Flexible Packet Transport: An Approach to Core Network Optimization

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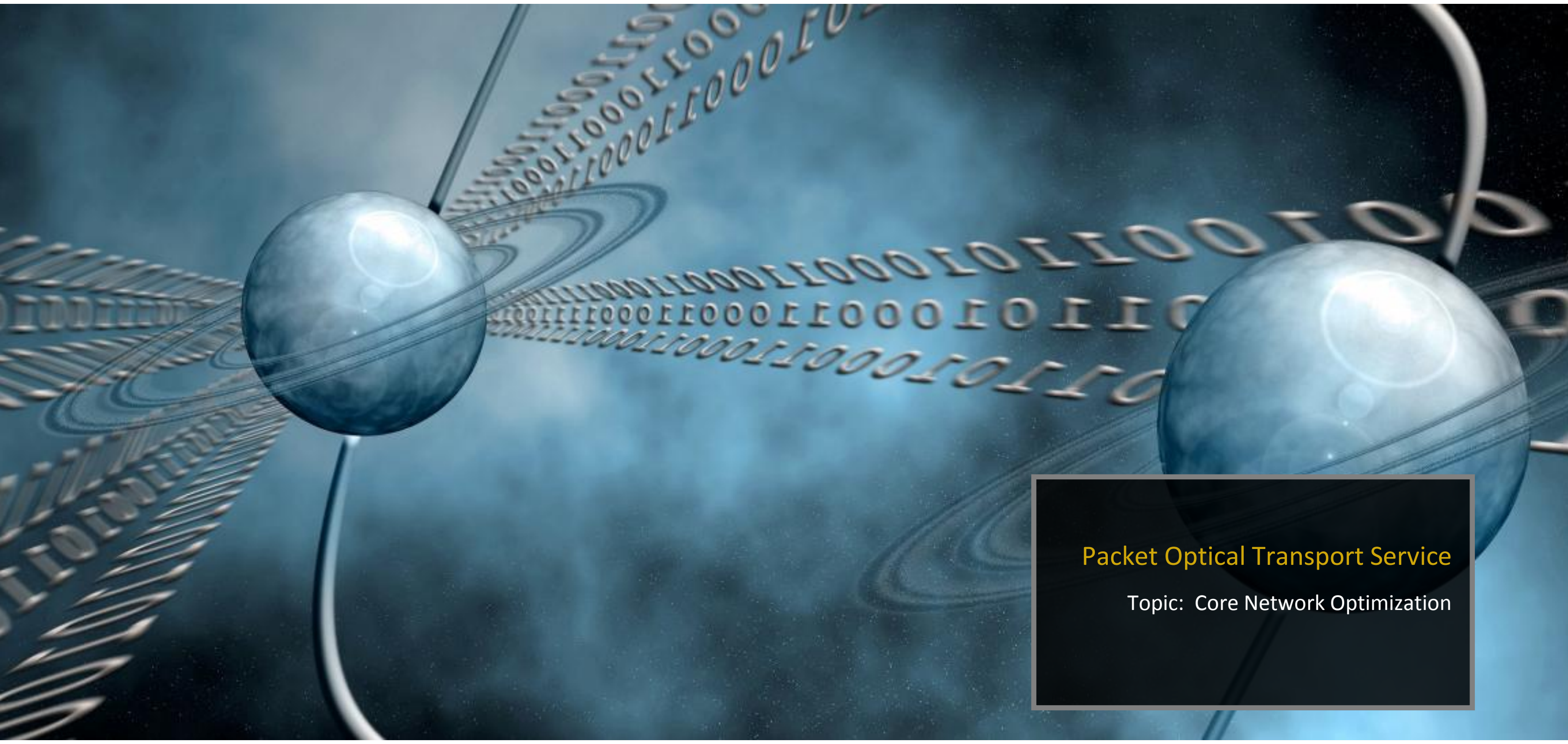


Executive Summary

Core network traffic continues to grow at a rapid rate primarily because of IP video growth. In order to effectively serve demand, service providers and vendors are busy developing new technologies and architectures to scale core routing and transport networks. ACG Research introduced the concept of a NG LSR in a recent white paper, and now Cisco is providing a similar approach to scaling core networks using label switched paths (LSP) to maximize the utilization of the core network but within the CRS-3 product line.

