0 | (don't care) | Remove NodeID destinations from association group. Then assess End Points (next line) – if any specified |
| > 0 | (don't care) | > 0 *) | Remove End Point destinations from association group *). |
| > 0 | = 0 | = 0 | Remove all NodeID destinations and End Point destinations from association group. |
| = 0 | > 0 | (don't care) | Remove NodeID destinations from all association groups. Then assess End Point destinations (next line) – if any specified |
| = 0 | (don't care) | > 0 *) | Remove End Point destinations from all association groups *). |
| = 0 | = 0 | = 0 | Remove all NodeID destinations and End Point destinations from all association groups. |

CC:008E.02.04.11.007
CC:008E.02.04.11.008    *) The receiving node MUST treat the Bit Address flag and the End Point identifier as one scalar value.
The receiving node MUST remove End Points if an exact match can be found, while it MAY ignore the removal request if an exact match cannot be found; even though there may exist associations for individual End Point destinations which are covered by the End Point bitmap address.

**Marker (8 bits)**

Refer to the description in 4.14.4 in the Multi Channel Association Set Command.

### 4.14.7.1      Examples

**Remove specified NodeID from Group 3**

Get association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||||
| MULTI_CHANNEL_ASSOCIATION_GET ||||||||
| Grouping Identifier = 3 ||||||||

Current association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||||
| MULTI_CHANNEL_ASSOCIATION_REPORT ||||||||
| Grouping Identifier = 3 ||||||||
| Max Nodes Supported = 5 ||||||||
| Reports to Follow = 0 ||||||||
| NodeID = 11 ||||||||
| NodeID = 12 ||||||||
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 2 ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 3 ||||||||
| Multi Channel NodeID = 17 ||||||||
| End Point = 2 ||||||||

Remove NodeID = 12 from Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||||
| MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||
| Grouping Identifier = 3 ||||||||
| NodeID = 12 ||||||||

New association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||||
| MULTI_CHANNEL_ASSOCIATION_REPORT ||||||||
| Grouping Identifier = 3 ||||||||
| Max Nodes Supported = 5 ||||||||
| Reports to Follow = 0 ||||||||
| NodeID = 11 ||||||||
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 2 ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 3 ||||||||
| Multi Channel NodeID = 17 ||||||||
| End Point = 2 ||||||||

## Remove specified End Point from Group 3

Get association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_GET |||||||| 
| Grouping Identifier = 3 |||||||| 

Current association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_REPORT |||||||| 
| Grouping Identifier = 3 |||||||| 
| Max Nodes Supported = 5 |||||||| 
| Reports to Follow = 0 |||||||| 
| NodeID = 11 |||||||| 
| NodeID = 12 |||||||| 
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 2 |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 3 |||||||| 
| Multi Channel NodeID = 17 |||||||| 
| End Point = 2 |||||||| 

Remove Multi Channel NodeID = 16,3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_REMOVE |||||||| 
| Grouping Identifier = 3 |||||||| 
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 3 |||||||| 

New association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_REPORT |||||||| 
| Grouping Identifier = 3 |||||||| 
| Max Nodes Supported = 5 |||||||| 
| Reports to Follow = 0 |||||||| 
| NodeID = 11 |||||||| 
| NodeID = 12 |||||||| 
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 2 |||||||| 
| Multi Channel NodeID = 17 |||||||| 
| End Point = 2 ||||||||

## Remove bit addressable End Points from Group 3

Get association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION** | | | | | | | |
| **MULTI_CHANNEL_ASSOCIATION_GET** | | | | | | | |
| Grouping Identifier = 3 | | | | | | | |

Current association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION** | | | | | | | |
| **MULTI_CHANNEL_ASSOCIATION_REPORT** | | | | | | | |
| Grouping Identifier = 3 | | | | | | | |
| Max Nodes Supported = 5 | | | | | | | |
| Reports to Follow = 0 | | | | | | | |
| NodeID = 11 | | | | | | | |
| NodeID = 12 | | | | | | | |
| MULTI_CHANNEL_ ASSOCIATION_REPORT_MARKER | | | | | | | |
| Multi Channel NodeID = 16 | | | | | | | |
| End Point = 134 (b1000 0110) | | | | | | | |
| Multi Channel NodeID = 17 | | | | | | | |
| End Point = 2 | | | | | | | |

Remove Multi Channel NodeID = 16,2 and 16,3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION** | | | | | | | |
| **MULTI_CHANNEL_ASSOCIATION_REMOVE** | | | | | | | |
| Grouping Identifier = 3 | | | | | | | |
| **MULTI_CHANNEL_ ASSOCIATION_REPORT_MARKER** | | | | | | | |
| Multi Channel NodeID = 16 | | | | | | | |
| End Point = 134 (b1000 0110) | | | | | | | |

Note: The Multi Channel Node MUST report end points as bit addressable in order to be removed in the same manners.

New association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| **COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION** | | | | | | | |
| **MULTI_CHANNEL_ASSOCIATION_REPORT** | | | | | | | |
| Grouping Identifier = 3 | | | | | | | |
| Max Nodes Supported = 5 | | | | | | | |
| Reports to Follow = 0 | | | | | | | |
| NodeID = 11 | | | | | | | |
| NodeID = 12 | | | | | | | |
| MULTI_CHANNEL_ ASSOCIATION_REPORT_MARKER | | | | | | | |
| Multi Channel NodeID = 17 | | | | | | | |
| End Point = 2 | | | | | | | |

## Remove specified NodeID and End Point from Group 3

Get association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_GET |||||||| 
| Grouping Identifier = 3 |||||||| 

Current association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_REPORT |||||||| 
| Grouping Identifier = 3 |||||||| 
| Max Nodes Supported = 5 |||||||| 
| Reports to Follow = 0 |||||||| 
| NodeID = 11 |||||||| 
| NodeID = 12 |||||||| 
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 2 |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 3 |||||||| 
| Multi Channel NodeID = 17 |||||||| 
| End Point = 2 |||||||| 

Remove NodeID = 12 & Multi Channel NodeID = 16,3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_REMOVE |||||||| 
| Grouping Identifier = 3 |||||||| 
| NodeID = 12 |||||||| 
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 3 |||||||| 

New association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION |||||||| 
| MULTI_CHANNEL_ASSOCIATION_REPORT |||||||| 
| Grouping Identifier = 3 |||||||| 
| Max Nodes Supported = 5 |||||||| 
| Reports to Follow = 0 |||||||| 
| NodeID = 11 |||||||| 
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER |||||||| 
| Multi Channel NodeID = 16 |||||||| 
| End Point = 2 |||||||| 
| Multi Channel NodeID = 17 |||||||| 
| End Point = 2 ||||||||

## Remove all associations from Group 3

Get association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_GET ||||||||
| Grouping Identifier = 3 ||||||||

Current association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REPORT ||||||||
| Grouping Identifier = 3 ||||||||
| Max Nodes Supported = 5 ||||||||
| Reports to Follow = 0 ||||||||
| NodeID = 11 ||||||||
| NodeID = 12 ||||||||
| MULTI_CHANNEL_ ASSOCIATION_REPORT_MARKER ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 2 ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 3 ||||||||
| Multi Channel NodeID = 17 ||||||||
| End Point = 2 ||||||||

Remove all NodeIDs from Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||
| Grouping Identifier = 3 ||||||||

New association settings for Group 3

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REPORT ||||||||
| Grouping Identifier = 3 ||||||||
| Max Nodes Supported = 5 ||||||||
| Reports to Follow = 0 ||||||||

## Remove specific NodeID from all Groups

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_ MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||
| Grouping Identifier = 0 ||||||||
| NodeID = 12 ||||||||

**Remove specific Multi Channel NodeID from all Groups**

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||
| Grouping Identifier = 0 ||||||||
| MULTI_CHANNEL_<br>ASSOCIATION_REPORT_MARKER ||||||||
| Multi Channel NodeID = 16 ||||||||
| End Point = 3 ||||||||

**Remove all associations from all Groups**

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||

or

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COMMAND_CLASS_<br>MULTI_CHANNEL_ASSOCIATION ||||||||
| MULTI_CHANNEL_ASSOCIATION_REMOVE ||||||||
| Grouping Identifier = 0 ||||||||

### 4.14.8 Multi Channel Association Supported Groupings Get Command

This command is used to request the number of association groups that this node supports.

CC:008E.02.05.11.001    The Multi Channel Association Supported Groupings Report Command MUST be returned in response to this command.

CC:008E.02.05.11.002    This command MUST NOT be issued via multicast addressing.
CC:008E.02.05.11.003    A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION ||||||||
| Command = MULTI_CHANNEL_ASSOCIATION_GROUPINGS_GET ||||||||

### 4.14.9  Multi Channel Association Supported Groupings Report Command

This command is used to advertise the maximum number of association groups implemented by this node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION | | | | | | | |
| Command = MULTI_CHANNEL_ASSOCIATION_GROUPINGS_REPORT | | | | | | | |
| Supported Groupings | | | | | | | |

**Supported Groupings (8 bits)**

This field is used to advertise the number of association groups that this node supports.

CC:008E.02.06.11.001    Grouping Identifiers MUST be assigned in a consecutive range starting from 1.

CC:008E.02.06.11.002    The value advertised by this field MUST be the total number of supported association groups; whether associations are managed via the Association Command Class or the Multi Channel Association Command Class.

CC:008E.02.06.11.003    Each of these association groups MUST support NodeID destinations as well as End Point destinations.

### 4.15  Multi Channel Association Command Class, version 3

The Multi Channel Association Command Class is used to manage associations to Multi Channel End Point destinations as well as to NodeID destinations.

The following sections specify commands which were extended or added in version 3.

#### 4.15.1  Compatibility considerations

The considerations of section 4.14.1 also apply to this version the following additions:

CC:008E.03.00.21.001    A device supporting this Command Class version MUST also

- support the Multi Channel Association Command Class, version 2
- support the (non-Multi Channel) Association Command Class, version 2

This version introduces support for the creation of an End Point Association to the Root Device of another device, e.g. a gateway, by allowing the destination End Point 0 as a valid value.
This allows a gateway to create a single Lifeline association from a Multi Channel device and subsequently receive status messages or sensor reports from the Root Device as well as the End Points of that device. Refer to section 4.15.2.

CC:008E.03.00.21.002    The use of Multi Channel encapsulation MUST comply with Table 19.

**Table 19, V3 Associations and the transmissions they may trigger**

| Source → Destination | | Association type | Allowed transmissions |
|---|---|---|---|
| NodeID → NodeID | (V2) | NodeID | Non-encapsulated |
| End Point → NodeID | (V2) | NodeID | Non-encapsulated |
| NodeID → End Point | (V2) | End Point | Encapsulated *) (src≥0, dst>0) |
| End Point → End Point | (V2) | End Point | Encapsulated (src>0, dst>0) |
| End Point → Root Device | (V3) | End Point | Encapsulated (src>0, dst=0) |
| Root Device → Root Device | (V3) | End Point | Non-encapsulated **) or Encapsulated (src>0, dst=0) |

*) The source End Point MAY be different than 0 if the associated group is an End Point Group mapped to the Root Device
**) Command must be sent non-encapsulated if both End Points are zero. However, the End Point association from a Root Device Lifeline group to a Root Device also allows a source End Point to send encapsulated commands to the Root Device Lifeline destination. Refer to 4.15.2.

