EXECUTIVE SUMMARY

Makers of network equipment based on Internet Protocol (IP) and Multiprotocol Label Switching (MPLS) technology have convinced most service providers that the migration to converged backbones can begin in earnest, and carriers themselves say that they expect to put more revenue-generating services onto IP/MPLS backbones. But even as the move to IP/MPLS picks up steam, Heavy Reading’s research has uncovered some significant problems that manufacturers and carriers will have to overcome to ensure the success of this technology transition.

Right now, carriers do not believe that IP/MPLS can deliver the levels of network resilience and equipment reliability that define “carrier-class” performance. And carriers have serious reservations about the lack of operations, administration, and maintenance (OAM) systems in IP/MPLS switches and routers. This gap between carrier hopes for IP/MPLS services and their fears about IP/MPLS’s technology limitations could have a huge impact on the speed and degree of carrier migration to converged services running over IP/MPLS backbones.

The impact of a premature rollout of IP/MPLS could be devastating for service providers and their customers. By expanding the role of IP/MPLS in their networks before the technology is proven to be ready for carrier-class duty, service providers could be putting their most lucrative product lines – data services aimed at enterprise customers – at risk. Carriers are fearful that the lack of robust OAM will drive operating expenses for converged services up to an unacceptable level. Beyond concerns about opex, premature deployment of IP/MPLS creates the potential for some serious performance problems for enterprise customers. Without carrier-grade resilience and reliability in place, service providers will not be able to offer the “five-nines” class of network reliability for which corporate customers are willing to pay a steep premium.

Resilience, Reliability, and OAM in Converged Networks: A Heavy Reading Competitive Analysis, written by Geoff Bennett, Heavy Reading’s Chief Technologist, exposes and explores the disconnect between carrier plans to accelerate IP/MPLS deployment and their concerns about the technology’s perceived shortcomings. The report is based on two foundations:

1. Extensive interviews with executives at leading carriers around the world that deliver clear insight into service provider expectations and concerns about the migration to IP/MPLS.

2. A detailed comparative analysis of IP/MPLS core and edge switches from more than a dozen leading manufacturers, including a point-by-point dissection of product features in the three key focus areas: network resilience, node reliability, and network OAM.
The report covers 19 products from 13 suppliers of IP/MPLS core and edge switches, including eight public companies and five private companies.

- Alcatel SA (NYSE: ALA; Paris: CGEP:PA)
- Avici Systems Inc. (Nasdaq: AVCI; Frankfurt: BVC7)
- Chiaro Networks Inc.
- Cisco Systems Inc. (Nasdaq: CSCO)
- Huawei Technologies Co. Ltd.
- Hyperchip Inc.
- Juniper Networks Inc. (Nasdaq: JNPR)
- Laurel Networks Inc.
- Nortel Networks Corp. (NYSE/Toronto: NT)
- Procket Networks Inc.
- Redback Networks Inc. (Nasdaq: RBAK)
- Riverstone Networks Inc. (OTC: RSTN.PK)
- Tellabs Inc. (Nasdaq: TLAB; Frankfurt: BTLA)

The core of the report is an exclusive, point-by-point comparative analysis of IP/MPLS products in the context of three critical feature sets:

- Network Resilience
- Node Reliability
- Network OAM

For all 19 products surveyed, full comparison tables are provided for more than 40 key resilience, reliability, and OAM features. Tables are accompanied by extensive vendor notes adding explanation and context to the compared features.

**SELECTED KEY FINDINGS**

Key findings from the report include the following:

**Carriers now believe in IP/MPLS as the primary convergence technology for their network infrastructures – in theory.** Interviews with top technologists in the carrier world confirm Heavy Reading's earlier research conclusions that service providers now believe that IP/MPLS is a better choice than either ATM or a more dynamic TDM (time-division multiplexing) layer to provide the underpinnings for converged backbones. But while carriers are making the theoretical commitment to migrate to IP/MPLS, the timing and pace of that migration are still to be determined.

**The migration of high-revenue legacy services to IP/MPLS is underway now, but it will proceed slowly until carriers believe that IP/MPLS technology is truly carrier-grade, and until they are confident that they will achieve enough savings in operations expenses to justify the move.** Again confirming earlier Heavy Reading research, service providers say they are now moving some legacy services, such as private circuits and Frame Relay, to a converged backbone. Complete commitments to service migration have yet to be made, however, because of carrier concerns about network resilience, technology reliability, and OAM systems now available to them.
The good news is that most IP/MPLS hardware is now generally accepted as being carrier-grade. The bad news is that IP/MPLS software is not yet carrier-grade in terms of reliability, and software reliability may be even more important in IP/MPLS networks than hardware reliability. Based on our analysis of product features now built into IP/MPLS core and edge switches, Heavy Reading believes that most mainstream IP/MPLS equipment installed in critical parts of carrier networks is now able to boast “five-nines” (99.999 percent) or better hardware reliability. But that level of reliability has not been demonstrated on the software side. While legacy networks are generally driven from a network operations center, intelligence in the converged network is distributed and is much more dependent on software, particularly at the network edge. Although this approach offers significant advantages to carriers, it leaves them far more vulnerable to software instability than in the past.

