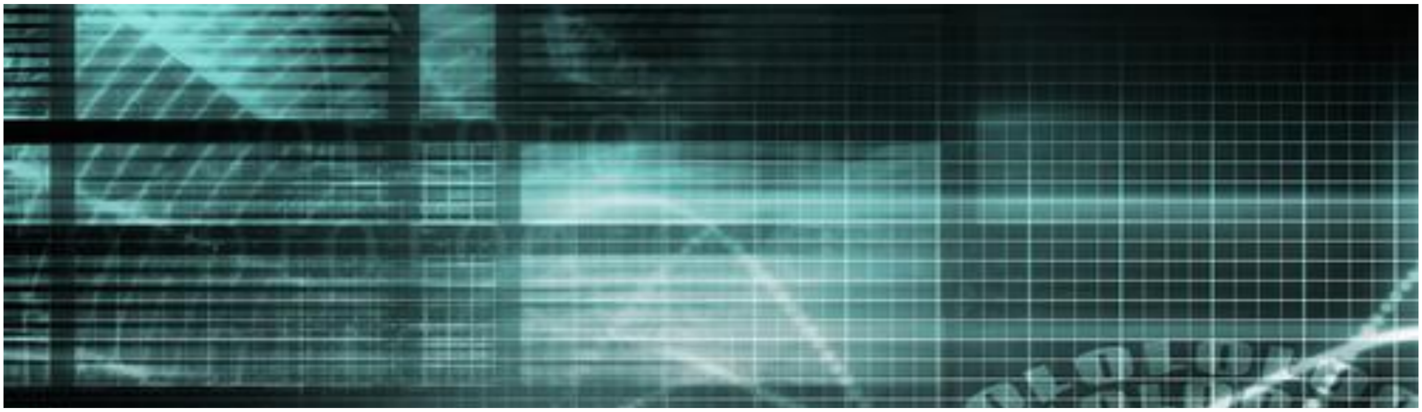
Business Case for BTI Intelligent Cloud Connect for Content, Co-lo and Network Providers



Executive Summary

Cloud computing, video streaming, and social media are contributing to a dramatic rise in metro and regional inter data center traffic that includes data center to data center, data center to access networks and local traffic, and data center to peering and partner traffic. Traffic patterns also are changing: data centers are moving closer to the end user or "eyeballs" and east-west traffic is flowing between all of these data center connections. Inter data center network architectures are being reconfigured to respond to the increased traffic volumes and changing traffic patterns. The architectural challenges include cost effectively accommodating the rapidly expanding traffic volumes, providing network flexibility, and supporting service innovation.

BTI Intelligent Cloud Connect (ICC) is a converged optical, LSR and application-aware architecture that responds to these challenges. The converged platform provides 10 Gbps and 100 Gbps DWDM wavelengths, MPLS Label Switch Router (LSR), and a Network Function Virtualization-based (NFV) applications module. The LSR approach is optimized for cloud connectivity applications. It costs less than full-fledged Layer 3 routers by excluding unnecessary core route processing and look-up overhead not required for data center transit points. Costs are reduced further by delivering transparent transport DWDM wavelengths, Layer 2+ switching, and NFV applications all in a single platform with unified management and control.

ACG Research conducted a case study of a typical metro data center network to compare the five-year total cost of ownership (TCO) of the BTI Intelligent Cloud Connect architecture with two alternative solutions: 1) LSR Composite: separate LSR, transparent optical transport, and network analytics platforms; 2) L3 Composite: separate L3 router, transparent optical transport, and network analytics platforms. BTI's ICC architecture produces a lower cost solution than the LSR Composite and L3 Composite alternatives by eliminating the redundancies associated with the separate network elements of the alternative solutions. BTI's proNX Management and Control Software reduces capital expense (CapEx) by eliminating costly control functionality located within each network element of the LSR Composite and Layer 3 router alternatives and decreases operation expense (OpEx) by simplifying and automating many operational processes.

