DATA CENTER

Scale-Out Architectures with Brocade DCX 8510 Inter-Chassis Links

The Brocade® DCX® 8510 Backbone family offers second-generation, optical Inter-Chassis Link (ICL) connectivity, enabling massive fabric scalability while simplifying network topologies. This paper provides guidelines for the proper configuration and implementation of Brocade QSFP-based optical ICLs.
## CONTENTS

ICL Overview .................................................................................................................................................. 3
ICL Licensing .................................................................................................................................................. 3
Supported Topologies ...................................................................................................................................... 3
  Core/Edge Topology ...................................................................................................................................... 4
  Mesh Topology ............................................................................................................................................. 4
QSFP-Based ICL Connection Requirements .................................................................................................. 5
ICL Trunking and Trunk Groups .................................................................................................................. 6
Core Blade (CR16-8) Port Numbering Layout ............................................................................................. 8
Core Blade (CR16-4) Port Numbering Layout ............................................................................................. 8
Summary ....................................................................................................................................................... 9
ICL OVERVIEW

Brocade Inter-Chassis Links (ICLs) are high-performance ports for interconnecting multiple Brocade DCX Backbones, enabling industry-leading scalability while preserving ports for server and storage connections. Now in its second generation, the new Brocade optical ICLs—based on Quad Small Form Factor Pluggable (QSFP) technology—connect the core routing blades of two Brocade DCX 8510 chassis. Each QSFP-based ICL port combines four 16 Gbps links, providing up to 64 Gbps of throughput within a single cable. Available with Brocade Fabric OS® (FOS) v7.0 and later, Brocade offers up to 32 QSFP ICL ports on the Brocade DCX 8510-8 and up to 16 QSFP ICL ports on the DCX 8510-4.

The optical form factor of the Brocade QSFP-based ICL technology offers several advantages over the copper-based ICL design in the original Brocade DCX platforms. First, Brocade has increased the supported ICL cable distance from 2 meters to 50 meters, providing greater architectural design flexibility. Second, the combination of four cables into a single QSFP provides incredible flexibility for deploying a variety of different topologies, including a massive 9-chassis full-mesh design with only a single hop between any two points within the fabric. In addition to these significant advances in ICL technology, the Brocade DCX 8510 ICL capability still provides dramatic reduction in the number of ISL cables required—a four to one reduction compared to traditional ISLs with the same amount of interconnect bandwidth. And since the QSFP-based ICL connections reside on the core routing blades instead of consuming traditional ports on the port blades, up to 33 percent more FC ports are available for server and storage connectivity.

ICL LICENSING

An ICL POD (Ports on Demand) license is applicable to both the Brocade DCX 8510-8 and DCX 8510-4. Descriptions of applicable licensing for the Brocade DCX 8510 with Brocade FOS v7.0 are noted below. (Please note that the licensing of copper-based ICLs on the original Brocade DCX platforms is different, and the following information does not apply to the Brocade DCX or DCX-4S.)

ICL POD License: Brocade DCX 8510-8

- 1 ICL POD license on the Brocade DCX 8510-8 enables the first 16 QSFP ICL ports (enabling ICL ports 0–7 on each core blade). This is equivalent to 16 × 64 Gbps, or 1 Tbps of bandwidth.
- 2 ICL POD licenses enable the remaining 16 QSFP ICL ports (enabling ICL ports 8–15 on each core blade), so all 32 QSFP ports across both core routing blades are enabled. This is equivalent to 32 × 64 Gbps, or 2 Tbps of bandwidth.

ICL POD License: Brocade DCX 8510-4

- Only 1 ICL POD license is required to enable all 16 QSFP ICL ports available on the two core blades of the Brocade DCX 8510-4. This is equivalent to 16 × 64 Gbps, or 1 Tbps of bandwidth.

Enterprise ICL License: Brocade DCX 8510-8 and Brocade DCX 8510-4

- If you have more than four Brocade DCX 8510 chassis in a fabric using ICLs, an Enterprise ICL License is required for each of these Brocade DCX 8510s in the fabric. This license is in addition to the ICL POD license requirements noted above, which enable the actual ICL ports.

SUPPORTED TOPOLOGIES

Two network topologies are supported with the Brocade DCX 8510 Backbone platforms and optical ICLs: core/edge and mesh. Both topologies deliver unprecedented scalability while dramatically reducing ISL cables.