#### 4.15.2  Z-Wave Plus considerations

The considerations of version 2 also apply to this version.

Version 3 adds support for creation of an End Point Association to the Root Device of another device, e.g. a gateway.

CC:008E.03.00.11.001    A controlling device MUST verify that a device supports Multi Channel Association Command Class, Version 3 before creating an End Point Association to the Root Device of another device.

---

Multi Channel End Points may implement functionality relevant to a Lifeline destination, e.g. individual meter reports from a power strip. Multi Channel encapsulation allows the Lifeline destination to distinguish between apparently identical commands from different End Points.

As specified by the Multi Channel Command Class, a Root Device must not use Multi Channel encapsulation when communicating to another Root Device, i.e. if both End Points are zero. It does however still make sense to create an End Point Association from one Root Device to another Root Device, e.g. a gateway.

Consider, as an example, a two-channel temperature sensor. By creating an End Point association from the Lifeline Association Group to the Root Device of a gateway, the gateway may receive unsolicited Multi Channel encapsulated sensor reports from each of the sensor End Points as well as non-encapsulated battery status messages from the sensor Root Device.

| | |
|---|---|
| CC:008E.03.00.12.001 | The Root Device of a Multi Channel device SHOULD implement support for the Multi Channel Association Command Class if any of the End Points provide association capabilities. If the Root Device implements such support, the Root Device MAY forward Multi Channel encapsulated commands to the association destination on behalf of End Points. |
| CC:008E.03.00.13.001 | |

| | |
|---|---|
| CC:008E.03.00.11.002 | A NodeID association MUST NOT be created in response to a request for an End Point association to the Root Device (destination End Point 0). |
| | If a NodeID Association is created from the Root Device Lifeline Association Group, End Point |
| CC:008E.03.00.11.003 | commands MUST NOT be transmitted via the Lifeline Association Group of the root device. All |
| CC:008E.03.00.11.004 | commands originating from the Root Device (Tamper Alarm, Device Reset Locally, etc.) MUST be sent non-encapsulated to the Lifeline destination. |
| CC:008E.03.00.11.005 | If a NodeID association is created, two End Points MUST NOT forward identical commands (e.g. Multilevel Sensor Report::Temperature) via the Lifeline group, as the lack of source End Point information will prevent a receiving application from distinguishing the individual commands from each other. |

| | |
|---|---|
| CC:008E.03.00.11.006 | If an End Point Association is created from the Lifeline group, End Points MUST send relevant Multi Channel encapsulated commands to the Lifeline group destination. |

| | |
|---|---|
| CC:008E.03.00.13.002 | A Multi Channel device MAY forward commands from multiple Multi Channel End Points to the Lifeline group destination. |

### 4.15.3  Security considerations

The considerations of section 4.14.3 also apply to this version.

---

### 4.15.4 Multi Channel Association Set Command

This command is used to request that one or more destinations are added to a given association group.

CC:008E.03.01.13.001 The destinations MAY be a mix of NodeID destinations and End Point destinations.

CC:008E.03.01.12.001 The receiving node SHOULD add the specified destinations to the specified association group.
CC:008E.03.01.13.002 This command MAY be ignored if the association group is already full.

CC:008E.03.01.11.001 Routing slaves MUST have return routes assigned to all association destinations.

CC:008E.03.01.51.001 Unless the association destination is a gateway, a controlling node MUST NOT create an association if the association destination node does not support the controlling commands (Set/Get types) that the
CC:008E.03.01.51.002 actual association group will be sending. The AGI Command Class MUST be used to probe the commands that a given association group will be sending.
CC:008E.03.01.52.001 A controlling node SHOULD NOT create an association if the source and destination nodes are bootstrapped with different security levels.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_MULTI_CHANNEL_ASSOCIATION | | | | | | | |
| Command = MULTI_CHANNEL_ASSOCIATION_SET | | | | | | | |
| Grouping Identifier | | | | | | | |
| NodeID 1 | | | | | | | |
| ... | | | | | | | |
| NodeID M | | | | | | | |
| Marker = MULTI_CHANNEL_ASSOCIATION_SET_MARKER | | | | | | | |
| Multi Channel NodeID 1 | | | | | | | |
| Bit address 1 | End Point 1 | | | | | | |
| … | | | | | | | |
| Multi Channel NodeID N | | | | | | | |
| Bit address N | End Point N | | | | | | |

**Grouping Identifier (8 bits)**

This field is used to specify the actual association group.

CC:008E.03.01.11.002 A node receiving an unsupported Grouping Identifier MUST ignore this command.

**NodeID (M bytes)**

The NodeID fields specify a list of NodeID destinations that are to be added to the specified association group as a NodeID association.

CC:008E.03.01.11.003 A NodeID association created via this field MUST be identical to a NodeID association created with the (non-Multi Channel) Association Set command.

**Marker (8 bits)**

CC:008E.03.01.11.004

This field is used to indicate the end of NodeID destinations and the start of End Point destinations. The Marker field MUST be set to the value MULTI_CHANNEL_ASSOCIATION_SET_MARKER. The field MAY be omitted if no End Point destinations are specified.

**Multi Channel NodeID (N bytes)**

The Multi Channel NodeID, Bit Address and End Point fields specify a list of End Point destinations which are to be added to the specified association group as an End Point association.

CC:008E.03.01.13.003

The complete identification of an End Point destination requires a NodeID as well as an End Point identifier. This command MAY carry multiple copies of the same Multi Channel NodeID in combination with different End Point identifiers.

**Bit address + End Point (N bytes)**

CC:008E.03.01.11.005

These fields MUST be processed in combination with the Multi Channel NodeID field.

CC:008E.03.01.12.005

The receiving node SHOULD treat the Bit Address flag and the End Point identifier as one scalar value; thus creating only one association group entry. Using a single scalar value enables:

- Better utilization of association group capacity
- Simple transmission of command for a multi-End Point destination
- Well-defined removal of bit addressed End Points

Refer to the Multi Channel Command Class for the actual encoding of bit addressed End Points.

CC:008E.03.01.11.006

The 7-bit End Point value MUST be in the range 0..127.

### 4.16 Node Naming and Location Command Class, version 1

The Node Naming and Location Command Class is used to assign a name and a location text string to a supporting node.

#### 4.16.1 Node Name Set Command

This command is used to set the name of the receiving node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_NODE_NAMING ||||||||
| Command = NODE_NAMING_NODE_NAME_SET ||||||||
| Reserved ||||| Char. Presentation |||
| Node name char 1 ||||||||
| … ||||||||
| Node name char N ||||||||

**Node name char (N bytes)**

This field is used to indicate the actual assigned name for the node.

This field MUST be encoded using the specified character representation in the Char.Presentation field.

The Node name string MUST NOT contain any appended termination characters.

The length of this field MUST be in the range 1..16 bytes. The length of this field MUST be determined from the frame length.

A node receiving this command with a Node name char longer than 16 bytes MUST ignore any byte/character following the 16th byte.

Devices using the Unicode UTF-16 characters representation can set Name strings using a maximum of 8 characters because each character is encoded with 2 bytes. In this case, the first byte MUST be the most significant byte.

**Reserved**

This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Char. Presentation (3 bits)**

This field is used to indicate the character encoding for the Node name char field.
This field MUST comply with Table 20:

**Table 20, Node Name Set::Char. Presentation encoding**

| Value | Description |
|-------|-------------|
| 0x00 | Using standard ASCII codes, see Appendix A (values 128-255 are ignored) |
| 0x01 | Using standard and OEM Extended ASCII codes, see Appendix A |
| 0x02 | Unicode UTF-16 |

All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be
ignored by a receiving node.

### 4.16.2   Node Name Get Command

This command is used to request the stored name from a node.

The Node Name Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_NODE_NAMING ||||||||
| Command = NODE_NAMING_NODE_NAME_GET ||||||||

### 4.16.3   Node Name Report Command

This command is used to advertise the name assigned to the sending node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_NODE_NAMING ||||||||
| Command = NODE_NAMING_NODE_NAME_REPORT ||||||||
| Reserved ||||| Char. Presentation |||
| Node name char 1 ||||||||
| … ||||||||
| Node name char N ||||||||

For fields' description, refer to 4.16.1 Node Name Set Command
A sending node MUST comply with fields' description from 4.16.1 Node Name Set Command

### 4.16.4 Node Location Set Command

The Node Location Set Command is used to set a location name in a node in a Z-Wave network.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_NODE_NAMING ||||||||
| Command = NODE_NAMING_NODE_LOCATION_SET ||||||||
| Reserved ||||| Char. Presentation |||
| Node location char 1 ||||||||
| … ||||||||
| Node location char N ||||||||

**Node location char (N bytes)**

This field is used to indicate the actual assigned location for the node.

This field MUST be encoded using the specified character representation in the Char. Presentation field.

The Node location string MUST NOT contain any appended termination characters.

The length of this field MUST be in the range 1..16 bytes. The length of this field MUST be determined from the frame length.

A node receiving this command with a Node location char longer than 16 bytes MUST ignore any byte/character following the 16th byte.

Devices using the Unicode UTF-16 characters representation can set Location strings using a maximum of 8 characters because each character is encoded with 2 bytes. In this case, the first byte MUST be the most significant byte.

**Reserved**

This field MUST be set to 0 by a sending node and MUST be ignored by a receiving node.

**Char. Presentation (3 bits)**

This field is used to indicate the character encoding for the Node location char field.
This field MUST comply with Table 20.

**4.16.5  Node Location Get Command**

This command is used to request the stored node location from a node.

The Node Location Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_NODE_NAMING | | | | | | | |
| Command = NODE_NAMING_NODE_LOCATION_GET | | | | | | | |

**4.16.6  Node Location Report Command**

This command is used to advertise the node location.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_NODE_NAMING | | | | | | | |
| Command = NODE_NAMING_NODE_LOCATION_REPORT | | | | | | | |
| Reserved | | | | | Char. Presentation | | |
| Node location char 1 | | | | | | | |
| … | | | | | | | |
| Node location char N | | | | | | | |

For fields' description, refer to 4.16.4 Node Location Set Command
A sending node MUST comply with fields' description from 4.16.4 Node Location Set Command.

### 4.17 Remote Association Activation Command Class, version 1 [OBSOLETED]

---

**THIS COMMAND CLASS VERSION HAS BEEN OBSOLETED**

New implementations MUST NOT use this command class.