KEY FINDINGS

BTI Intelligent Cloud Connect provides converged optical and LSR based architecture that responds to the challenges of today's metro data center networks. Compared to LSR Composite and L3 Composite alternatives, BTI has:

- 58% and 71% lower TCO than the LSR and L3 Composite alternatives, respectively
- 59% lower CapEx and 56% lower OpEx than the LSR Composite alternative
- 72% lower CapEx and 69% lower OpEx than the L3 Composite alternative
- 13% and 28% lower TCO for the applications function than the LSR Composite and L3 Composite alternatives, respectively

Introduction

Adoption of cloud computing, video streaming, and social media are contributing to a dramatic rise in inter data center traffic. Traffic patterns also are changing: content, co-location, hosting and network providers are moving data centers closer to the "eyeballs" of the network. Cloud computing models are spawning new east-west traffic flows among data centers, peering points and partner networks. The resulting inter data center flows are growing rapidly into the terabit per second range with a shift in the traffic pattern primarily from long-haul to within the metro.

Inter data center cloud network architectures are being reconfigured to respond to the massive traffic volumes and changing traffic patterns. Architectural challenges include:

- Accommodate rapidly expanding traffic capacity cost effectively by:
    - Maximizing scale economics and minimize upfront investment
    - Maximizing network and data center utilization
    - Reducing operation expense (OpEx) support burdens with increased automation and programmability
    - Containing power, cooling and space costs
- Provide network flexibility and support service innovation by:
    - Providing low-latency performance
    - Accommodating workload mobility and virtualization
    - Providing application assurance
    - Increasing service differentiation and control with embedded intelligence and analytics

BTI Intelligent Cloud Connect (ICC) Converged Optical and LSR Network Solution

BTI provides a converged optical, LSR and application-aware solution that reduces cost, provides network flexibility, and supports service innovation for the growing traffic in metro networks today. The BTI Intelligent Cloud Connect platform provides 10 Gbps and 100 Gbps DWDM wavelengths, MPLS Label Switch Routing (LSR), and an integrated Network Function Virtualization-based (NFV) applications module. The BTI proNX Management and Control Software provides centralized intelligence and multilayer optimization and control.

The LSR approach is optimized for cloud connectivity applications. High-bandwidth Label Switched Paths (LSPs) are used to create an inter data center fabric that makes a metro cluster of data centers function as a single data center. Providers can police LSPs based on individual flows. For example, bandwidth between data centers can be expanded dynamically to accommodate virtual machine workload shifts by simply adding additional LSPs. Paths also can be provisioned across the LSRs by creating a pseudowire tunnel for the packet flow.

The LSR approach provides guaranteed service assurance in contrast to a traditional Layer 3 network where packets are delivered across learned routes with limited service assurance. LSR, in addition, costs less than full-fledged Layer 3 routers by excluding unnecessary core route processing and look-up overhead. The LSR approach also provides more dynamic and granular traffic engineering capabilities than OTN or native DWDM approaches. Thus, LSR achieves higher utilization of optical wavelengths and a more cost-effective solution.

BTI is the only vendor offering LSR functionality on a packet optical transport platform. Costs are reduced by delivering transparent transport DWDM wavelengths and Layer 2+ switching capabilities in a single platform with unified management and control. Specifically:

- Capital expense (CapEx) is reduced by consolidating equipment and network layers
- OpEx is reduced through simplified administration and the converged system design

The BTI Applications Module provides fast and flexible implementation of NFV based applications for service creation and innovation without impairment to the Layer 2+ network performance for both distributed and centralized models. It is an easy to deploy COTS based Linux platform that incorporates low-cost, state-of-the-art components.

Total Cost of Ownership (TCO) Case Study

A case study of a typical metro data center network is used to compare the TCO of the BTI Intelligent Cloud Connect solution with:

1. LSR Composite: Separate LSR, optical transport, and network analytics network elements
2. L3 Composite: Separate Layer 3 router, optical transport, and network analytics network elements

Figure 1 shows the topology of the model network.