This paper compares and contrasts the two approaches to architecting a flexible label switching packet transport network. The first architecture provides an integrated solution to IP services, peering, aggregation, and flexible packet transport in a single platform. The second approach uses separate platforms for core routing and packet transport. This paper uses a detailed TCO model to compare the design, configuration, CapEx, and OpEx of each of these approaches. Our results show that the integrated solution has 44 percent lower CapEx and 36 percent lower OpEx (Figures 5 & 6) than the multibox architecture.

Key Takeaways

- Cisco's approach provides an integrated solution to IP services, peering, aggregation, and flexible packet transport in a CRS-3 platform.
- Results show that CapEx was reduced by 44% with a single product solution.
- Results show OpEx was reduced by 36% with a single product solution.
- Cisco's flexible packet transport blade for the CRS-3 is almost an LSR on a blade.

Core Network Architecture

Service providers' core networks provide routing and transport functions for a large variety of services. Many service providers have moved to layered core transport architectures (Figure 1). The top layer includes IP routing, TDM, and private line services. The middle layer is responsible for optimizing wavelength utilization and load balancing traffic to efficiently scale the core network while minimizing transport expenses. This layer uses a combination of flexible packet transport for optimizing packet services and OTN switching for optimizing TDM and private line services. The bottom layer is the optical transport network that provides wavelength services in the form of 10G, 40G or 100G wavelengths.

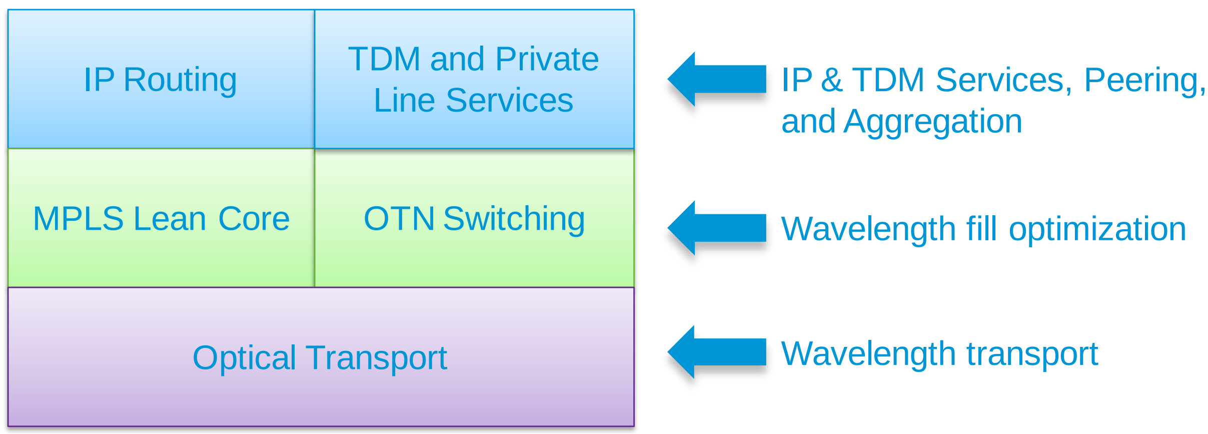


Figure 1. Core Transport Architecture

The functions of a flexible packet transport core are to:

- Efficiently fill wavelengths in the transport network
- Optimize and load balance traffic to minimize network capacity requirements
- Scale core network capacity while minimizing packet transport port costs

