OPAL-RT Multi-System Expansion link

User Guide

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FROM IMAGINATION... TO REAL-TIME
What is the Multi-System Expansion Link?

- **OPAL-RT Multi-System Expansion link (MuSE)**\(^1\) is a fully integrated feature of OPAL-RT Software and FPGA solutions that facilitates management of a large number of I/O channels.

- The MuSE link expands the I/O capability of the real-time simulators by enabling connection of multiple FPGA-based I/O expansion boxes to the simulator.

- Based on **standard multi-mode optical fibers** and **small form-factor pluggable (SFP) 5Gbps transceivers**, this innovative feature allows you to manage **up to 4096 I/O channels** from your simulation model.

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\(^1\) This link is also referred to as High Speed Link (HSL)
Who should use the MUSE link?

The MuSE link is the solution when:

- Devices under test are scattered over a large space and at a distance from the simulator,
- The number of I/Os channels needed is larger than what the typical simulator would allow via PCIe connections.
MuSE link architecture

- The typical topology is a star configuration with one simulator as the central node, connected to up to 16 remote boxes,
- The number of chassis is limited only by the number of available SFP sockets on the simulator.

- The network of remote chassis is easily set up using the existing SFP sockets of the simulator, standard multi-mode optical fibers and small form-factor pluggable (SFP) transceivers, and does not require additional PCIe inter-connection hardware.
Hardware support

- The MuSE link is supported on most OPAL-RT platforms:

**Central nodes**

- OP5707
- OP4510

**Remote I/Os**

- OP4200
- OP4520
- OP5607

OP5607 and OP4520 can also be programmed as central nodes if connected to an OP5030 industrial target.
The configuration of the FPGA for the MuSE link does not require advanced knowledge of high-speed communication programming:

The MuSE link capability is automatically integrated into the FPGA programming file during its generation with OPAL-RT’s RT-XSG tool after the User has selected the **Architecture type** *(Central or Remote)* option.

- Existing chassis can be upgraded to support the new link simply by updating the FPGA programming file.
Software support

Configuration and management of remote I/Os is done via the RT-LAB or HYPERSIM User Interface.

Example configuration for OP4510 Central + OP4200 Remote.
Software features

- Detection and initialization of the systems connected to the central unit are handled automatically at model load time.

- Remote programming of the FPGA bitstreams of the remote units is supported.\(^1\)

- Central units programmed with a MuSE-link-compatible bitstream can run legacy models using Simulink I/O blocks when the remote units are not in use.

- The real-time synchronization signal is propagated to all units.\(^2\)

\(^1\) Early versions of the link require JTAG programming.
\(^2\) Early versions of the link require the legacy daisy-chain plastic optical fiber or copper cable.
Applications

RT-XSG Legacy Generic Aurora blockset and the MuSE link can coexist in the same system

• Simulators can connect simultaneously to expansion chassis via MuSE link and to 3rd-party devices via the Generic Aurora link

• Expansions chassis can connect simultaneously to a simulator via MuSE link and to 3rd-party devices via the Generic Aurora link

• Upgrading existing systems to make them compatible with the MuSE link only requires regenerating the bitstream.
Specifications

Platforms

<table>
<thead>
<tr>
<th>Platform</th>
<th>OP4200</th>
<th>OP4510</th>
<th>OP4520</th>
<th>OP5607</th>
<th>OP5707</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical links</td>
<td>2 (*)</td>
<td>4</td>
<td>4 (*)</td>
<td>16 (*)</td>
<td>16</td>
</tr>
<tr>
<td>Supported mode</td>
<td>Remote</td>
<td>Central</td>
<td>Remote (**)</td>
<td>Remote (**)</td>
<td>Central</td>
</tr>
</tbody>
</table>

(*) Only one link is used for the MuSE link in remote mode
(**) Central mode also supported if chassis is connected via PCIe to an OP5030 target

Link specifications

<table>
<thead>
<tr>
<th>Communication protocol</th>
<th>Aurora 8b10b</th>
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<tbody>
<tr>
<td>Link Speed</td>
<td>5Gbps</td>
</tr>
<tr>
<td>SFP transceivers</td>
<td>Avago AFBR-57R5APZ 850nm</td>
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<tr>
<td>Optical fiber</td>
<td>Duplex Multi-Mode 50/125μm or 62/125μm, LC-LC</td>
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<tr>
<td>Cable length</td>
<td>Up to 150m, depending on fiber type</td>
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Interested in expanding your simulator using the MuSE link? 

Contact your sales representative for more details.