Carriers are worried that operating expenses for IP/MPLS backbones will be much higher than promised, in large part because of the continuing lack of effective OAM in IP/MPLS networks. OAM has always been poor in IP networks, and it has been completely left out of the foundation MPLS standards recently submitted to the Internet Engineering Steering Group (IESG) of the Internet Engineering Task Force (IETF). Although new services will work just fine without OAM, when something goes wrong with the service, it will cost more to fix the problem than if there had been effective OAM. Many carrier technologists interviewed for this report cited opex concerns as the biggest stumbling block to widespread migration to running converged services over IP/MPLS.

OAM is an essential component for making IP/MPLS truly carrier-grade, but to date, OAM has been treated as an afterthought by vendors and standards bodies. Our analysis of OAM features offered by makers of IP/MPLS equipment shows clearly that OAM support is severely lacking in today’s core and edge switch products. To make matters worse, many vendors currently have no plans to add needed OAM features to their product lines. Based on interviews with carriers, Heavy Reading believes vendors that do not make a strong move to boost their OAM capabilities could lose out to those that take OAM more seriously.

REPORT STRUCTURE

Resilience, Reliability, and OAM in Converged Networks: A Heavy Reading Competitive Analysis begins with a detailed analysis of the key issues regarding carrier concerns about network resilience, node reliability, and network OAM functions in converged IP/MPLS-based networks, and how these critical factors interact with one another. The analysis is accompanied by extensive comments from carrier technologists on the issues that are most important to them.

Excerpt From Section II: Overview

**Operational Costs:** Although every network is different in the exact proportions of its cost elements, most carriers we’ve spoken to agree that operational costs over the lifetime of a network outweigh all of the other costs combined. There’s absolutely no doubt that resilient circuits have a lower operational cost for the carrier than nonresilient circuits.

Al Blackburn, research director of advanced network architecture concepts at BellSouth, says:

“From our perspective, concepts like five nines and 50ms protection are effectively the ‘gold standard,’ and anything less than these are just not the gold standard. Now is that an unrealistic standard to try to live up to? Well, when you’re talking about devices that are less capable, there’s no doubt that the operational cost does go up. We’re motivated to build highly reliable networks, and we’re motivated to have the tools to run and maintain those highly reliable networks, because we know that our customers want a highly reliable network, and we know our operational costs for that kind of network are lower.”
This thought is echoed by the head of operations for a global bandwidth provider:

"The protected customer never sees a fault, and if it's a transatlantic circuit, say 6,000 miles of actual cable distance, then you can bet that faults occur from time to time. With the unprotected customers, each one of them will be sure to call the NOC [network operations center] whenever there's a fault. It could be a card failure, but the good thing about a card failure or other equipment failure is that it's quick to fix. If it's a terrestrial or submarine fiber cut, then it could take a lot longer, and yet they'll be calling the NOC every fifteen to thirty minutes wanting to know what we're doing to fix it. So the actual cost of running that circuit is higher. The NOC hates us selling unprotected services, because they need to hire more personnel to run them. And from a customer perspective, even though they should know it's an unprotected circuit, they get to see it go down. Right now customers are not used to unprotected services. Maybe two or three years from now the perception will change, but at the moment we definitely feel there are disadvantages as well as advantages to breaking away from protected services."

This detailed overview section is followed by a full competitive analysis of 19 different IP/MPLS products. The competitive analysis sections include clear definitions and explanations of all resilience, reliability, and OAM features covered in the report.

The report concludes with a series of recommendations ("calls to action") for equipment vendors, carriers, and standards bodies to address the issues that now threaten to delay or derail the move to converged services over IP/MPLS backbones at this critical stage in the technology’s development.

The report is essential reading for a wide range of industry participants, including:

- **IP/MPLS equipment vendors**: How do your products compare on a feature-by-feature basis with those of your competitors? What features are missing from your product line that are most important to carrier customers? What steps can you take to ensure that your product lines have a clear competitive edge over those of your competition?

- **Telecom carriers**: How close to "carrier-class" is today's IP/MPLS equipment? What are the risks of pushing ahead with IP/MPLS migration before carrier-class equipment is available, and are those risks worth taking? What are the chances that vendors will address critical carrier issues quickly, especially regarding MPLS OAM?

- **Investors**: Which vendors are closest to meeting carrier demands for IP/MPLS resilience, reliability, and OAM? Are current expectations for the migration to IP/MPLS-based services realistic given the concerns raised by carriers about the technology?

*Resilience, Reliability, and OAM in Converged Networks: A Heavy Reading Competitive Analysis* is published in PDF format.