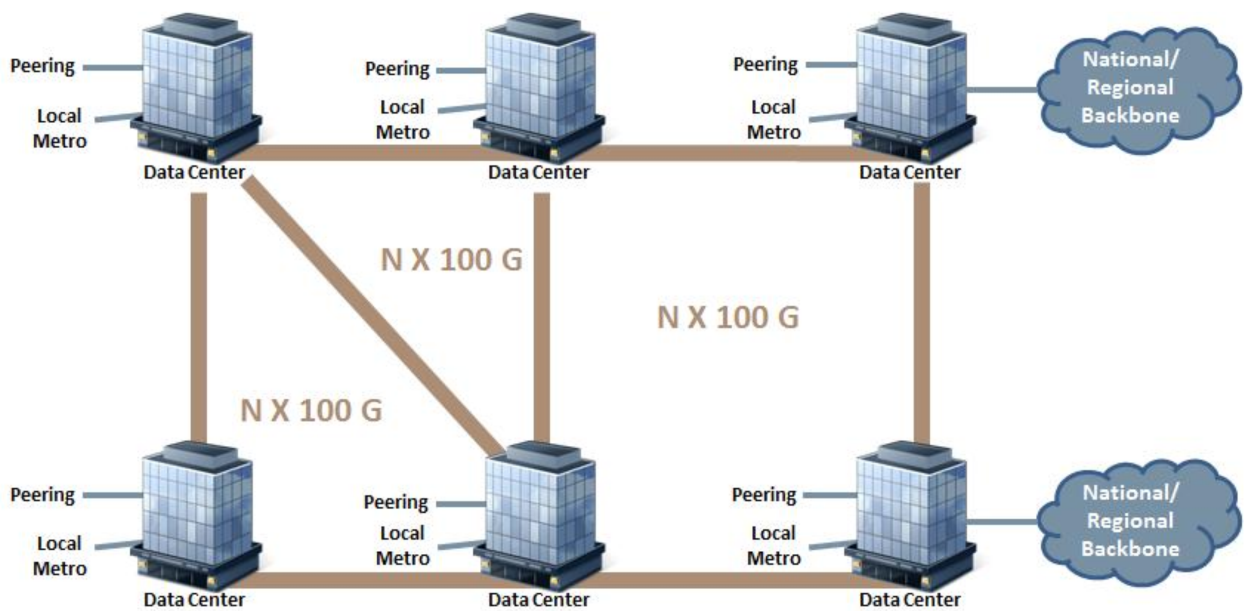


Figure 1 – Metro Cloud Data Center Network

Three to six data centers such as those used by content, co-location, and hosting providers are typically located within a metro area. This case study uses six data centers interconnected with N X 100 Gbps optical links. Each data center location is connected to the local access area and to carrier providers. The two data centers on the right side of the diagram provide links to the long-haul network. Each data center is connected to the local access network using 10 Gbps Ethernet links, a mix of 10 Gbps; and 100

Gbps Ethernet links are used to connect to carrier and service providers; and 100 Gbps Ethernet links are used for the connections to the long-haul network.

Figure 2 shows the total traffic that ingresses or egresses each data center[1].

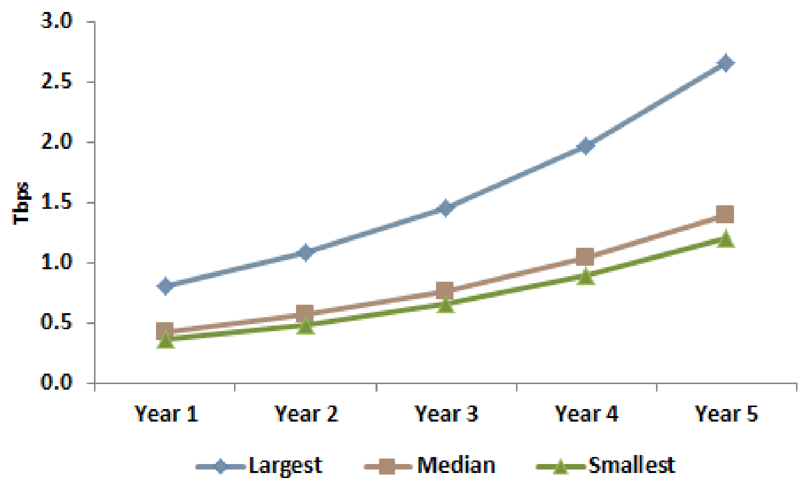


Figure 2 – Total Traffic In/Out of Each Data Center

Year 1 traffic capacity is typical of today's initial network builds. Total traffic is projected to grow at 35 percent CAGR for five years because of the rapid adoption of cloud services and video streaming. Thus, traffic volumes are projected to reach the terabit per second range within a year.

Table 1 shows the allocation of total traffic within the metro.