This paper compares the two approaches to building a flexible packet transport core. The first approach uses one platform to implement packet transport and a separate platform for core IP routing functions. This is contrasted to Cisco's approach, which provides an integrated solution to IP services, peering, aggregation, and flexible packet transport in a CRS-3 platform. The integrated CRS-3 solution supports each layer of the core architecture at optimal price points using a combination of Cisco's MSC, FP, and LSP forwarding engines. The functions of each of these CRS cards are described in the following:

Card	Function
MSC	Full IP services with rich H-QoS functions
FP	Focus on IP peering and aggregation with 8 service queues
LSP	Flexible packet transport function optimized for label switching

Table 1. CRS Card Functions

Cisco's solution minimizes the deployment of network equipment resulting in a 44 percent savings in CapEx and a 36 percent savings in OpEx as compared to the other approach. These are cumulative savings that were calculated over five years.

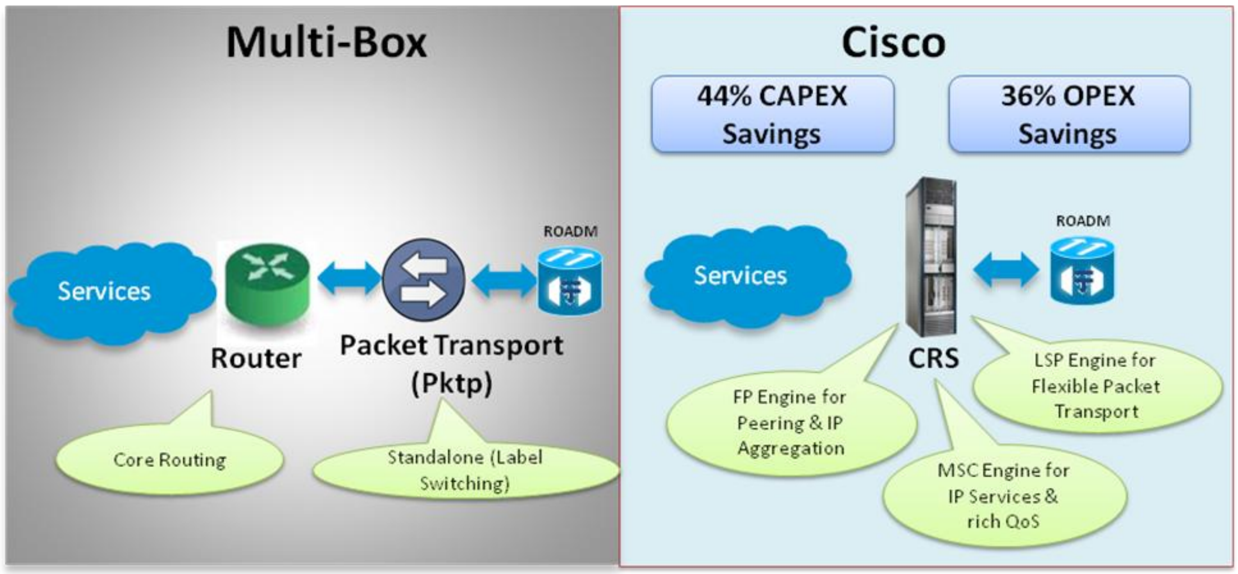


Figure 2. Core Network TCO Model

TCO Model Assumptions

The TCO model compares the integrated Cisco CRS-3 architecture with a multibox architecture. Some key model assumptions are:

- The network is a 15 node core transport network
- Origin destination traffic between nodes varies between 140 Gbps and 420 Gbps
- The Cisco solution includes:
    - CRS-3 routers
    - LSP Cards + 100 GE interface modules + 100 GE SR optics
    - Optical transport network
- The multibox solution includes:
    - Core routers
    - Packet transport switches
    - 10 GE and 100 GE cards with pluggable 10GE and 100GE SR optics
    - Optical transport network
- The model calculates routes for packets, LSPs, and wavelengths across a mesh network to dimension the network assuming 70% link utilizations
- Link capacity drives the CapEx calculations
- OpEx is driven by multiple assumptions, including system configuration and power consumption

In the hypothetical multibox (router + packet transport, aka pktp) network and the Cisco network (Figures 3 & 4) full IP routing is carried out at the origin and destination nodes and MPLS label switching forwards packets at the transit nodes.