Note: Always refer to the Brocade SAN Scalability Guidelines for Brocade FOS v7.x for current supported ICL topology scalability limits.
Core/Edge Topology

A core/edge topology, also known as CE, is an evolution of the well-established and popular “star” topology often used in data networks. CE designs have dominated Storage Area Network (SAN) architecture for many reasons, including the fact that they are well tested, well balanced, and economical. Figure 1 shows how a customer could deploy two Brocade DCX 8510s at the core and six at the edge for a highly scalable, cost-effective topology. In most environments, servers are attached to the edge chassis, with storage being attached to the core. By connecting each edge chassis to each core, all hosts/targets are separated by a maximum of one hop, regardless of where they are attached to the Brocade DCX 8510s. (A variety of different CE designs can be implemented, with varying ratios of core versus edge chassis being used to meet the needs of any environment.)

Mesh Topology

Mesh was a common design philosophy when SAN fabrics were first being built, as they were simple and easy to manage. But as larger fabrics became more common, the cabling infrastructure to support such a topology became impossible to manage. And without direct connections between every pair of chassis, knowing where each storage and server port is located in order to provide ideal fabric routes can quickly become an operational nightmare. Brocade optical ICL technology solves these issues by easily allowing each Brocade DCX 8510 to connect directly to every other DCX 8510 in the fabric. This drastically simplifies design and operational issues associated with deployment. Figure 2 shows a nine-chassis active-active mesh topology using ICLs.

Figure 1. Eight-chassis core/edge topology supported with Brocade DCX 8510 and FOS v7.0.1

Figure 2. Nine-chassis mesh topology supported with Brocade DCX 8510 and FOS v7.0.1
**QSFP-BASED ICL CONNECTION REQUIREMENTS**

To connect multiple Brocade DCX 8510 chassis via ICLs, a minimum of four ICL ports (two on each core blade) must be connected between each chassis pair. With 32 ICL ports available on the Brocade DCX 8510-8 (with both ICL POD licenses installed), this supports ICL connectivity with up to eight other chassis and at least 256 Gbps of bandwidth to each connected Brocade DCX 8510. Figure 3 shows a diagram of the minimum connectivity between a pair of Brocade DCX 8510-8s. (Note: The physical location of ICL connections may be different from what is shown here, as long as there are at least two connections per core blade.)

The dual connections on each core blade must reside within the same ICL trunk boundary on the core blades. ICL trunk boundaries are described in detail in the next section. If more than four ICL connections are required between a pair of Brocade DCX 8510 chassis, additional ICL connections should be added in pairs, with each additional pair residing within the same trunk boundary.

A maximum of 16 ICL connections or ICL trunk groups between any pair of Brocade DCX 8510 chassis is supported unless deployed using Virtual Fabrics, where a maximum of 16 ICL connections can be assigned to a single Logical Switch. This limitation is due to the maximum supported number of connections for Fabric Shortest Path First (FSPF) routing. Effectively, this means that there should never be more than 16 ICL connections between a pair of Brocade DCX 8510 chassis, unless Virtual Fabrics is enabled and the ICLs are assigned to two or more Logical Switches.

QSFP-based ICLs and traditional ISLs are not concurrently supported between a single pair of Brocade DCX 8510 chassis. All inter-chassis connectivity between any pair of Brocade DCX 8510 chassis must be done by using either ISLs or ICLs.

The final layout and design of ICL interconnectivity is determined by the customer’s unique requirements and needs, which dictate the ideal number and placement of ICL connections between Brocade DCX 8510 chassis. Brocade Professional Services can assist in designing complex ICL-based designs.
ICL TRUNKING AND TRUNK GROUPS

Trunking involves taking multiple physical connections between a chassis or switch pair and forming a single “virtual” connection, aggregating the bandwidth for traffic to traverse across. Brocade offers a number of hardware-based trunking solutions, including trunking for traditional ISLs, trunking for Integrated Routing (FCR connectivity), trunking for Access Gateway, and also trunking for ICLs. This section describes the trunking capability used with the QSFP-based ICL ports on the Brocade DCX 8510 platforms. (Note that trunking is enabled automatically for ICL ports and cannot be disabled by the user.)

As previously described, each QSFP-based ICL port actually has four independent 16-Gbps links, each of which terminates on one of four separate ASICs located on each core blade. Figure 4 shows that each core blade has groups of four ICL ports (indicated by the green box around the groups of ports). Each of the Brocade DCX 8510-4 core blades has two groups of four ICL ports, and each Brocade DCX 8510-8 core blade has four groups of four ICL ports.

Figure 4. Core blade trunk groups

Trunk groups (collections of ports that can combine to form a single aggregate trunk) are defined within each of these groups of four ports, as shown by the green box around each group. Since there are four separate links for each QSFP-based ICL connection, each of these ICL port groups is comprised of four trunks, with up to four links each. This is shown in Figure 5, where there is one group with four ICL connections (the top left group in the illustration), forming four trunk groups of four links each, and a second group with only two ICL connections (the bottom left group in the illustration), still forming four trunk groups but with only two links each.