Traffic Flow	Percentage of Total Traffic
Local to data center	50%
Inter metro data center	30%
To the long-haul	20%
To network analytics process	5%

Table 1 – Distribution of Traffic Flows within a Metro Data Center Cluster

The table reflects the changed pattern of traffic flows from the dominance of long-haul flows in the past to one where half of the traffic of the total flow is served by the local data center and only 20 percent of total traffic transits the long-haul network. This change is a response to virtualization of computing, which is driving down computing costs relative to the cost of network transport. The result is that on-net computing resources and video streaming content are being moved closer to end-users, the "eyeballs" of the network.

[1] The maximum of ingress or egress traffic is used to compute required port capacities.

Five percent of total traffic flow within each data center goes to the network analytics engine and is used for network monitoring and the creation of value-added NFV service applications.

The traffic projection and traffic flow percentages are used to estimate traffic volumes for each network interface at each network node. A traffic engineering algorithm is used to estimate traffic capacities required to support the traffic load and protection capacity across the intra metro network. The traffic engineering outputs then are used to estimate the number of 10 Gbps and 100 Gbps ports required at each data center. Figure 1 shows these values for the median-sized data center node.

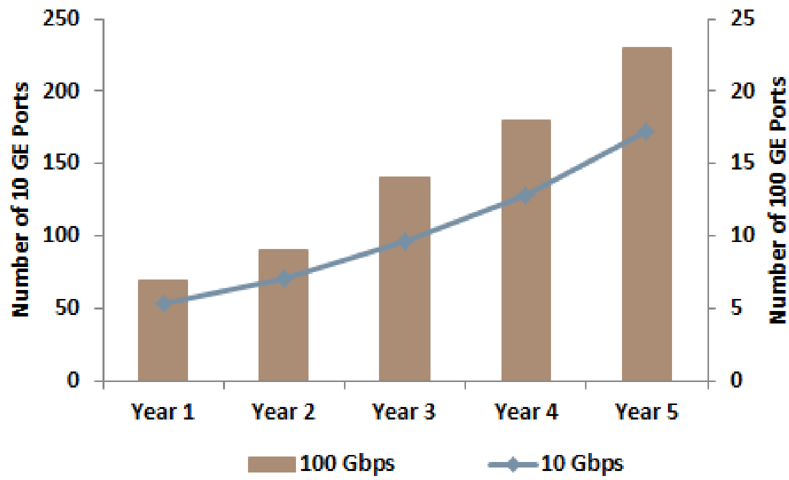


Figure 3 – Number of 10 Gbps and 100 Gbps Ports Required at a Median-Sized Data Center

The 100 Gbps and 10 Gbps ports are graphed on separate axes to put the 10:1 port capacity difference into perspective. The resulting port requirements for each network interface are used to configure each of the three solution alternatives.

General Modeling Assumptions

Total cost of ownership is calculated for five years. CapEx includes the cost of the LSR, optical and network analytics network elements as well as the associated network management equipment and software. All CapEx items are priced at current market rates paid by data center, co-location and hosting providers. Currently, market rates are heavily discounted from systems vendors' list prices.

Table 2 defines the OpEx items used in the study.

Operations Expense Item	Definition
Engineering, Facilities, and Installation (EF&I)	Engineering, facilities, and installation of network equipment
Network Upgrades & Patches	Includes both hardware and software upgrades to the network
Operations, Administration and Maintenance (OA&M)	Network provisioning, surveillance, monitoring, data collection, maintenance, and fault isolation
Testing and Certification Operations	Testing and certification for all new hardware and software releases that go into the production network
Training	Training expenses required initially and also on an on-going basis
Service Contracts	Vendor service contracts for on-going support of network equipment
Floor Space Cost	Floor space cost for typical large network data center and colocation facilities
Power Cost	Cost of powering network equipment
Cooling Cost	Cost of cooling network equipment

Table 2 – Definition of OpEx Items

BTI Intelligent Cloud Connect Configuration

Figure 4 provides a schematic of the BTI Intelligent Cloud Connect configuration.