---

The Remote Association Activation Command Class is used to remote activations of Association grouping identifiers in other nodes.

**Mandatory requirement:** Both 'local' and 'remote' node MUST implement the Association Command Class as illustrated below. In addition the 'local' node MUST implement the Remote Association Configuration Command Class as 'Supported'.

The Remote Association Activation Command Class and the Remote Association Configuration Command Class are additions to the functionality to the existing Association Command Class.



**Figure 8, Remote Association Activation Command Class**

The Remote Association Configuration Command Class enables a 1$^{st}$ node (any node) to configure a 2$^{nd}$ node (local node) to issue a Remote Association Activate Command to a 3$^{rd}$ node (remote node), which instruct the 3$^{rd}$ node to activate one of its locally stored association group identifiers as defined by the Association Command Class.

#### 4.17.1 Remote Association Activate Command

The Remote Association Activate Command is used to instruct a 'remote' node to activate one of its locally stored association group identifiers as defined by the Association Command Class. This will subsequently generate a number of Commands being issued from the 'remote node to the NodeIDs associated to the grouping identifier

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_REMOTE_ASSOCIATION_ACTIVATE | | | | | | | |
| Command = REMOTE_ASSOCIATION_ACTIVATE | | | | | | | |
| Grouping identifier | | | | | | | |

**Grouping identifier (8 bits)**

This group identifier used to specify the grouping identifier on the remote node

**4.18   Remote Association Configuration Command Class, version 1 [OBSOLETED]**

---

**THIS COMMAND CLASS VERSION HAS BEEN OBSOLETED**

New implementations MUST NOT use this command class.

---

The Remote Association Configuration Command Class is used to configuration of the Remote Association Activation Command Class.

**Mandatory requirement:** Both 'local' and 'remote' node MUST implement the Association Command Class as 'supported'. In addition the 'local' node MUST implement the Remote Association Configuration Command Class as 'supported' and the node used to make the configuration ('any node' in the description below) MUST implement it as 'controlled'.

The Remote Association Configuration Command Class is an addition to the functionality of the existing Association Command Class.



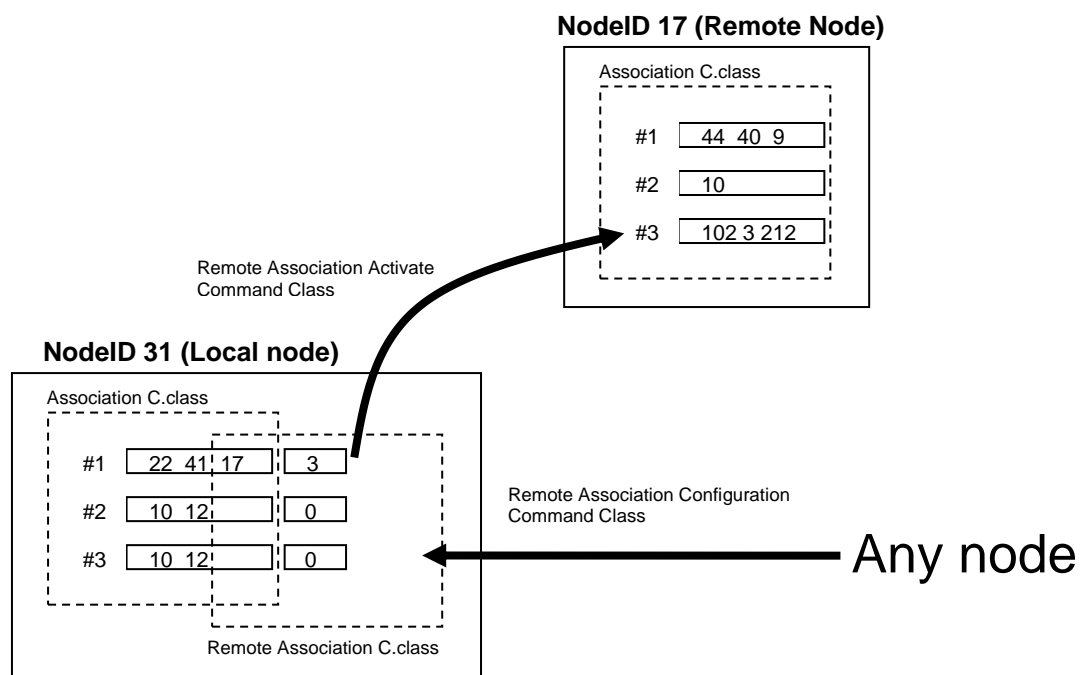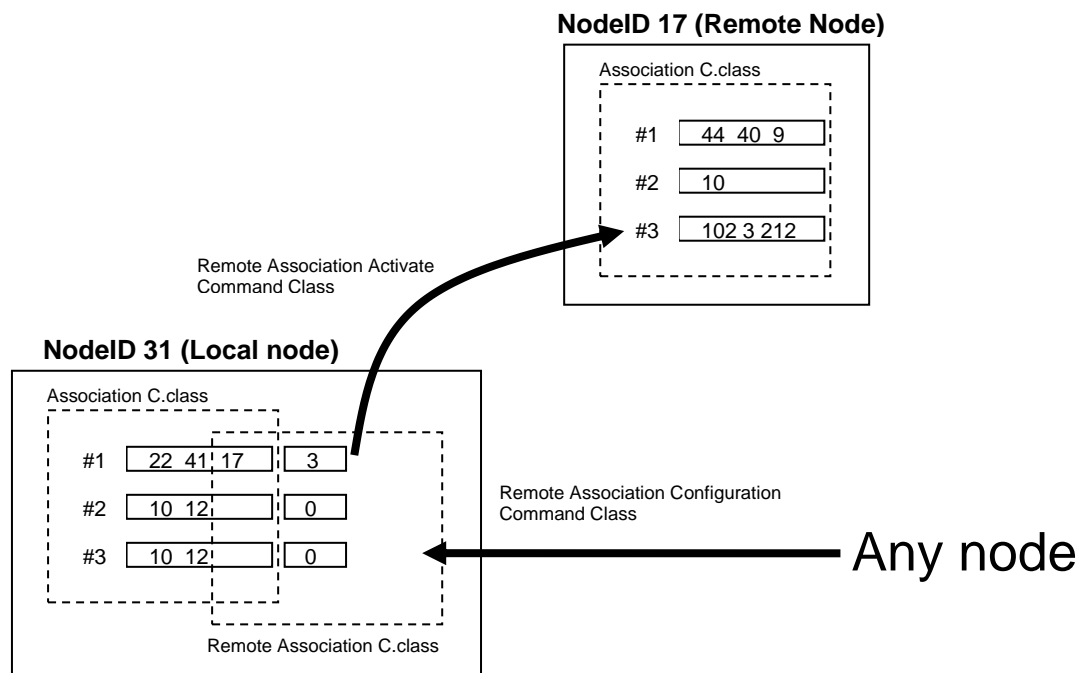**Figure 9, Remote Association Configuration Command Class**

The Remote Association Configuration Command Class enables a 1st node (Any node) to configure a 2nd node (Local node) to issue a Remote Association Activate Command to a 3rd node (Remote node), which instructs the 3rd node to activate one of its locally stored association group identifiers as defined by its Association Command Class.

---

### 4.18.1 Remote Association Configuration Set Command

The Remote Association Configuration Set Command links two nodes' 'Association Command Class' defined grouping identifiers together. It allows one node (local node) to use its grouping identifiers to control a second node's (remote node) grouping identifiers, using the Remote Association Activation Command Class.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_REMOTE_ASSOCIATION ||||||||
| Command = REMOTE_ASSOCIATION_CONFIGURATION_SET ||||||||
| Local Grouping identifier ||||||||
| Remote NodeID ||||||||
| Remote Grouping identifier ||||||||

**Local Grouping identifier (8 bits)**

Like in the Association Command Class, the Local Grouping identifier is used to specify the grouping identifier on the local node.

A Local grouping identifier = 0x0 will erase all links between local and remote grouping identifiers.

**Remote NodeID (8 bits)**

This NodeID used to specify the Node, which should receive the Remote Association Activate Command.

A NodeID = 0x0 will remove a link between the specified local grouping identifier and a remote grouping identifier.

**Remote Grouping identifier (8 bits)**

This group identifier used to specify the grouping identifier on the remote node.

### 4.18.2 Remote Association Configuration Get Command

The Remote Association Configuration Get Command is used to request the link between a Local Grouping identifier and a Remote Grouping identifier on a node.

The Remote Association Configuration Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_REMOTE_ASSOCIATION | | | | | | | |
| Command = REMOTE_ASSOCIATION_CONFIGURATION_GET | | | | | | | |
| Local Grouping identifier | | | | | | | |

**Local Grouping identifier (8 bits)**

Like in the Association Command Class, the Local Grouping identifier is used to specify the grouping identifier on the local node.

### 4.18.3 Remote Association Configuration Report Command

The Remote Association Configuration Report Command returns the remote NodeID and the grouping identifier.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_REMOTE_ASSOCIATION | | | | | | | |
| Command = REMOTE_ASSOCIATION_CONFIGURATION_REPORT | | | | | | | |
| Local Grouping identifier | | | | | | | |
| Remote NodeID | | | | | | | |
| Remote Grouping identifier | | | | | | | |

**Local Grouping identifier (8 bits)**

This group identifier used to specify the grouping identifier on the local node

**Remote NodeID (8 bits)**

This NodeID used to specify the remote node that the Remote Association Activate Command is sent to. If no link is established between the Local Grouping Identifier and a Remote Grouping Identifier, the Remote NodeID will return zero (0x0)

**Remote Grouping identifier (8 bits)**

This Remote grouping identifier used to specify the grouping identifier on the remote node that should be activated.

### 4.19  Version Command Class, version 1

The Version Command Class may be used to obtain the Z-Wave library type, the Z-Wave protocol version used by the application, the individual command class versions used by the application and the vendor specific application version from a Z-Wave enabled device.

#### 4.19.1  Compatibility Considerations

CC:0086.01.00.21.001
CC:0086.01.00.22.001

In a Multi Channel device, the Version Command Class MUST be supported by the Root Device, while the Version Command Class SHOULD NOT be supported by individual End Points.

CC:0086.01.00.21.002

There may be cases where a given Command Class is not implemented by the Root Device of a Multi Channel device. However, the Root Device MUST respond to Version requests for any Command Class implemented by the Multi Channel device; also in cases where the actual Command Class is only provided by an End Point.

CC:0086.01.00.21.003

A node supporting a Command Class having a version higher than 1 MUST support the Version Command Class to be able to identify the supported version. If a node does not support the Version Command Class at its highest security level, it may be assumed that all command classes implement version 1.

#### 4.19.2  Security Considerations

The Version Command Class provides information about the device implementation. This information can potentially be used by an attacker to find vulnerabilities.

CC:0086.01.00.41.001

If a node supports this Command Class, it MUST comply with Table 21.