Each trunk group from the lower group of ICL ports has 32 Gbps of bandwidth (16 Gbps from each of the two links in the trunk group). If another pair of ICL connections is added to this lower group of ports (utilizing the remaining two available ICL ports in the group), there are four trunk groups, each with four links, for a total of 64 Gbps of bandwidth per trunk group, just like the trunk groups created by the upper group of ICL ports.
Figure 5. ICL Trunking and trunk groups (shown for a single Brocade DCX 8510-8 core blade)

A trunk can never be formed by links within the same QSFP ICL port, because each of the four links within the port terminate on different ASICs and are thus always part of unique trunk groups.

Any time additional ICL connections are added to a chassis, they should be added in pairs, and each pair of ICL connections should be added within a common trunk group. Ideally, two pairs should be added, with one pair for each core blade in the chassis, providing full redundancy in the event of a core blade failure.

The port mapping information shown in Figure 6 and Figure 7 also indicates the ICL port groupings (and trunk group associations) by showing ports in the same group as being the same color.
CORE BLADE (CR16-8) PORT NUMBERING LAYOUT

Figure 6 shows the layout of ports 0–15 on the Brocade DCX 8510-8 CR16-8 line card. You can also see what the switchshow output would be if executing a switchshow command within Brocade FOS using the CLI.

The colored groups of external ICL ports indicate those ports that belong to common trunk groups. For example, ports 0–3 (shown in blue below) forms 4 trunk groups, with one link being added to each trunk group from each of the four external ICL ports. For the Brocade DCX 8510-8, there can be up to 16 trunk groups created on each of the two core blades.

The first ICL POD license enables ICL ports 0–7. Adding a second ICL POD license enables the remaining eight ICL ports, ports 8–15. This applies to ports on both core blades.

<table>
<thead>
<tr>
<th>External ICL Port #</th>
<th>Switchshow Port #</th>
<th>External ICL Port #</th>
<th>Switchshow ICL Port #</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>28–31</td>
<td>15</td>
<td>60–63</td>
</tr>
<tr>
<td>6</td>
<td>24–27</td>
<td>14</td>
<td>56–59</td>
</tr>
<tr>
<td>5</td>
<td>20–23</td>
<td>13</td>
<td>52–55</td>
</tr>
<tr>
<td>4</td>
<td>16–19</td>
<td>12</td>
<td>48–51</td>
</tr>
<tr>
<td>3</td>
<td>12–15</td>
<td>11</td>
<td>44–47</td>
</tr>
<tr>
<td>2</td>
<td>8–11</td>
<td>10</td>
<td>40–43</td>
</tr>
<tr>
<td>1</td>
<td>4–7</td>
<td>9</td>
<td>36–39</td>
</tr>
<tr>
<td>0</td>
<td>0–3</td>
<td>8</td>
<td>32–35</td>
</tr>
</tbody>
</table>

Figure 6. Brocade DCX 8510-8 CR16-8 core blade: External ICL port numbering to “switchshow” (internal) port numbering.

Note: To disable ICL port 0, you need to issue the portdisable command on all four “internal” ports associated with that ICL port.

CORE BLADE (CR16-4) PORT NUMBERING LAYOUT

Figure 7 shows the layout of ports 0-15 on the Brocade DCX 8510-4 CR16-4 line card. You can also see what the switchshow output would be if executing a switchshow command within Brocade FOS using the CLI.

The colored groups of external ICL ports indicate those ports that belong to a common trunk group. For example, ports 0–3 (shown in blue below) form 4 trunk groups, with one link being added to each trunk group from each of the four external ICL ports. For the Brocade DCX 8510-4, there can be up to eight trunk groups created on each of the two core blades.

A single ICL POD license enables all eight ICL ports on the Brocade DCX 8510-4 core blades. This applies to ports on both core blades.
Figure 7. Brocade DCX 8510-4 CR16-4 core blade: External ICL port numbering to “switchshow” (internal) port numbering

Note: To disable ICL port 0, you need to issue the portdisable command on all four “internal” ports associated with that ICL port.

SUMMARY
The Brocade QSFP-based optical ICLs enable simpler, flatter, low-latency chassis topologies spanning up to a 50-meter distance with off-the-shelf cables. They dramatically reduce inter-switch cabling requirements and provide up to 33 percent more front end ports for servers and storage, giving more usable ports in a smaller footprint with no loss in connectivity.

To find out more about the Brocade DCX 8510 family and ICL features and benefits, talk to your sales representative or visit http://www.brocade.com/products/all/san-backbones/product-details/dcx8510-backbone/index.page.
not be currently available. Contact a Brocade sales office for information on feature and product availability. Export of technical data contained in this document may require an export license from the United States government.