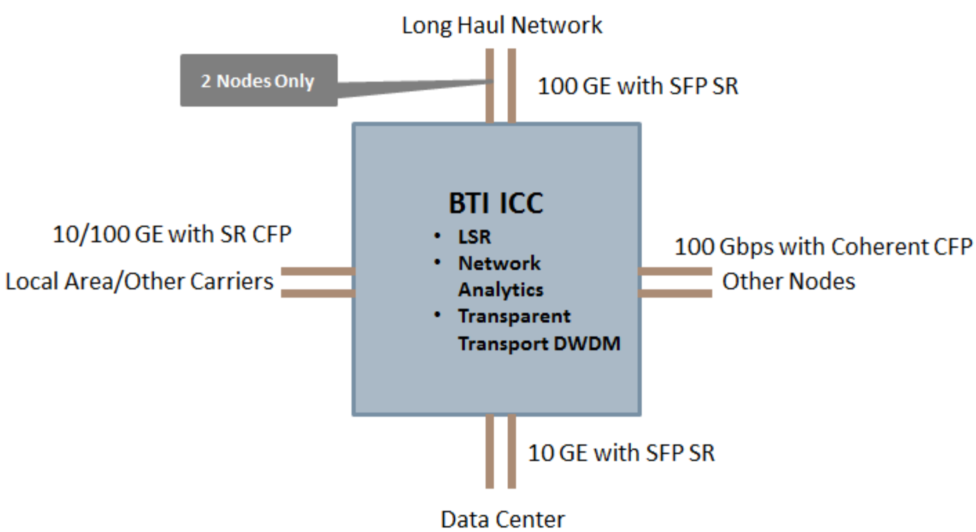


Figure 4 – BTI Intelligent Cloud Connect Configuration

The BTI ICC solution incorporates LSR, network analytics and DWDM in a single system. BTI proNX Management and Control Software provides centralized intelligence and control of all network nodes.

LSR Composite and L3 Composite Configurations

Figure 5 provides a schematic of the configuration used for the LSR Composite and L3 Composite configurations.

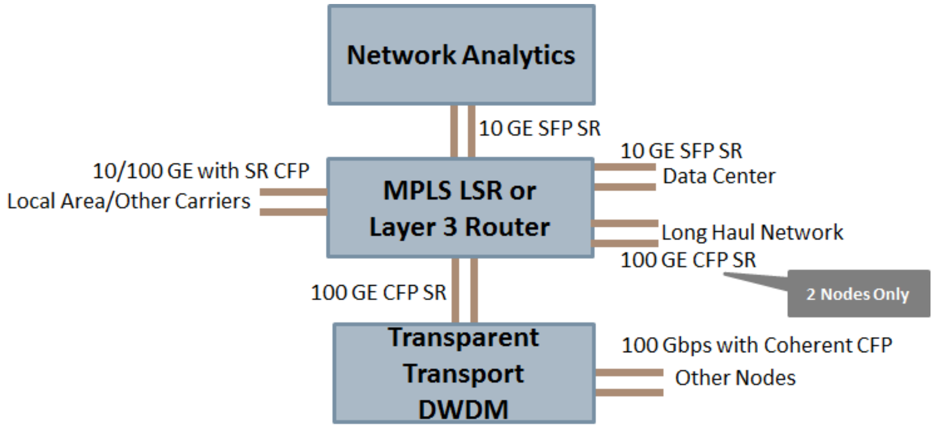


Figure 5 – LSR Composite or L3 Composite Node Configuration

The LSR Composite and L3 Composite configurations consist of three network elements: network analytics appliance, MPLS LSR or Layer 3 router, and transparent transport DWDM system. Management and interconnection of the three elements is complex. The need to deploy back-to-back ports to interconnect the three network elements and the triplicate cost of common equipment such as network operating systems, backplanes, and power supplies are a primary source of extra cost as compared to the BTI solution. The BTI ICC, which supports all three functions in a single platform, simplifies management by presenting a single network element to manage rather than multiple elements and enables a single restoration scheme that costs less than multiple restoration schemes.

TCO Comparisons

Figure 6 compares the TCO of the three alternatives for five years.

