



OpenLCB Standard	
Firmware Upgrade	
Sep 18, 2015	Proposal

1 Introduction (Informative)

This Standard defines a method for using OpenLCB protocols for upgrading the firmware of an OpenLCB node. This Standard is agnostic to the physical layer.

2 Intended Use (Informative)

- 5 This method is expected to be implemented in common Configuration Tool (CT) software packages. Any hardware device that is able to follow the interactions defined here and thereby receive a firmware upgrade through this method will be able to be updated using commonly available CT software. This reduces the burden of the manufacturers in that they don't need to develop and provide tools and user interface for firmware upgrade capability, as well as increases
- 10 user satisfaction, because the user does not have to acquire and learn to use a new tool for each hardware manufacturer, but can use a tool she is already familiar with to update all conforming hardware nodes.

- 15 This Standard does not define new protocols, but identifies a specific subset of the OpenLCB protocol stack that is necessary for the firmware upgrade to function, and defines the exact sequence of operations that are expected to happen during a firmware upgrade.

The intended use of this subset is to allow manufacturers to supply their hardware with dual firmware, consisting of a “bootloader” component with the minimum required support for firmware update, as well as a replaceable “production” firmware for full node operation.

3 References and Context (Normative)

- 20 For more information on format and presentation, see:

- OpenLCB Common Information Technical Note

For information on OpenLCB message transport and OpenLCB communications, see:

- OpenLCB Message Network Standard. That Standard also defines the Uninitialized state and the Node Initialization Complete message.

- 25 The defined method relies on commands and messages defined in the following standards:

- OpenLCB Memory Configuration Standard, which defines, among others, the commands “Reset/Reboot”, “Enter Bootloader”, “Stream Write”.
- OpenLCB Stream Transport Draft Standard, which defined how streams are opened, data transferred, aborted with error and completed.

30 4 Message Formats (Normative)

This Standard does not define any messages.

5 States (Normative)

A powered-on hardware node may be in one of the following two states:

- 35 • Bootloader state. In this state the node supports a writable Memory Space under the number of the Firmware Space to receive the firmware upgrade data, as defined in the firmware upgrade interaction. The hardware is not expected to perform any of its regular operations. The OpenLCB node shall still be standards compliant.
- Operating state. In this state the node performs its desired function. The node in Operating state must not export a writable Memory Space under the number of the Firmware Space.

40 6 Interactions (Normative)

6.1 Definitions

There are two nodes involved in the firmware upgrade process:

The **Configuration Tool** (CT) is the node with a user interface that is in possession of the new manufacturer-supplied firmware data file.

- 45 The **Target Node** is the node whose firmware is being updated.

6.2 State transitions

A node may not transition between Bootloader state and Operating state without returning to Uninitialized state, as defined by the OpenLCB Message Network standard.

- 50 At power-up a hardware node shall start up in Operating state by default, unless one of the following conditions hold:

- Regular operation is impossible due to the lack of a working firmware. In this case the Target Node may, but is not required to, emit a Producer-Consumer Event Report (PCER) message with the Well-Known Event ID “Firmware Corrupted” after reaching Initialized state.
- 55 • The user has requested firmware upgrade mode using a hardware switch, if one is available. In this case, the Target Node may, but is not required to, emit a PCER message with the Well-Known Event ID “Firmware Upgrade Requested by Hardware Switch” after reaching Initialized state.

- 60 To request a Target Node to transition from Bootloader state to Operating state, the Configuration Tool shall send a Memory Configuration protocol “Reset/Reboot” command. The Target Node acknowledges the completion of the state transition by sending a Node Initialization Complete message.

To request a Target Node to transition to Bootloader state (from either Bootloader or Operating state), a Configuration Tool shall send a Memory Configuration protocol “Enter Bootloader” command. The

node acknowledges the completion of the state transition, if one was necessary, by sending a Node
 65 Initialization Complete message.

6.3 Data Transfer

The Configuration Tool shall transfer the manufacturer-supplied firmware data by performing a
 Memory Configuration protocol Stream Write to the memory space of Firmware Space, with a starting
 offset of zero (0). The stream data bytes are the unmodified, uninterpreted, exact sequence of the
 70 manufacturer-supplied firmware upgrade file.

If the node being upgraded encounters an error, it may abort the data transfer by aborting the stream
 with an error code. If the transfer is aborted, the node is required to stay in Bootloader state. If the CT
 re-tries the transfer, it shall do so from offset zero again. If the Target Node aborted the transfer, it is not
 required to be able to return to Operating state until the transfer is re-tried and successfully completed;
 75 however, it is required to be able to boot after a power cycle and return to Bootloader state, able to
 accept a new firmware upgrade attempt.

The Target Node being upgraded may, but is not required to, throttle the incoming data on the stream
 by means allowed by the Stream protocol.

After transferring all the bytes in the manufacturer-supplied firmware data file, the CT shall wait until it
 80 would be allowed to send more data according to the Stream protocol. Then the CT shall close the
 stream as defined in the Stream protocol. Afterwards the CT may, but is not required to, initiate a
 transition to Operating state.

6.4 Full sequence of firmware upgrade

For a more detailed description of the messages transferred, please see the Firmware Upgrade
 85 Technical Note.

1. The CT sends a Memory Configuration datagram command “Enter Bootloader”. Note that a
 Datagram Received OK reply message is not always returned to this request.
2. The CT waits for a Node Initialization Complete message from the Target Node.
3. The CT performs the Data Transfer.
- 90 4. The CT resets the Target Node using a Memory Configuration datagram command “Reset”.

7 Allocations (Normative)


This section describes the numerical values that were referenced in earlier sections and are not defined
 in their respective standards.

7.1 Memory Space numbers

0xEF	Firmware Space
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7.2 Error Codes

The Target Nodes may, but are not required to, use the following error codes to denote specific conditions relating to the firmware upgrade process.

0x2088	Temporary error, Transfer error. The firmware written has failed checksum.
0x1088 	Permanent error, invalid arguments. The firmware data is incompatible with this hardware node.
0x1089	Permanent error, invalid arguments. The firmware data is invalid or corrupted.

100 7.3 Well-Known Event IDs

01.01.00.00.00.00.06.01	Firmware Corrupted
01.01.00.00.00.00.06.02	Firmware Upgrade Requested by Hardware Switch

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