# OPTIMIZING THE PERFORMANCE AND MANAGEMENT OF 2 GBIT/SEC SAN FABRICS WITH ISL TRUNKING

***ISL Trunking significantly increases performance, manageability, and reliability for critical switch-switch communications***

Steve Daheb
Director of Product Marketing
Brocade Communications Systems, Inc.

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Long used in traditional Ethernet networking, Inter-Switch Link (ISL) Trunking can also dramatically improve the performance, manageability, and reliability for business-critical storage applications in Fibre Channel environments. By aggregating up to four ISLs into a single logical 8 Gbit/sec trunk group, this feature supports efficient high-speed communications throughout Storage Area Networks (SANs). By optimizing available switch resources, ISL Trunking decreases congestion. In addition, ISL Trunking reduces administrative workload since ISLs can be managed as a single entity rather than individually. Moreover, ISL Trunking can significantly increase data availability: even if an individual ISL failure occurs, I/O can continue at a reduced bandwidth as long as at least one ISL in the trunk group remains avail-able. Together, these capabilities give organizations a powerful and flexible tool to extract the greatest performance and value from their SAN investments.

**The Basics of ISL Trunking**

Scalable SAN fabrics are made possible by the ability to link switches not just to SAN devices but to other switches as well, through ISLs. Today, many organizations depend on ISLs as a way to increase both performance and redundancy throughout the SAN fabric. However, as SANs continue to grow and applications require even higher performance, some organizations are exceeding the capabilities of 1 Gbit/sec and even 2 Gbit/sec ISLs. ISL Trunking aggregates two, three, or four ISLs into a single logical “trunk” group. This trunk group combines the bandwidth of all ISLs to optimize data traffic load-sharing while preserving the in-order delivery of Fibre Channel frames. As a result, organizations can enjoy the benefits of increased performance and reliability in their SAN infrastructures.

### *The Need for In-Order Frame Delivery*

Because many Fibre Channel SAN nodes cannot reorder frames during data transfer, the frames must be delivered in the right order to provide efficient communications. To guarantee that all frames are delivered in order, Brocade developed Fabric Shortest Path First (FSPF), now the standard routing protocol for Fibre Channel frames. FSPF provides a way to detect link failures, determine the next shortest route for data traffic, update the routing table, and provide fixed routing paths within a SAN fabric.

When multiple fixed routing paths are available, data streams are allocated among the available paths. If an ideal combination of streams is active, the traffic load is evenly distributed—contributing to optimal network performance. However, if different combinations of data streams are running simultaneously, all of the active streams might be allocated to a single path. As a consequence, certain traffic patterns might become unevenly distributed—leaving some paths congested and other paths underutilized (see Figure 1).

In this example, each of the four ISLs between the two switches has a maximum untrunked capacity of 2 Gbit/sec with a theoretical maximum throughput of 8 Gbit/sec for the entire trunk group. Without ISL Trunking, however, the effective throughput of the four ISLs is only 5 Gbit/sec total since two of the 2 Gbit/sec data streams are competing for the same path. (1 Gbit/sec + 1.5 Gbit/sec + 0.5 Gbit/sec + 1 Gbit/sec + 1 Gbit/sec = 5 Gbit/sec.)

### *Optimal Performance with Guaranteed In-Order Delivery*

The primary value of ISL Trunking is its ability to optimize network performance while guaranteeing in-order delivery of the trunked frames. In fact, ISL Trunking ensures that all links are efficiently utilized and that no single host can monopolize all the bandwidth of the ISLs in the trunk group (see Figure 2).

In this example, ISL Trunking aggregates the four individual paths into one—enabling bandwidth sharing while preserving in-order frame delivery. As a result, ISL Trunking increases performance for a total throughput of 7 Gbit/sec compared to the previous 5 Gbit/sec. (2 Gbit/sec + 1.5 Gbit/sec + 0.5 Gbit/sec + 1 Gbit/sec + 2 Gbit/sec =7 Gbit/sec.)

## Strategic Business Benefits of ISL Trunking

ISL Trunking is designed to facilitate a wide range of business benefits for a variety of SAN environments, providing strategic advantages such as:

- Increased performance and greater network efficiency

- Higher availability throughout the fabric
- Simplified fabric design
- Reduced management workload
- Lower total cost of ownership

***Increased Performance and Greater Network Efficiency***

ISL Trunking significantly reduces congestion and increases performance for switch-to-switch communications. Because network traffic is efficiently distributed across all of the links in the trunk group, no host can consume all of the available bandwidth. As a result, all ISLs are effectively utilized—maximizing throughput and boosting performance to exceed what the ISLs would achieve independently. This level of performance is ideal for supporting data-intensive applications such as video streaming, data warehousing, or high-speed enterprise backup.

***Higher Availability throughout the Fabric***

In addition to increasing performance, ISL Trunking enables organizations to implement the appropriate level of availability to meet their particular requirements for reducing both planned and unplanned downtime. For instance, when an ISL is added to an existing trunk group, there is no disruption in service. Instead, all I/O is immediately spread across the available ISLs, and the bandwidth in the trunk group expands dynamically. In most cases, if an ISL is removed or fails, there is minimal or no disruption to service since the I/O is distributed across the remaining ISLs. In extreme situations where the primary link for the trunk group is removed or fails, there is a slight pause as the I/O is rerouted over the remaining ISLs.To provide the highest level of reliability, organizations can deploy trunk groups in redundant fabrics that help ensure ISL failures do not disrupt business operations.

***Simplified Fabric Design, Reduced Management Workload, and Lower Total Cost of Ownership***

One of the key advantages of ISL Trunking is its ability to dramatically reduce the planning, implementation, and management costs for large SAN fabrics. For example, ISL Trunking is extremely effective at solving a major challenge of large network design: how to accurately model for performance. Because ISL Trunking automatically ensures optimal efficiency in switch-to-switch communications, organizations do not need to spend time modeling and

testing multiple design scenarios. Instead, they can simply deploy ISL Trunking to ensure maximum network performance.

Aggregating multiple links into a single logical trunk also reduces the number of links that need to be monitored and managed—greatly reducing administrative workload and cost. Moreover, because ISL Trunking increases performance throughout the SAN fabric, it enables organizations to extract the most value from their switch, server, and storage investments. In fact, more effective ISL utilization translates directly into more usable ports for server or storage connectivity. Especially in large SANs with numerous SAN devices, the resulting hardware savings can be significant.

**A Strategic Tool to Meet Current and Future Requirements**

An advanced fabric service, ISL Trunking:

- Logically joins two, three, or four ISLs into a single logical ISL trunk group
- Provides a maximum bandwidth of 8 Gbit/sec per trunk group
- Preserves in-order delivery of Fibre Channel frames
- Dynamically distributes bandwidth to ISLs within the trunk group

A powerful yet easy-to-use technology, ISL Trunking maximizes resource utilization between switches to facilitate the development of highly scalable, reliable, and manageable SANs. As a result, networks based on Brocade 2 Gbit/sec switches are ideal for organizations that want to implement cost-effective SAN fabrics that address a variety of current and future business requirements.