**Table 21, Version Command Class support**

|  | **After Non-Secure inclusion** | **After Secure inclusion** |
|---|---|---|
| **Non-Secure or Less-Secure communication** | The node MUST support the Version Command Class and advertise it in the NIF.. | The node MUST NOT support the Version Command Class and MUST NOT advertise it in the NIF or Security Commands Supported Report commands. |
| **Secure communication at the highest Security Class** | N/A | The node MUST support the Version Command Class and advertise it in the Security Commands Supported Report commands. |

**4.19.3 Version Get Command**

The Version Get Command is used to request the library type, protocol version and application version from a device that supports the Version Command Class. Refer to [1].

CC:0086.01.11.11.001 The Version Report Command MUST be returned in response to this command.

CC:0086.01.11.11.002 This command MUST NOT be issued via multicast addressing.
CC:0086.01.11.11.003 A receiving node MUST NOT return a response if this command is received via multicast addressing. The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_GET | | | | | | | |

**4.19.4 Version Report Command**

The Version Report Command is be used to advertise the library type, protocol version and application version from a device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_REPORT | | | | | | | |
| Z-Wave Library Type | | | | | | | |
| Z-Wave Protocol Version | | | | | | | |
| Z-Wave Protocol Sub Version | | | | | | | |
| Application Version | | | | | | | |
| Application Sub Version | | | | | | | |

**Z-Wave Library Type (8 bits)**

CC:0086.01.12.11.001 This field MUST carry the Z-Wave Protocol Library Type.
CC:0086.01.12.11.002 The value MUST comply with Table 22.

**Table 22, Z-Wave Library Type**

| Library Type | Description | Version |
|:---:|:---|:---:|
| 0x00 | N/A | - |
| 0x01 | Static Controller | 1 |
| 0x02 | Controller | 1 |
| 0x03 | Enhanced Slave | 1 |
| 0x04 | Slave | 1 |
| 0x05 | Installer | 1 |
| 0x06 | Routing Slave | 1 |
| 0x07 | Bridge Controller | 1 |
| 0x08 | Device Under Test (DUT) | 1 |
| 0x09 | N/A | 1 |
| 0x0A | AV Remote | 1 |
| 0x0B | AV Device | 1 |

CC:0086.01.12.11.003    Values marked as not applicable (N/A) MUST be ignored by a receiving node.

CC:0086.01.12.11.004    All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

**Z-Wave Protocol Version & Z-Wave Protocol Sub Version**

These fields advertise information specific to Software Development Kits (SDK) provided by Sigma Designs. Refer to Sigma Designs SDK documentation.

**Application Version (8 bits)**

Returns the Application Version and can have values in the range 0 to 255. The manufacturer assigns the Application Version.

**Application Sub Version (8 bits)**

Returns the Application Sub Version and can have values in the range 0 to 255. The manufacturer assigns the Application Sub Version.

### 4.19.5 Version Command Class Get Command

The Version Command Class Get Command is used to request the individual command class versions from a device.

CC:0086.01.13.11.001    The Version Command Class Report Command MUST be returned in response to this command.

Only versions from the command classes shown in the NIF, in the Security Command Supported Report or in the Multi Channel Capability Report can be requested.

It is not possible to get a version number for the Generic and Specific Device Classes.

CC:0086.01.13.11.002
CC:0086.01.13.11.003

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_COMMAND_CLASS_GET | | | | | | | |
| Requested Command Class | | | | | | | |

**Requested Command Class (8 bits)**

This field is used to indicate the Command Class identifier that is being requested.

### 4.19.6 Version Command Class Report Command

The Version Command Class Report Command is used to report the individual command class versions from a device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_COMMAND_CLASS_REPORT | | | | | | | |
| Requested Command Class | | | | | | | |
| Command Class Version | | | | | | | |

**Requested Command Class (8 bits)**

The Requested Command Class field specifies what Command Class the returned version belongs to.

**Command Class Version (8 bits)**

CC:0086.01.14.11.001    If the requested Command Class is supported, this field is used to return the Command Class Version. This field MUST be in the range 1..255. It starts with 1 and is incremented every time a new version of the Command Class is released.

CC:0086.01.14.11.002    If the requested Command Class is not supported or controlled, a responding node MUST set the Command Class Version field to 0x00.

### 4.20   Version Command Class, version 2

The Version Command Class, version 2 is extended to report the version of various firmware images such as a host processor firmware, etc. in addition to the firmware image running in the Z-Wave chip.

As an example, one may construct a product comprising a Z-Wave chip and a secondary host processor that maintains a security certificate. With Firmware Update Meta Data Command Class, version 3 the Z-Wave chip, the host processor and the security certificate may all be updated via individual firmware IDs. Version 2 of the Version Command Class (this Command Class) allows a controlling node to request the corresponding version information for each firmware ID.

Commands not mentioned here remain the same as specified for Version Command Class, version 1.

### 4.20.1   Version Report Command

This command is used to report the library type, protocol version and application version from a node.

Version 2 of this command renames the fields Application Version and Application Sub Version to Firmware 0 Version and Firmware 0 Sub Version. The use remains the same.

CC:0086.02.12.11.001    A node MUST advertise the version of all firmware images which can be updated via the Firmware Update Command Class.

CC:0086.02.12.11.002    A one-chip system MUST comply with the following:

CC:0086.02.12.11.003    • The Firmware 0 Version MUST reflect the complete firmware implementing the Z-Wave protocol stack as well as the Z-Wave application.

CC:0086.02.12.11.004    A multi-processor system MUST comply with the following:

CC:0086.02.12.11.005    • The Firmware 0 Version MUST reflect the firmware implementing the Z-Wave protocol stack and the inter-chip interface module that enables the Z-Wave application to run in the host processor.

CC:0086.02.12.11.006
CC:0086.02.12.13.001    Another firmware number (e.g. Firmware 1) version MUST reflect the Z-Wave application that runs in the host processor. Any firmware number larger than 0 MAY be used for this purpose.

CC:0086.02.12.13.002    A node MAY advertise the version of additional images hosted by the node; even if such images cannot be updated via the Firmware Update Command Class.

An illustration is given in Figure 10 and Figure 11.
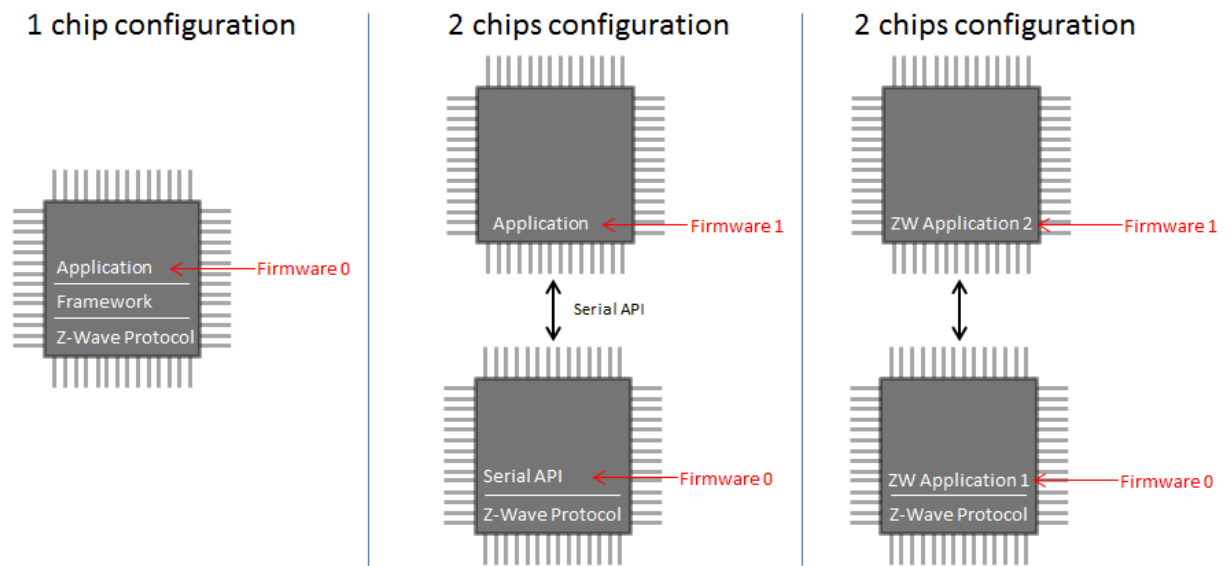
**Figure 10, Version Report::Firmware numbering**
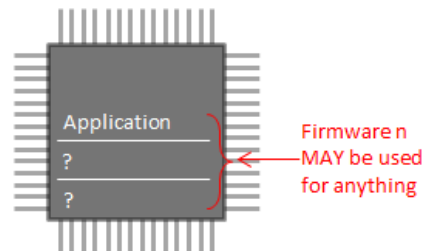


**Figure 11, Version Report::Firmware numbering (2)**

Further, version 2 of the Version Report command introduces a Hardware Version field as well as new version fields for each additional firmware image implemented by the actual device.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_REPORT | | | | | | | |
| Z-Wave Protocol Library Type | | | | | | | |
| Z-Wave Protocol Version | | | | | | | |
| Z-Wave Protocol Sub Version | | | | | | | |
| Firmware 0 Version | | | | | | | |
| Firmware 0 Sub Version | | | | | | | |
| Hardware Version | | | | | | | |
| Number of firmware targets | | | | | | | |
| Firmware 1 Version | | | | | | | |
| Firmware 1 Sub Version | | | | | | | |
| … | | | | | | | |
| Firmware N Version | | | | | | | |
| Firmware N Sub Version | | | | | | | |

**Z-Wave Library Type (8 bits)**

For a description, refer to section 4.19.4.

**Z-Wave Protocol Version and Z-Wave Protocol Sub Version**

These fields advertise information specific to Software Development Kits (SDK) provided by Sigma Designs. Refer to Sigma Designs SDK documentation.

**Firmware 0 Version (8 bits)**

CC:0086.02.12.11.007

Returns the Firmware 0 Version. Firmware 0 is dedicated to the Z-Wave chip firmware. The manufacturer MUST assign a version number. Previously called Application Version.

**Firmware 0 Sub Version (8 bits)**

CC:0086.02.12.11.008

Returns the Firmware 0 Sub Version. Firmware 0 is dedicated to the Z-Wave chip firmware. The manufacturer MUST assign a sub version number. Previously called Application Sub Version.

**Hardware Version (8 bits)**

CC:0086.02.12.11.009
CC:0086.02.12.11.00A
CC:0086.02.12.12.001

The Hardware Version field MUST report a value which is unique to this particular version of the product. The value MUST be updated to a new value every time the hardware is modified for a given product. The value 0x00 SHOULD NOT be used for the Hardware Version.