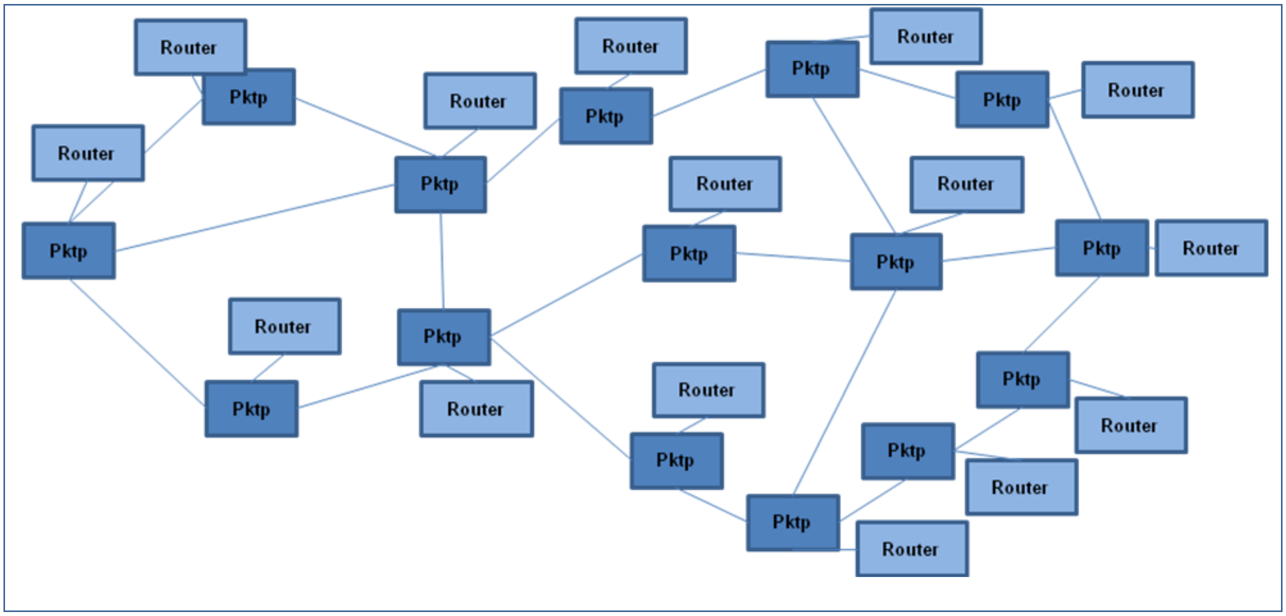


Figure 3. Hypothetical Multi-Box (Router + Packet Transport aka Pktp) Network

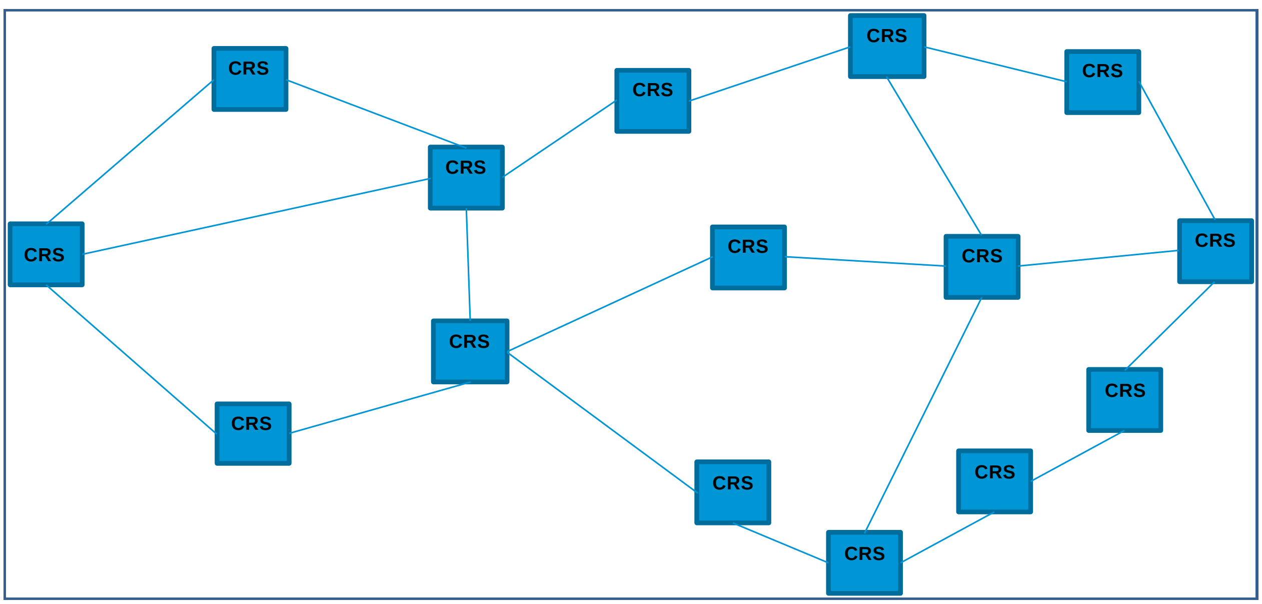
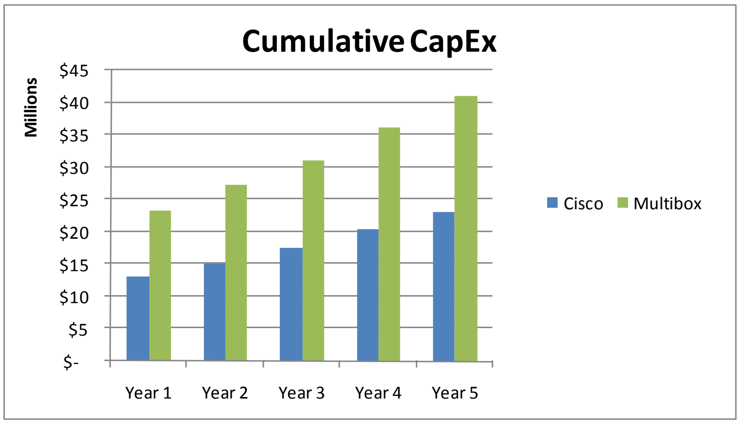


Figure 4. Cisco Network

TCO Model Results

A flexible packet transport core is a cost-effective architecture for packet transport. However, there are different approaches to building a flexible packet core. The multibox architecture with separate platforms for routing and packet transport is more expensive than an integrated solution that uses the

Cisco CRS-3. Our analysis shows that separate platforms add additional CapEx, power, cooling, floor space, and network management