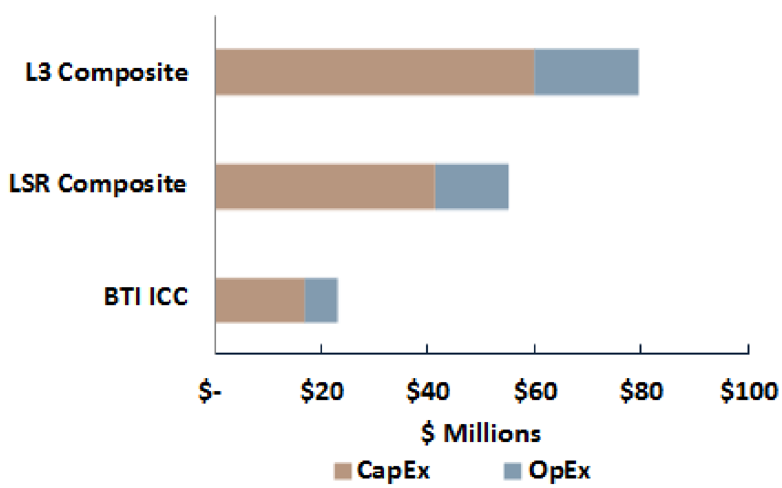


Figure 6 – Cumulative Five-Year TCO Comparison

BTI's TCO for five years is 58 percent lower than the LSR Composite alternative and 71 percent lower than the L3 Composite alternative. BTI's CapEx is 59 percent lower than the LSR Composite alternative and 72 percent lower than the L3 Composite alternative. BTI's OpEx is 56 percent lower and 69 percent lower for the LSR Composite and L3 Composite alternatives, respectively.

BTI's Intelligent Cloud Connect architecture produces a lower cost solution than the LSR Composite and L3 Composite alternatives by eliminating the redundancies associated with the alternative three network element architectures. BTI's proNX Management and Control Software reduces CapEx by eliminating costly control functionality located within each network element of the LSR Composite and L3 Composite alternatives and reduces OpEx by simplifying and automating many operational processes. Both the BTI and LSR Composite alternatives have more cost advantages than the L3 Composite alternative because they eliminate unnecessary core route processing and look-up overhead.

Elimination of back-to-back port connections is the primary source of BTI's CapEx advantage. The BTI converged architecture further reduces CapEx by consolidating common equipment such as the backplane and power supplies that are triplicate in the alternative architectures. BTI's proNX also improves capital efficiency by enabling automated two-way communications between the applications plane and the data plane. This enables operating at higher utilization levels without compromising network performance, quality or availability. The NFV Based BTI Applications Module reduces CapEx by providing a flexible platform for many network functions and thereby increases the utilization of application hosting assets. BTI ICC also has clear CapEx advantages than both Composite alternatives because it is a new design expressly developed to address emerging core networking requirements; whereas, the Composite alternatives were designed to address the core switching and routing requirements of the last decade.

Vendor service contract expense is the largest OpEx item. BTI's vendor service contract expense is 58 percent lower and 71 percent lower than the LSR Composite and L3 Composite alternatives, respectively. The expense comparisons are similar to the CapEx comparisons because vendors' service contract pricing is closely linked to the associated equipment prices.

Figure 7 compares five-year cumulative OpEx for all other OpEx items.