CC:0086.02.12.11.00B

It MUST be possible to uniquely determine the hardware characteristics from the Hardware Version field in combination with the Manufacturer ID, Product Type ID and Product ID fields of Manufacturer Specific Info Report of the Manufacturer Specific Command Class.
This information allows a user to pick a firmware image version that is guaranteed to work with this particular version of the product.

Note that the Hardware Version field is intended for the hardware version of the entire product, not just the version of the Z-Wave radio chip.

**Number of Firmware Targets (8 bits)**

CC:0086.02.12.11.00C

The Number of Firmware Targets field MUST report the number of firmware Version + Sub Version fields following this field. The Firmware 0 Version fields are not included.

CC:0086.02.12.11.00D

The field MUST be zero if the device only implements a Firmware 0 target, the Z-Wave chip.

**Firmware Version (N * 8 bits)**

CC:0086.02.12.11.00E

Returns the Firmware n Version. The manufacturer MUST assign a unique Firmware n Version.

**Firmware Sub Version (N * 8 bits)**

CC:0086.02.12.11.00F

Returns the Firmware n Sub Version. The manufacturer MUST assign a unique Firmware n Sub Version.

### 4.21   Version Command Class, version 3

The Version Command Class, version 3 allows supporting nodes to advertise capabilities related to the Version Command Class and optionally provide a detailed list of information regarding implementation on the Z-Wave chip.

#### 4.21.1   Compatibility considerations

The Version Command Class, version 3 is backwards compatible with the Version Command Class, version 2. A node supporting the Version Command Class, version 3 MUST also support the Version Command Class, version 2.

All commands and fields not described in this version remain unchanged from version 2.

The Version Command Class, version 3 introduces the possibility for a node to advertise its supported Version Command Class capabilities with the following commands:

- Version Capabilities Get Command
- Version Capabilities Report Command

Supporting nodes MUST advertise support for commands present in previous versions of this Command Class for backwards compatibility.
The following commands are optionally implemented by supporting nodes:

- Version Z-Wave Software Get Command
- Version Z-Wave Software Report Command

The Version Z-Wave Software Get/Report commands are used to provide detailed information on the actual software running on the Z-Wave radio SoC.

#### 4.21.2   Version Capabilities Get Command

This command is used to request which version commands are supported by a node.

The Version Capabilities Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION |||||||||
| Command = VERSION_CAPABILITIES_GET |||||||||

### 4.21.3 Version Capabilities Report Command

This command is used to advertise the version commands supported by the sending node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_CAPABILITIES_REPORT | | | | | | | |
| Reserved | | | | | ZWS | CC | V |

**V (Version) (1 bit)**

This field is used to advertise support for the version information queried with the Version Get Command.
This field MUST be set to 1.

**CC (Command Class) (1 bit)**

This field is used to advertise support for the Command Class version information queried with the
Version Command Class Get Command.
This field MUST be set to 1.

**ZWS (Z-Wave Software) (1 bit)**

This field is used to advertise support for the detailed Z-Wave software version information queried with
the Version Z-Wave Software Get Command.

The value 1 MUST indicate that the sending node supports the Version Z-Wave Software Get Command.
The value 0 MUST indicate that the sending node does not support the Version Z-Wave Software Get
Command.

### 4.21.4 Version Z-Wave Software Get Command

This command is used to request the detailed Z-Wave chip software version information of a node.

A node advertising no support for detailed Z-Wave software version information in the Version
Capabilities Report Command MUST ignore this command.

The Version Z-Wave Software Report Command MUST be returned in response to this command unless
it is to be ignored.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION | | | | | | | |
| Command = VERSION_ZWAVE_SOFTWARE_GET | | | | | | | |

### 4.21.5  Version Z-Wave Software Report Command

This command is used to advertise the detailed Z-Wave chip software version information of a node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_VERSION |||||||| 
| Command = VERSION_ZWAVE_SOFTWARE_REPORT |||||||| 
| SDK version 1 (MSB) |||||||| 
| SDK version 2 |||||||| 
| SDK version 3 (LSB) |||||||| 
| Application Framework API Version 1 (MSB) |||||||| 
| Application Framework API Version 2 |||||||| 
| Application Framework API Version 3 (LSB) |||||||| 
| Application Framework Build Number 1 (MSB) |||||||| 
| Application Framework Build Number 2 (LSB) |||||||| 
| Host Interface Version 1 (MSB) |||||||| 
| Host Interface Version 2 |||||||| 
| Host Interface Version 3 (LSB) |||||||| 
| Host Interface Build Number 1 (MSB) |||||||| 
| Host Interface Build Number 2 (LSB) |||||||| 
| Z-Wave Protocol Version 1 (MSB) |||||||| 
| Z-Wave Protocol Version 2 |||||||| 
| Z-Wave Protocol Version 3 (LSB) |||||||| 
| Z-Wave Protocol Build Number 1 (MSB) |||||||| 
| Z-Wave Protocol Build Number 2 (LSB) |||||||| 
| Application Version 1 (MSB) |||||||| 
| Application Version 2 |||||||| 
| Application Version 3 (LSB) |||||||| 
| Application Build Number 1 (MSB) |||||||| 
| Application Build Number 2 (LSB) |||||||| 

**SDK version (24 bits)**

This field is used to advertise the SDK version used for building the Z-Wave chip software components for the node.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the SDK version.

**Application Framework API Version (24 bits)**

This field is used to advertise the application framework API version used by the node.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the application framework API version.

**Application Framework Build Number (16 bits)**

This field is used to advertise the application framework build number running on the node.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the application framework build number.

This field MUST be set to 0 if the Application Framework API Version field is set to 0.

**Host Interface Version (24 bits)**

This field is used to advertise the version of the API exposed to a host CPU.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the actual API version. This field MUST be set to 0 by a node running on a single chip.

**Host Interface Build Number (16 bits)**

This field is used to advertise the build number of the API software exposed to a host CPU.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the actual API build number.
This field MUST be set to 0 if the Host Interface Version field is set to 0.

**Z-Wave Protocol Version (24 bits)**

This field is used to advertise the Z-Wave protocol version used by the node.

This field MUST be set to the same value as the Z-Wave Protocol Version and Z-Wave Protocol Sub Version fields present in the Version Report Command.

Byte 1 of this field MUST be set to the same value as the Z-Wave Protocol Version field present in the Version Report Command.
Byte 2 of this field MUST be set to the same value as the Z-Wave Protocol Sub Version field present in the Version Report Command.

**Z-Wave Protocol Build Number (16 bits)**

This field is used to advertise the actual build number of the Z-Wave protocol software used by the node.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the Z-Wave protocol build number.

**Application Version (24 bits)**

This field is used to advertise the version of application software used by the node on its Z-Wave chip.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the application version.

This field MUST be set to 0 by a node if its application is running on a host CPU.
If a supporting node's application is running on the Z-Wave chip:

- Byte 1 of this field MUST be set to the same value as the Z-Wave Application field present in the Version Report Command.
- Byte 2 of this field MUST be set to the same value as the Z-Wave Application Sub Version field present in the Version Report Command.

**Application Build Number (16 bits)**

This field is used to advertise the actual build of the application software used by the node on its Z-Wave chip.

The value 0 MUST indicate that this field is unused. Other values MUST indicate the application build number.

#### 4.21.5.1    Version fields

Fields indicating version numbers are composed of 3 bytes. Version fields MUST be used and interpreted in the following manner:

If used, Byte 1 of a version field MUST represent the major version digit.
If used, Byte 2 of a version field MUST represent the minor version digit.
If used, Byte 3 of a version field MUST represent the patch version digit.

For example, if the node used Z-Wave SDK version 6.51.09, it MUST set the SDK version field to 0x063309. Unused bytes MUST be set to 0.

### 4.22 Wake Up Command Class, version 1

The Wake Up Command Class allows a battery-powered device to notify another device (always listening), that it is awake and ready to receive any queued commands.
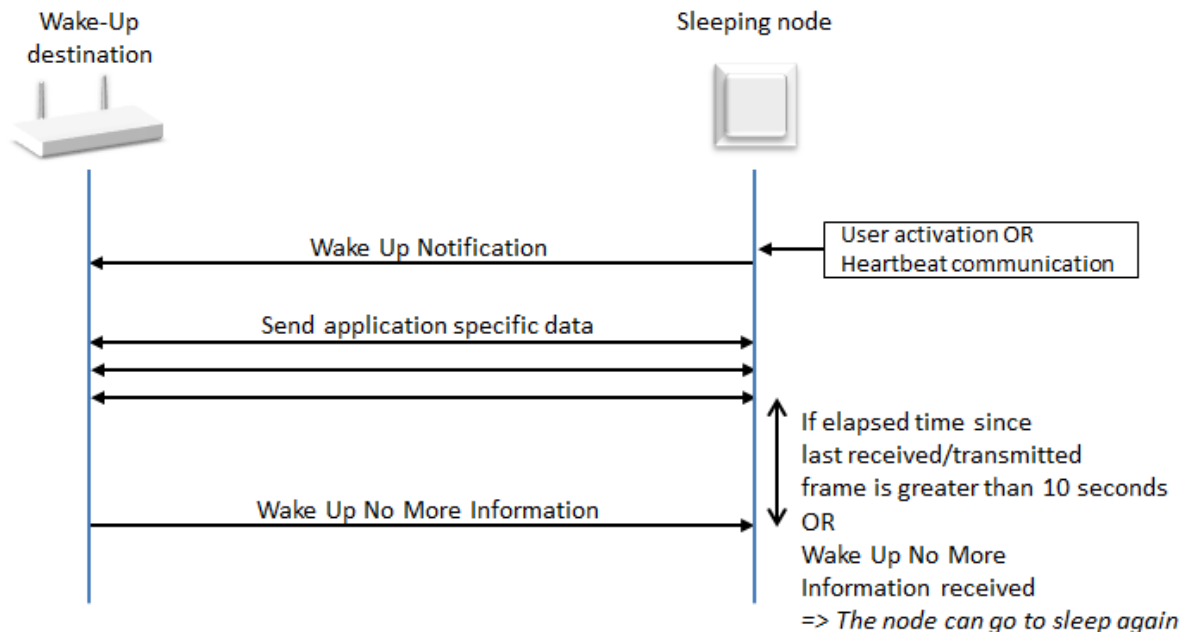


**Figure 12, Wake Up sequence**

<div style="display:flex"><div style="width:180px">CC:0084.01.00.12.001</div><div>This Command Class SHOULD be implemented by battery powered devices. Wake Up Notification commands SHOULD be handled immediately by the destination node in order to minimize battery consumption.</div></div>

#### 4.22.1 Terminology

The <u>Wake Up period</u> is defined as the period during which a Wake Up node is supposed to be awake after issuing a Wake Up Notification Command to its <u>Wake Up destination</u>.

The Wake Up period starts when the supporting node issues a Wake Up Notification and it ends either 10 seconds after the last received/transmitted frame or at the reception of a Wake Up No More Information Command by the Wake Up destination.