expenses. Therefore, any additional platforms must greatly reduce core routing and transport expenses to justify their additional cost. Cisco's integrated solution also provides IP services, IP aggregation, and flexible packet transport in the same platform at the right price points. The following charts depict the cumulative CapEx and OpEx of the two approaches over a five year period.



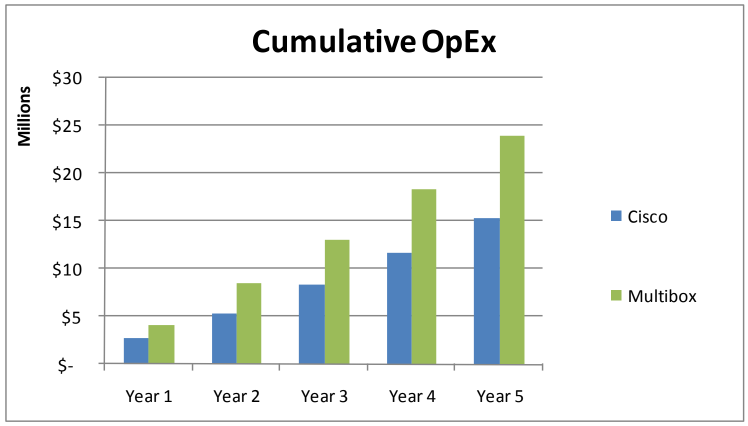


Figure 5. Cumulative CapEx and OpEx of the Two Approaches

As expected, the environmental expenses associated with power, cooling and floor space are higher with the multibox solution. Multiple platforms also yield higher network management expenses.

