Foreword

The one-time fantasy of routing light is slowly turning into reality. The race is well and truly on to develop and deploy the optical devices that will deliver tomorrow’s ‘intelligent optical core’.

While industry bodies like the IETF (The Internet Engineering Task Force) and OIF (Optical Internetworking Forum) are busy developing standards to ensure a cohesive evolution, vendors wanting to maintain a competitive advantage are already developing products that span the gap between the IP and optical layers. But with the standards still evolving, how can anyone be sure that their devices will interoperate, let alone deliver on performance expectations? At this early stage of development, functional and conformance testing provides vendors with confidence that they are on the right track.

The Bridge Between IP & Optical

Generalized multi-protocol label switching (GMPLS), an integral part of the next generation of data networks, is the bridge that will connect the IP and optical layers. GMPLS extends MPLS to encompass time division, wavelength, and spatial switching. One consequence of GMPLS is that label switched paths (LSPs) now pass through different types of label switching routers (LSRs) — for example, SONET ADMs, and OXCs — and this requires extensions to the current signaling and routing protocols.

Interoperability

Ensuring functional conformance to the evolving standards that govern the varying networking devices is a crucial step to achieving interoperability and reliability. Always open to interpretation, protocol specifications are never perfect. Many network failures can be attributed to differences in the implementation of a control plane protocol, causing two network elements to interoperate in an unpredictable way. A conformance test suite exercises the protocol interaction between devices, and tests responses to both positive and negative stimuli.

Modifications and additions to the existing MPLS routing and signaling protocols that provide this common control plane include the following:

- Enhancements to the routing protocols (OSPF, ISIS) to advertise the availability of optical resources. These include generalized representation of link types, bandwidth on wavelengths, link protection type, and fiber identifiers.
- Enhancements to the signaling protocols (RSVP, CR-LDP) that explicitly specify an LSP across the various LSRs. These enhancements are for traffic engineering purposes.
Testing Interoperability

Initially, testing should concentrate on functional and regression tests to ensure the device under test (DUT) supports basic GMPLS functionality. This involves testing the GMPLS signaling and routing capabilities of the DUT. Conformance testing follows next, where vendors must carefully follow protocol specifications to ensure the DUT reacts appropriately to both positive and negative stimuli. Finally, the DUT must undergo thorough performance and stress testing to verify performance limits and understand the behavior under stress. Stress for a GMPLS-based optical network involves creating complex topologies, with complex resource utilization, and stimulating this topology with simulated fiber or equipment failure events and observing the performance.

Conformance is a critical testing stage in this plan, as it is key to achieving interoperability between the different vendors’ devices. Once the DUT’s performance has been verified in positive network situations, conformance test suites should focus on negative test cases to simulate the types of errors the DUT may encounter in a live network. Test equipment must be capable of generating negative stimuli, for example, illegal states, corrupt or malformed messages, or simply a failure to respond. These negative test cases are central to proving robustness by representing ‘real world’ events that may corrupt, confuse, or crash the control plane.

To demonstrate the importance of testing negative conditions, consider what could happen if, instead of discarding a malformed resource usage advertisement, a network device interpreted the corrupt information and re-advertised a potentially false indication of resource availability to other devices. If the network erroneously thought no resources were available, it would bring all network activity to a standstill. While it may seem an unlikely scenario, this and many other situations must be verified if the network is to attain high reliability.

GMPLS will play an integral role in deploying the next generation of data networks. With huge revenue streams dependent on core optical transport networks, reliability is central to the success of any core optical network operator. A rigorous testing program is required to prove reliability before operators deploy these new intelligent optical devices. Such a program should be in place from the earliest stages of development to focus on functional, stress, conformance and interoperability testing. Only then should the focus shift to overall performance parameters, such as throughput, loss, and jitter.

The Optical Internetworking Forum (OIF)

The OIF showcased the best of these new devices at the ‘OIF Interoperability Booth’, SuperComm, June 3-7, Atlanta, Georgia, USA. This interoperability event was a huge step towards the integration of the edge/metro networks to the optical core. This initial step is an Optical-UNI (User Network Interface), which is a signaling interface that can be used by optical network clients such as tera-bit IP routers and ATM switches to invoke services that an optical network offers to the clients. Agilent Technologies is a key contributor to the OIF and participated at the OIF booth.

For more information about Agilent Technologies Optical Routing Test Solution, please email opticaltest@agilent.com or visit www.agilent.com/comms/opticaltest

For more on the OIF, visit www.OIF.com

You can read more about the OIF Interoperability event in next month’s edition of INSIGHT.