#### 4.22.2 Interoperability considerations

CC:0084.01.00.31.001    The Wake Up Notification Command Class MUST NOT be covered by any association group. This also means that the Wake Up Notification Command Class MUST NOT be covered by the Lifeline association group.

CC:0084.01.00.32.001    A node sending periodical or triggered unsolicited commands at the same time it wakes up SHOULD send the unsolicited commands before the Wake Up Notification Command.

CC:0084.01.00.32.002    A supporting node SHOULD NOT send unsolicited commands during the Wake Up period.

### 4.22.3  Wake Up Interval Set Command

This command is used to configure the Wake Up interval and destination of a node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_INTERVAL_SET | | | | | | | |
| Seconds 1 (MSB) | | | | | | | |
| Seconds 2 | | | | | | | |
| Seconds 3 (LSB) | | | | | | | |
| NodeID | | | | | | | |

**Seconds (24 bits)**

This field is used to specify the time in seconds between Wake Up periods for the receiving node.

CC:0084.01.04.11.001    The first byte MUST be the most significant byte.

CC:0084.01.04.11.002    Values in the range 1..16777215 MUST indicate the time between Wake Up periods.
The value 0 MUST indicate that the receiving node MUST Wake Up when initiated by an event
determined by the application e.g. a pushbutton activation.

**NodeID (8 bits)**

This field is used to specify the Wake Up destination NodeID.

CC:0084.01.04.11.003    A receiving node MUST assume the indicated NodeID as Wake Up destination. i.e. the Wake Up
Notification Command MUST be sent to the NodeID specified in this field.

### 4.22.4  Wake Up Interval Get Command

This command is used to request the Wake Up Interval and destination of a node.

CC:0084.01.05.11.001    The Wake Up Interval Report Command MUST be returned in response to this command.

CC:0084.01.05.11.002    This command MUST NOT be issued via multicast addressing.
CC:0084.01.05.11.003    A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination
are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_INTERVAL_GET | | | | | | | |

### 4.22.5 Wake Up Interval Report Command

This command is used to advertise the current Wake Up interval and destination.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_INTERVAL_REPORT | | | | | | | |
| Seconds 1 (MSB) | | | | | | | |
| Seconds 2 | | | | | | | |
| Seconds 3 (LSB) | | | | | | | |
| NodeID | | | | | | | |

**Seconds (24 bits)**

This field is used to advertise the time in seconds between Wake Up periods at the sending node.

CC:0084.01.06.11.001 The first byte MUST be the most significant byte.

CC:0084.01.06.11.002 Values in the range 1..16777215 MUST indicate the time between Wake Up periods.
The value 0 MUST indicate that the receiving node MUST Wake Up when initiated by an event determined by the application e.g. a pushbutton activation.

**NodeID (8 bits)**

This field is used to advertise the Wake Up destination NodeID configured at the sending node.

CC:0084.01.06.11.003 The sending node MUST send the Wake Up Notification Commands to the advertised NodeID in this field.

### 4.22.6 Wake Up Notification Command

This command allows a node to notify its Wake Up destination that it is awake.

CC:0084.01.07.12.001
CC:0084.01.07.11.001 The sending node SHOULD start a timer allowing it power down again in case no Wake Up No More Information Command is received. If implemented, the timer MUST comply with the timing requirements defined in the Z-Wave Plus Device Types Specification [9].

CC:0084.01.07.13.001
CC:0084.01.07.11.002
CC:0084.01.07.12.002 A node MAY send this command as broadcast if no Wake Up destination NodeID is configured. A receiving node MUST NOT return a Wake Up No More Information Command in response to this command issued via broadcast. Upon receiving this command via broadcast, a receiving node SHOULD configure a relevant Wake Up destination issuing a Wake Up Interval Set Command to the node that issued this command via broadcast.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_NOTIFICATION | | | | | | | |

### 4.22.7  Wake Up No More Information Command

CC:0084.01.08.13.001

This command is used to notify a supporting node that it MAY return to sleep to minimize power consumption.

CC:0084.01.08.12.001

A node receiving the Wake Up No More Information Command SHOULD return a MAC layer Ack frame for the Wake Up No More Information Command before returning to sleep. Not acknowledging the command will cause a number of retransmissions.

CC:0084.01.08.12.002

It is RECOMMENDED that the handling of the Wake Up No More Information Command and the associated time window for MAC layer acknowledgement is left to the protocol layer in order to simplify application design.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_NO_MORE_INFORMATION | | | | | | | |

### 4.23   Wake Up Command Class, version 2

The Wake Up Command Class version 2 enables read back of the Wake Up Interval capabilities in a node.

#### 4.23.1   Compatibility considerations

CC:0084.02.00.21.001   A node supporting Wake Up Command Class, version 2 MUST also support Wake Up Command Class, version 1.

All commands not mentioned in this version remain unchanged from the Wake Up Command Class, version 1.

CC:0084.02.00.22.001   A version 2 supporting node may receive a Wake Up Interval Set outside the range of supported intervals from a version 1 controlling node. A version 2 supporting node SHOULD NOT ignore a Wake Up Interval Set with an invalid time period and set the Wake Up Interval to a supported value.

#### 4.23.2   Wake Up Interval Set Command

The Wake Up Interval Set Command is used to configure the wake up interval of a device and the NodeID of the device receiving the Wake Up Notification Command.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_INTERVAL_SET | | | | | | | |
| Seconds 1 (MSB) | | | | | | | |
| Seconds 2 | | | | | | | |
| Seconds 3 (LSB) | | | | | | | |
| NodeID | | | | | | | |

All fields not described below remain unchanged from version 1

**Seconds (24 bits)**

This field is used to specify the time in seconds between Wake Up periods for the receiving node.

CC:0084.02.04.11.001    The first byte MUST be the most significant byte.

CC:0084.02.04.11.002    Values in the range 1..16777215 MUST indicate the time between Wake Up periods.
The value 0 MUST indicate that the receiving node MUST Wake Up when initiated by an event determined by the application e.g. a pushbutton activation.

CC:0084.02.04.11.003    A receiving node MUST accept any interval value within the interval limits advertised by the Wake Up Interval Capabilities Report Command.

CC:0084.02.04.12.001    A receiving node SHOULD NOT ignore this command if this field contains a non-valid value and it SHOULD apply the following:

CC:0084.02.04.12.002
- If the received value is higher than the minimum valid value (advertised in the Wake Up Interval Capabilities Report Command), the receiving node SHOULD round down the value to the next valid value but SHOULD NOT set it to 0 if 0 is the minimum value.

CC:0084.02.04.12.003
- If the value specified in this field is lower than the minimum valid value, the receiving node SHOULD apply the minimum valid value.

CC:0084.02.04.12.004    A receiving node SHOULD accept the value 0, even if the Minimum Wake Up Interval advertised by the Wake Up Interval Capabilities Report Command is larger than 0. If accepted, the value 0 MUST disable the timer-based transmission of Wake Up Notification Commands.

CC:0084.02.04.12.005    The node SHOULD be able to issue a Wake Up Notification in response to some local activation, e.g. a button press.

### 4.23.3  Wake Up Interval Capabilities Get Command

This command is used to request the Wake Up Interval capabilities of a node.

CC:0084.02.09.11.001    The Wake Up Interval Capabilities Report Command MUST be returned in response to this command.

CC:0084.02.09.11.002
CC:0084.02.09.11.003    This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing. The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP |||||||||
| Command = WAKE_UP_INTERVAL_CAPABILITIES_GET |||||||||

### 4.23.4  Wake Up Interval Capabilities Report Command

This command is used to advertise the Wake Up Interval capabilities of a node.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_WAKE_UP | | | | | | | |
| Command = WAKE_UP_INTERVAL_CAPABILITIES_REPORT | | | | | | | |
| Minimum Wake Up Interval Seconds 1 (MSB) | | | | | | | |
| Minimum Wake Up Interval Seconds 2 | | | | | | | |
| Minimum Wake Up Interval Seconds 3 (LSB) | | | | | | | |
| Maximum Wake Up Interval Seconds 1 (MSB) | | | | | | | |
| Maximum Wake Up Interval Seconds 2 | | | | | | | |
| Maximum Wake Up Interval Seconds 3 (LSB) | | | | | | | |
| Default Wake Up Interval Seconds 1 (MSB) | | | | | | | |
| Default Wake Up Interval Seconds 2 | | | | | | | |
| Default Wake Up Interval Seconds 3 (LSB) | | | | | | | |
| Wake Up Interval Step Seconds 1 (MSB) | | | | | | | |
| Wake Up Interval Step Seconds 2 | | | | | | | |
| Wake Up Interval Step Seconds 3 (LSB) | | | | | | | |

CC:0084.02.0A.11.001    Byte 1 MUST be the most significant byte for all fields in this command.

**Minimum Wake Up Interval Seconds (24 bits)**

CC:0084.02.0A.11.002    This field is used to advertise the minimum Wake Up Interval supported by the sending node. The field MUST be in the range 0..16777215

CC:0084.02.0A.11.00B    The value 0 MUST indicate that the receiving node MUST supports Wake Up when initiated by an event determined by the application e.g. a pushbutton activation.

CC:0084.02.0A.11.00C    Values in the range 1..16777215 MUST indicate Minimum supported Wake Up interval in seconds

**Maximum Wake Up Interval Seconds (24 bits)**

CC:0084.02.0A.11.003    This field is used to advertise the maximum Wake Up Interval supported by the sending node. The field MUST comply with Table 23

**Table 23, Wake Up Interval Capabilities Report::Maximum Wake Up Interval Seconds encoding**

| Decimal | Description |
|---|---|
| 0 | This value is used to indicate that there is no minimum / maximum / default wake up interval. In this case, the sending node is activated by e.g. user interaction in form of a button press.<br><br>If this field is set to 0, the Minimum and Default Wake Up Interval fields MUST also be 0. |
| &lt;min interval&gt; ..16777215 | Values in this range indicate the maximum wake up interval in seconds supported by the sending node.<br><br>This field MUST NOT be set to a lower value than the Minimum Wake Up Interval Seconds value.<br><br>This field MAY be set to the same value as the Minimum Wake Up Interval Seconds value, which means the sending node only supports one value. |

CC:0084.02.0A.11.004

CC:0084.02.0A.11.005

CC:0084.02.0A.13.001

**Default Wake Up Interval Seconds (24 bits)**

This field is used to advertise the default Wake Up Interval value for the sending node.

CC:0084.02.0A.11.006
This field MUST be set to a value included in the range defined by the Minimum Wake Up Interval and the Maximum Wake Up Interval

CC:0084.02.0A.12.001
The Default Wake Up Interval SHOULD be 0 if the Minimum Wake Up Interval is 0.