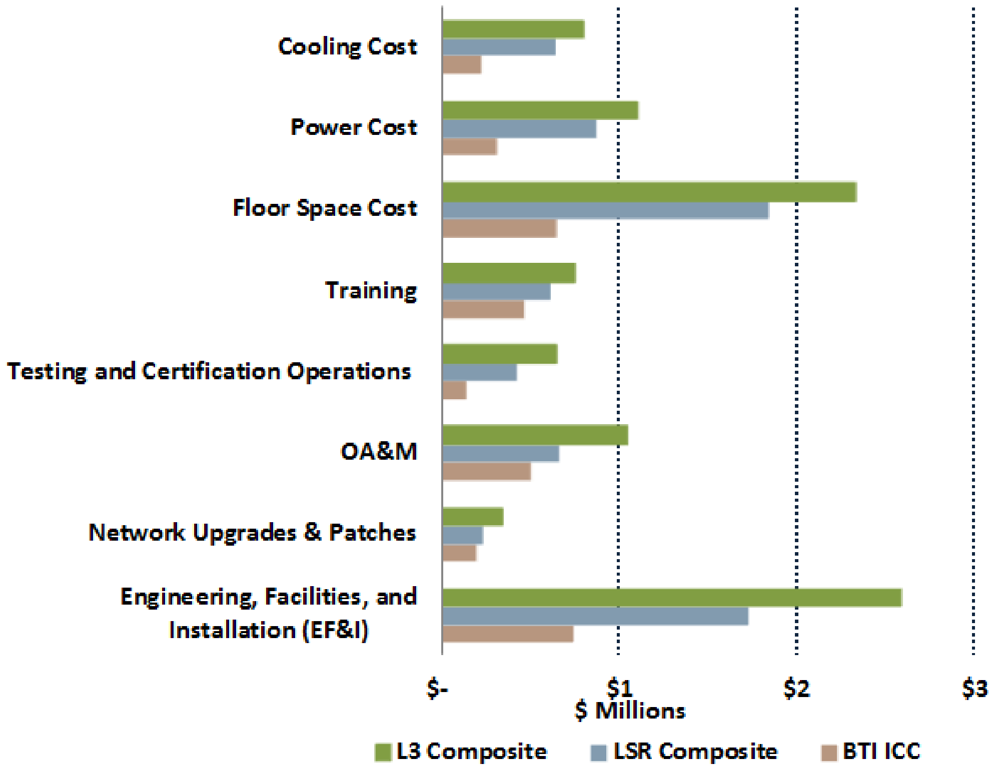


Figure 7 – Five-Year Cumulative OpEx Items (Excludes Vendors' Service Contracts)

Environmental expenses (cooling, power, and floor space) provide the most cost savings. The BTI consolidated architecture consumes less power than the alternatives because it eliminates back-to-back ports, redundant equipment, runs at higher utilization levels, and uses more modern components. The design also has higher port density and is more energy efficient than the technologies used in the composite alternatives. Cooling, power, and even floor space requirements are all driven by the power consumed by the network elements. (A NEBS power per square foot limit is the controlling floor space requirement factor for this class of network equipment.)

Engineering, facilities and installation expense is the second largest savings source. The installation costs of the BTI platform are lower because the BTI architecture uses less equipment and the management system simplifies and automates the engineering and installation processes. Operation, administration and management, and network upgrades and patches also cost less for the BTI architecture for similar reasons: there is less work to perform on fewer platforms.

Training, and testing and certification operations are lower with the BTI architecture because one converged system must be studied and tested versus three products (and vendors) for the alternatives.

Benefits of the BTI Applications Module

The BTI NFV Based Applications Module is implemented as a blade in the Intelligent Cloud Connect chassis. It can easily be deployed (or redeployed anywhere in the network) as needed. The BTI proNX Management and Control Software is used to implement applications such as network analytics, policy managers or network security applications without site visits. This capability enables rapid and flexible value-added service offerings such as bandwidth on demand, differentiated security policies, and proactive network management processes. The programmable and automated process also supports self-service portals that meet customers' expectations for network visibility and control.

The responsiveness and flexibility of the application module also permits low-cost and rapid introduction of new services and features as well as fast shutdown of less successful offerings. This allows a quick response to market changes and faster service creation, which enhances the monetization of the network in a more timely fashion.

Conclusion

Cloud computing, video streaming, and social media are contributing to a dramatic rise in inter data center traffic between data centers, access networks, peering points and partners. Traffic patterns are changing with data centers moving closer to end-users and east-west traffic flowing between data centers. The result is that intra metro data center links are growing to the terabit per second range, and the majority of the revenue traffic is staying within the metro area.

Inter data center network architectures are being reconfigured to respond to the increased traffic volumes and changing traffic patterns. The architectural challenges include cost effectively accommodating rapidly expanding traffic volumes, providing network flexibility, and supporting service innovation.

BTI Intelligent Cloud Connect is a category defining converged optical, LSR and application-aware solution that responds to these challenges. The converged platform provides 10 Gbps and 100 Gbps DWDM wavelengths, MPLS Label Switch Routing, and a NFV based applications module. BTI is the only vendor that offers LSR functionality on a packet optical transport platform, as well as optional applications modules.

A case study of a typical metro data center network compared the five-year TCO of the BTI converged architecture with two alternatives.

1. LSR Composite: Separate LSR, optical transport, and network analytics network elements
2. L3 Composite: Separate Layer 3 router, optical transport, and network analytics network elements

The case study shows that BTI's TCO for five years is 58 percent lower than the LSR Composite alternative and 71 percent lower than the L3 Composite alternative. BTI's CapEx is 59 percent lower than the LSR Composite alternative and 72 percent lower than the Layer 3 router alternative. BTI's OpEx is 56 percent lower and 69 percent lower for the LSR Composite and L3 Composite alternatives, respectively.