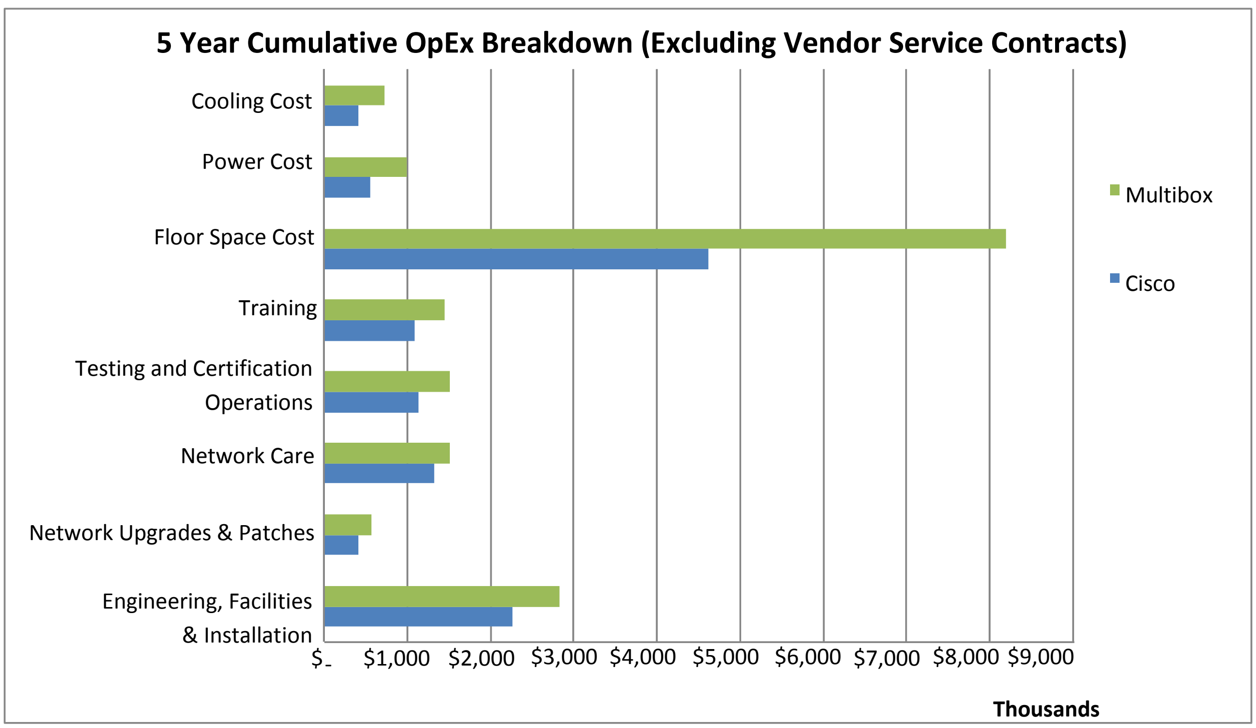


Figure 6. OpEx

Service providers may need to integrate a separate packet transport platform into their OSS if it is new and has not been previously qualified for deployment. This is an additional expense not considered in this analysis.

Conclusion

Optimal architectures for core routing and transport networks must provide network services, scalability, and cost optimization. Cisco's CRS-3 router provides a cost effective approach to integrating core IP services, peering, aggregation, and flexible packet transport functions into a single platform. In contrast to Cisco's integrated architecture, a multibox solution uses multiple platforms for IP services, core routing, and packet transport.

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