**Wake Up Interval Step Seconds (24 bits)**

CC:0084.02.0A.11.007
This field is used to advertise the resolution of valid Wake Up Intervals values for the sending node. The field MUST comply with Table 24

**Table 24, Wake Up Interval Capabilities Report::Wake Up Interval Step Seconds encoding**

| Decimal | Description |
|---|---|
| 0 | This value is used to indicate that no interval steps are possible. |
| | The battery-operated device only supports the minimum and maximum Wake Up Interval values. |
| | This field MUST be set to 0 if the maximum and the minimum interval are equal. |
| 1..16777215 | Values in this range indicate the Wake Up Interval step in seconds supported by the sending node. |
| | This field's value MUST NOT exceed the difference between the Minimum and Maximum Wake Up Intervals. |
| | This field SHOULD have a value so that the difference between the maximum and minimum Wake Up Interval is a multiple of this field's value. |
| | *Examples:* |
| | If a device has minimum wake up interval of 5 minutes (300 seconds) and a maximum wake up interval of 10 minutes (600 seconds), the wake up interval step MUST NOT exceed 5 minutes (300 seconds) as this would be larger than the difference of the minimum and maximum interval. A Wake Up Interval Step of 100 seconds indicates that the nodes supports the following Wake Up Intervals : 300 seconds 400 seconds 500 seconds 600 seconds |

CC:0084.02.0A.11.008

CC:0084.02.0A.11.009

CC:0084.02.0A.12.002

CC:0084.02.0A.11.00A

### 4.24 Z/IP Naming and Location Command Class, version 1

The Z/IP Naming and Location Command Class is used to manage the Name and a Location text strings of a Z/IP resource.

#### 4.24.1 Compatibility Considerations

A Z/IP resource is identified by an IPv6 address and an End Point ID. Capable Z/IP nodes SHOULD store the naming and location information locally in non-volatile storage. In addition, a Z/IP Resource Directory (RD) [18] MAY store the naming and location of all Z/IP Resources; also sleeping resources. The Z/IP RD manages node properties retrieved from actual nodes as well as extended information which is not always available in classic Z-Wave nodes.
Information managed by the Z/IP RD may be announced to Z/IP Clients via service discovery mechanisms such as mDNS [19].

Commands defined in this command class MUST be carried in Z/IP packets.

A client modifying the name and/or location information MUST ensure that the combined length of the Z/IP Name and Z/IP Location is 62 bytes or less in order to comply with DNS-SD limitations.

#### 4.24.2 Z/IP Name Set Command

This command is used to set the name of a Z/IP Resource.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZIP_NAMING ||||||||
| Command = ZIP_NAMING_NAME_SET ||||||||
| Name 1 ||||||||
| … ||||||||
| Name N ||||||||

**Name (N bytes)**

This field is used to specify the Name portion of the resource name.

The combined Name and Location strings MUST NOT be longer than 62 bytes.
The Name String MUST be UTF-8 encoded. Since a UTF-8 character may require two or more bytes, the maximum length of a name string depends on the composition of the string.
The Name String MUST NOT contain any appended termination characters. The number of bytes MUST be determined from the command length.

The name MUST NOT contain the dot (also known as period) character ".".
The escape sequence "\." (backslash followed by dot) MAY be used for encoding the dot character.
A user interface SHOULD allow users to enter names that contain dot characters.
If a dot character is entered, the user interface MUST replace the dot character with the escape sequence "\."before issuing this command.

The name MUST NOT contain the underscore character "_".
The name MUST NOT end with the dash character "-".

Node names MUST be case insensitive.

### 4.24.3 Z/IP Name Get Command

This command is used to request the name from a Z/IP Resource

The Z/IP Name Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZIP_NAMING ||||||||
| Command = ZIP_NAMING_NAME_GET ||||||||

### 4.24.4 Z/IP Name Report Command

This command is used to advertise the name of a Z/IP Resource.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZIP_NAMING ||||||||
| Command = ZIP_NAMING_NAME_REPORT ||||||||
| Name 1 ||||||||
| … ||||||||
| Name N ||||||||

**Name (N bytes)**

Refer to 4.24.2.

It may be attractive to use dots in names. The escape sequence "\." (backslash followed by dot) MAY be used for encoding the dot character in names.
A receiving device SHOULD display the escape sequence "\." as "." in user interfaces facing end users.

**4.24.5  Z/IP Location Set Command**

This command is used to set the location of a Z/IP Resource.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZIP_NAMING | | | | | | | |
| Command = ZIP_NAMING_LOCATION_SET | | | | | | | |
| Location 1 | | | | | | | |
| … | | | | | | | |
| Location N | | | | | | | |

**Location (N bytes)**

This field is used to specify the Location portion of the resource name.

The combined Name and Location strings MUST NOT be longer than 62 bytes.
The Location string MUST be UTF-8 encoded. Since a UTF-8 character may require two or more bytes, the maximum length of a location string depends on the composition of the string.
The Location string MUST NOT contain any appended termination characters. The number of bytes MUST be determined from the message length.

The location string MAY contain the dot (also known as the period) character ".".
A user interface MUST NOT replace the dot character with the escape sequence "\."before issuing this Command.

The location string MUST NOT contain the underscore character "_".

Each location sub-string (separated by the dot character ".") MUST NOT end with the dash character "-".

Node locations MUST be case insensitive.

**4.24.6  Z/IP Location Get Command**

This command is used to request the location from a Z/IP Resource

The Z/IP Location Report Command MUST be returned in response to this command.

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZIP_NAMING | | | | | | | |
| Command = ZIP_NAMING_LOCATION_GET | | | | | | | |

### 4.24.7 Z/IP Location Report Command

This command is used to advertise the location of a Z/IP Resource.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZIP_NAMING | | | | | | | |
| Command = ZIP_NAMING_LOCATION_REPORT | | | | | | | |
| Location 1 | | | | | | | |
| … | | | | | | | |
| Location N | | | | | | | |

**Location (N bytes)**

Refer to 4.24.5.

The escape sequence "\." (backslash followed by dot) MAY be used for encoding the dot character in locations.
A receiving node SHOULD display the escape sequence "\." as "." in user interfaces facing end users.

### 4.25  Z-Wave Plus Info Command Class, version 1 [OBSOLETED]

CC:005E.01.00.11.001

**THIS COMMAND CLASS VERSION HAS BEEN OBSOLETED**

New implementations MUST use the Z-Wave Plus Info Command Class Version 2.

### 4.26   Z-Wave Plus Info Command Class, version 2

The Z-Wave Plus Info Command Class is used to differentiate between Z-Wave Plus, Z-Wave for IP and Z-Wave devices. Furthermore this command class provides additional information about the Z-Wave Plus device in question.

CC:005E.02.00.11.001

The Z-Wave Plus Info Command Class defines two icon types. Icon types allow for a meaningful, homogeneous representation in user and installer Graphical User Interfaces (GUI), respectively. A Z-Wave Plus product MUST specify valid icon types. Icon types do not affect the operation of a product or how it is certified. The actual graphical appearance of icons is out of scope of this specification. Any app may define its own icon library mapping to the Icon Type identifiers.

#### 4.26.1   Compatibility Considerations

##### 4.26.1.1        Node Information Frame (NIF)

CC:005E.02.00.21.001

A supporting node MUST always advertise the Z-Wave Plus Info Command Class in its NIF, regardless of the inclusion status and security bootstrapping outcome.

CC:005E.02.00.21.002

The Z-Wave Plus Info Command Class MUST be advertised as the first supported command class in Node Information Frame (NIF).

#### 4.26.2   Multi Channel considerations

A Multi Channel device implements a Root Device and a number of Multi Channel End Points.

CC:005E.02.00.11.002

The Z-Wave Plus Info Command Class MUST be supported for each End Point in order to advertise individual icons for each End Point.
This means that the Z-Wave Plus Version, Role Type and Node Type information is advertised in a redundant fashion. The advertised Z-Wave Plus Version, Role Type and Node Type information values

CC:005E.02.00.11.003

MUST be identical for the Root Device and all Multi Channel End Points.

#### 4.26.3   Z-Wave Plus Info Get Command

The Z-Wave Plus Info Get Command is used to get additional information of the Z-Wave Plus device in question.

CC:005E.02.01.11.001

The Z-Wave Plus Info Report Command MUST be returned in response to this command.

CC:005E.02.01.11.002
CC:005E.02.01.11.003

This command MUST NOT be issued via multicast addressing.
A receiving node MUST NOT return a response if this command is received via multicast addressing.
The Z-Wave Multicast frame, the broadcast NodeID and the Multi Channel multi-End Point destination are all considered multicast addressing methods.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZWAVEPLUS_INFO | | | | | | | |
| Command = ZWAVEPLUS_INFO_GET | | | | | | | |

### 4.26.4 Z-Wave Plus Info Report Command

The Z-Wave Plus Info Report Command is used to report version of Z-Wave Plus framework used and additional information of the Z-Wave Plus device in question.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Command Class = COMMAND_CLASS_ZWAVEPLUS_INFO | | | | | | | |
| Command = ZWAVEPLUS_INFO_REPORT | | | | | | | |
| Z-Wave Plus Version | | | | | | | |
| Role Type | | | | | | | |
| Node Type | | | | | | | |
| Installer Icon Type MSB | | | | | | | |
| Installer Icon Type LSB | | | | | | | |
| User Icon Type MSB | | | | | | | |
| User Icon Type LSB | | | | | | | |

**Z-Wave Plus Version (8 bits)**

The Z-Wave Plus Version field enables a future revision of the Z-Wave Plus framework where it is necessary to distinguish it from the previous frameworks.

CC:005E.02.02.11.001 This field MUST be set to 1.

**Role Type (8 bits)**

The Role Type field indicates the role the Z-Wave Plus device in question possess in the network and functionalities supported. The full functionality is determined in conjunction with the Device Type.

**Node Type (8 bits)**

The Node Type field indicates the type of node the Z-Wave Plus device in question possess in the network.

The table below shows the current list of Node Types:

**Table 25, Node Type identifiers**

| Value | Identifier | Node Types |
|---|---|---|
| 0x00 | NODE_TYPE_ZWAVEPLUS_NODE | Z-Wave Plus node |
| 0x02 | NODE_TYPE_ZWAVEPLUS_FOR_IP_GATEWAY | Z-Wave Plus for IP gateway |

CC:005E.02.02.11.002 All other values are reserved and MUST NOT be used by a sending node. Reserved values MUST be ignored by a receiving node.

<u>Z-Wave Plus for IP gateway</u>

The device provides access to and from IP networks and allows IP hosts to discover resources in the Z-Wave network via Z/IP Discovery.

CC:005E.02.02.11.003    Two IP services MUST be available to represent Z-Wave resources in the IP domain: ICMP Echo (Ping) and UDP port 4123 (Z-Wave control protocol).

The device is typically a stand-alone device based on a residential IPv6 router. The Z-Wave interface is presented as an IP network interface to external clients but all IP communication to classic Z-Wave nodes is terminated by the gateway and forwarded in classic Z-Wave frames.

**Installer Icon Type (16 bits)**

The Installer Icon Type field indicates the icon to use in Graphical User Interfaces for network management, e.g. in a floor plan. Installer Icons provide a finer granularity than user icons, e.g. a light on/off resource may be a built-in wall outlet, a plug-in module or an entire power strip. A sensor may be a single sensor icon or multiple sensors in one casing.

For further details, refer to the User Icon Type section below.

**User Icon Type (16 bits)**

The User Icon Type field indicates the icon to use in Graphical User Interfaces for end users. User Icons provide a basic granularity, e.g. a light resource is always shown as a light bulb whether the physical device is a built-in wall outlet, a plug-in module or the output of a power strip.

CC:005E.02.02.11.004
CC:005E.02.02.13.001    In case of multi-endpoint devices, e.g. power strips or multi-sensors, the info command class MUST be supported and Icon Types MUST be specified for each endpoint.
The User Icon Type MAY differ for individual endpoints.

CC:005E.02.02.12.001    Icon types are defined by the Z-Wave Alliance [13]. The 16 bit identifier values defined by [13] allows the GUI designer to know how a given product would like to be represented using resources from the GUI designer's own favorite icon library. The icon graphics found in [13] are only suggested graphics. Output device icons SHOULD be tailored to the actual geographical region.

CC:005E.02.02.12.002
CC:005E.02.02.11.005    If a GUI does not know the specific icon type, it SHOULD use the generic icon type as a fallback alternative. The generic icon type MUST be derived by setting the least significant 8 bits of the icon type identifier to zero.

# APPENDIX A ASCII CODES

The standard ASCII table defines 128 character codes (from 0 to 127), of which, the first 32 are control codes (non-printable), and the remaining 96 character codes are printable characters. The table below shows the hexadecimal values of the ASCII character codes, e.g. the ASCII code for the capital letter "A" is equal to 0x41:

**Table 26, The standard ASCII Table**

|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | NUL | SOH | STX | ETX | EOT | ENQ | ACK | BEL | BS | TAB | LF | VT | FF | CR | SO | SI |
| 1 | DLE | DC1 | DC2 | DC3 | DC4 | NAK | SYN | ETB | CAN | EM | SUB | ESC | FS | GS | RS | U |
| 2 |   | ! | " | # | $ | % | & | ' | ( | ) | * | + | , | - | . | / |
| 3 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; | < | = | > | ? |
| 4 | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
| 5 | P | Q | R | S | T | U | V | W | X | Y | Z | [ | \ | ] | ^ | _ |
| 6 | ` | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 7 | p | q | r | s | t | u | v | w | x | y | z | { | | | } | ~ |   |

In addition to the 128 standard ASCII codes (the ones listed above ranging from 0 to 127), most systems have another 128 extra codes which form what is known as extended ASCII (with ranges from 128 to 255). The OEM Extended ASCII character set is included in all PC-compatible computers as the default character set when the system boots before loading any operating system and under MS-DOS. It includes some foreign signs, some marked characters and also pieces to draw simple panels. The table below shows the hexadecimal values of the OEM Extended ASCII character codes, e.g. the ASCII code for the capital letter "Æ" is equal to 0x92:

**Table 27, OEM Extended ASCII Table**

|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Ç | ü | é | â | ä | à | å | ç | ê | ë | è | ï | î | ì | Ä | Å |
| 9 | É | æ | Æ | ô | ö | ò | û | ù | ÿ | Ö | Ü | ¢ | £ | ¥ | ₧ | ƒ |
| A | á | í | ó | ú | ñ | Ñ | ª | º | ¿ | ⌐ | ¬ | ½ | ¼ | ¡ | « | » |
| B | ░ | ▒ | ▓ | │ | ┤ | ╡ | ╢ | ╖ | ╕ | ╣ | ║ | ╗ | ╝ | ╜ | ╛ | ┐ |
| C | └ | ┴ | ┬ | ├ | ─ | ┼ | ╞ | ╟ | ╚ | ╔ | ╩ | ╦ | ╠ | ═ | ╬ | ╧ |
| D | ╨ | ╤ | ╥ | ╙ | ╘ | ╒ | ╓ | ╫ | ╪ | ┘ | ┌ | █ | ▄ | ▌ | ▐ | ▀ |
| E | α | β | Γ | π | Σ | σ | µ | τ | Φ | Θ | Ω | δ | ∞ | φ | ∈ | ∩ |
| F | ≡ | ± | ≥ | ≤ | ⌠ | ⌡ | ÷ | ≈ | ° | ∙ | · | √ | ⁿ | ² | ■ |   |

Below are listed codes for players, radios etc. as an alternative to the OEM Extended ASCII codes. Undefined values MUST be ignored.

**Table 28, Players Table**

|   | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | ▪ | □ | ► | ▌▌ | ■ | • | ►► | ◄◄ | ◊ |   |   |   |   |   |   |   |
| 9 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| A |   | ¡ | ¢ | £ | ¤ | ¥ | ¦ | § | ¨ | © | ª | « | ¬ |   | ® | ¯ |
| B | ° | ± | ² | ³ | ´ | µ | ¶ | · | ¸ | ¹ | º | » | ¼ | ½ | ¾ | ¿ |
| C | À | Á | Â | Ã | Ä | Å | Æ | Ç | È | É | Ê | Ë | Ì | Í | Î | Ï |
| D | Ð | Ñ | Ò | Ó | Ô | Õ | Ö | × | Ø | Ù | Ú | Û | Ü | Ý | Þ | ß |
| E | à | á | â | ã | ä | å | æ | ç | è | é | ê | ë | ì | í | î | ï |
| F | ð | ñ | ò | ó | ô | õ | ö | ÷ | ø | ù | ú | û | ü | ý | þ | ÿ |

# APPENDIX B CRC-CCITT SOURCE CODE

The checksum algorithm implements a CRC-CCITT using initialization value equal to 0x1D0F and 0x1021 (normal representation) as the poly.

```
/****************************** ZW_crc.h ******************************
*********************************************************************/
#ifndef _ZW_CRC_H_
#define _ZW_CRC_H_

#include <ZW_typedefs.h>
/*********************************************************************/
/*                    EXPORTED FUNCTIONS                    */
/*********************************************************************/

WORD ZW_CreateCrc16( BYTE *pHeadeAddr, BYTE bHeaderLen, BYTE *pPayloadAddr, BYTE bPayloadLen );

/*========================== ZW_CheckCrc16 ===========================
**    CRC-CCITT (0x1D0F) calculation / check
**
**    In: byte string excluding 16bit check field
**    Out: CRC-16 value
** or
**    In: byte string including 16bit check field
**    Out: zero when OK
**-----------------------------------------------------------------*/

WORD ZW_CheckCrc16( WORD crc, BYTE *pDataAddr, WORD bDataLen );

#endif /* _ZW_CRC_H_ */
```

```
/****************************** ZW_crc.c ******************************
***********************************************************************/
#include <ZW_typedefs.h>
#include <ZW_crc.h>
#include <ZW_uart_api.h>
#define POLY 0x1021        /* crc-ccitt mask */


/*          CRC calculation              */


/*========================= ZW_CheckCrc16 ===========================
**    CRC-CCITT (0x1D0F) calculation / check
**
**    In:  byte string excluding 16bit check field
**    Out: CRC-16 value
**  or
**    In:  byte string including 16bit check field
**    Out: zero when OK
**
**  and
**    In: The crc input should normally be set to the initialization
**        value = 0x1D0F.
**        It can also be used to carry over crc value between separate
**        calculations of multiple parts of a frame, e.g. header and body.
**
**-------------------------------------------------------------------*/
WORD ZW_CheckCrc16( WORD crc, BYTE *pDataAddr, WORD bDataLen ) {
        BYTE WorkData;
        BYTE bitMask;
        BYTE NewBit;

        while(bDataLen--){
                WorkData = *pDataAddr++;
                for (bitMask = 0x80; bitMask != 0; bitMask >>= 1) {
                        /* Align test bit with next bit of the message byte, starting with msb. */
                        NewBit = ((WorkData & bitMask) != 0) ^ ((crc & 0x8000) != 0);
                        crc <<= 1;
                        if (NewBits) {
                                crc ^= POLY;
                        }
                } /* for (bitMask = 0x80; bitMask != 0; bitMask >>= 1) */
        }
        return crc;
}

WORD ZW_CreateCrc16( BYTE *pHeaderAddr, BYTE bHeaderLen, BYTE *pPayloadAddr, BYTE bPayloadLen){
        WORD crc;
        crc = 0x1D0F;
        crc = ZW_CheckCrc16(crc, pHeaderAddr, bHeaderLen);
        crc = ZW_CheckCrc16(crc, pPayloadAddr, bPayloadLen);
        return crc;
}
```

# REFERENCES

[1]    Sigma Designs, SDS10242, Software Design Spec., Z-Wave Device Class Specification.
[2]    Sigma Designs, SDS12657, Z-Wave Command Class Specification A-M.
[3]    Sigma Designs, SDS12652, Z-Wave Command Class Specification N-Z.
[4]    IETF RFC 4861, Neighbor Discovery for IP version 6 (IPv6),
       http://tools.ietf.org/pdf/rfc4861.pdf
[5]    IETF RFC 3122, Extensions to IPv6 Neighbor Discovery for Inverse Discovery Specification,
       http://tools.ietf.org/pdf/rfc3122.pdf
[6]    IETF RFC 2119, Key words for use in RFCs to Indicate Requirement Levels,
       http://tools.ietf.org/pdf/rfc2119.pdf
[7]    IETF RFC 2460, Internet Protocol, Version 6 (IPv6) Specification,
       http://tools.ietf.org/pdf/rfc2460.pdf
[8]    IETF RFC 4291, IP Version6 Addressing Architecture,
       http://tools.ietf.org/pdf/rfc4291.pdf
[9]    Sigma Designs, SDS11846, Z-Wave Plus Role Types Specification.
[10]   Sigma Designs, SDS11847, Z-Wave Plus Device Types Specification.
[11]   Graphical UI elements,
       http://en.wikipedia.org/wiki/Graphical_user_interface_elements
[12]   Sigma Designs, SDS13425. Z-Wave Plus Assigned Manufacturer IDs.
[13]   Sigma Designs, SDS13738, Z-Wave Plus Assigned Icon Types.
[14]   Sigma Designs, SDS13548, List of defined Z-Wave Command Classes
[15]   Sigma Designs, SDS13783, Z-Wave Transport-Encapsulation Command Class Specification
[16]   Sigma Designs, SDS13781, Z-Wave Application Command Class Specification
[17]   Sigma Designs, SDS13784, Z-Wave Network-Protocol Command Class Specification
[18]   Sigma Designs, SDS11633, Software Design Spec., Z/IP Resource Directory.
[19]   Sigma Designs, SDS11756, Software Design Spec., Z/IP DNS Discovery Support.
[20]