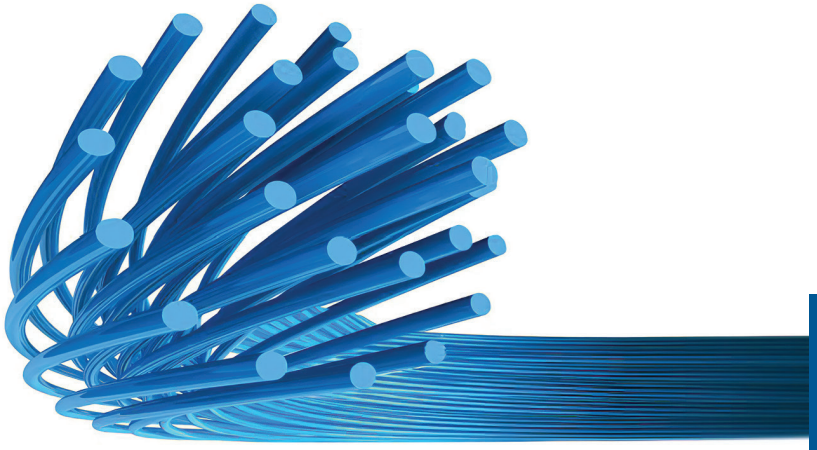
Building a more resilient optical network

How OTN-switching and mesh restoration are adding value to wavelength services

A white paper from Bell



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What's inside

With revenue and productivity increasingly dependent on network availability, organizations from retail to wholesale are demanding more than just speed and capacity from their wavelength services: they're looking for high levels of service resiliency and survivability as well. To meet that demand, telco carriers and service providers need to deliver more than just low latency and high capacity to their end customers. With the flexibility offered through an optical transport network (OTN) infrastructure, they can add a wide range of value-added services to their basic connectivity offerings, including multiple classes of restoration and protection that can survive multiple or simultaneous network failures

The need for more than just speed

As cloud computing and e-commerce continue to dramatically change the way business is conducted, organizations that rely on wavelength connectivity are demanding more than just speed from their service providers. With revenues so closely tied to website and data centre availability, wavelength services that also offer additional features and options to help protect against downtime have become increasingly essential.

To keep pace with the demands of their customers, telco carriers, Internet service providers, cloud providers and mobile network operators need to provide more than just speed and capacity. By taking advantage of the flexibility offered through a modern optical transport network (OTN) infrastructure, carriers can deliver a wider range of value-added features and options, such as mesh restoration, that can increase service resiliency and survivability – minimizing downtime and its impact on business revenue and productivity.

What today's organizations expect from their wavelength connectivity

Organizations of all kinds depend on wavelength (optical) connectivity to power their day-to-day operations. Wholesale wavelength customers, such as telco carriers and service providers, rely on wavelength to meet their data centre interconnect, mobile backhaul and bulk data transport needs. At the same time, wavelength connectivity is increasingly necessary to support the mission-critical applications deployed in their end-users' enterprise environments, including ERP, workforce collaboration, business continuity and disaster recovery.

Because of the speed and capacity optical networks can offer, the demand for wavelength services of up to 100 Gbps has seen explosive growth in recent years – and shows no signs of slowing down.

Analysts expect the wavelength services market to see growth rates of 9.5% during the forecast period, reaching $6.86 billion by 2026. The majority of new wavelength circuits deployed are now 10 Gbps rather than 1 Gbps. And with the price for 100 Gbps equipment finally dropping to the point where service providers can offer that level of connectivity at a market-acceptable rate, 100 Gbps has shifted from planning to actual deployments.

While the proliferation of high-bandwidth video services has played a large role in this growth, the demand for wavelength services among wholesale and retail enterprises has been driven primarily by the rise of cloud computing. As the cloud ecosystem develops, many organizations find wavelength services optimal for interconnecting the data centres in their private clouds to public cloud providers to leverage infrastructure-as-a-service (IaaS) capabilities.

At a minimum, these organizations expect high-capacity, high-performance connections to their data centres. But gone are the days when a telco carrier could sell itself on competitive pricing and sheer bandwidth alone. As optical network connectivity services evolve from dedicated implementations to shared, virtual implementations that support a wide range of emerging applications, organizations are starting to demand much more from their wavelength service providers.

[1] Source - Business Wire - Optical Wavelength Services - Global Market Outlook (2017-2026)

For example, they expect service turn-up to be much faster and completely automated. They want to be able to adjust bandwidth granularity in increments as small as 1 Gbps at a time, along with the ability to easily scale up to more than 100 Gbps when the time comes. And, they require performance guarantees to help to maximize resiliency and survivability.

Why resiliency and survivability matter

For most businesses, unscheduled downtime is unacceptable. When networks go down, productivity and revenue can take an immediate hit.

Every business is different, with varying levels of risk tolerance and reliance on technology, making it difficult to pinpoint the exact costs of network downtime.

Certain mission-critical applications, such as high-frequency trading, can be severely affected by just a few nanoseconds of downtime (let alone an entire hour). Other less-critical operations, like storage virtualization and synchronous disk replication, can tolerate only a few milliseconds of downtime. And while operations such as remote storage can handle 100 milliseconds or more of downtime, the end result is still the same: a negative impact on business revenue and productivity.

It isn't surprising, then, that among the key service attributes organizations are looking for from their wavelength providers, survivability and resiliency are near the top of the list.

Breaking down the cost of network downtime

According to ITIC 98% majority of firms say hourly downtime costs exceed $150,000 and 88% estimate a single hour of downtime costs $300,000 or higher. And three-in-10 corporations assert that one hour of downtime costs their firms $1 million or more.

Source : ITIC Reliability Survey, 2020

As data centres become where business consolidate all their IT resources, the optical networks connecting those data centres play an increasingly critical role in disaster recovery planning. But to help reduce downtime and maximize service availability, data centre interconnections must evolve from static configurations to a new level of operational performance, providing connections that have the ability to be dynamically rerouted if they fail to achieve required IT survivability specifications and maintain rapid changes in connectivity to the cloud.

The challenge facing carriers and service providers is that while their traditional optical services delivered over synchronous optical networking (SONET)/ synchronous digital hierarchy (SDH) and Dense Wavelength Division Multiplexing (DWDM) infrastructures provide multiple bandwidth offers, they typically offer very few options for resiliency. As a result, it is difficult for them to truly differentiate their offerings in the market. To successfully grow their service-related revenues, they must evolve to a value-based model, aligning the capabilities and features of their offerings with the evolving requirements of today's organizations.

New possibilities through OTN switching

Wholesale optical service offers are typically focused on basic connectivity: they're designed to carry a lot of traffic but without the 'bells and whistles' associated with Layer 2 or Layer 3 service offerings. However, increasing cloud adoption in the wholesale market – and increasing enterprise demands and expectations – has created a steady trend toward adding more value and more features into the basic Layer 1 service offering. For carriers and service providers, the key to being able to offer more value-added features is a modern transport infrastructure that incorporates OTN switching and an intelligent control plane.

An OTN-switched infrastructure with an intelligent control plane enables a self-aware network that autonomously maintains knowledge of all its available resources and assets, helping to improve decision making and degree of control. This makes it possible to automate a wide range of end-to-end network operations, including network discovery, service turn-up and tear down and maintenance planning and execution – resulting in a good customer experience and fast recovery from an outage for wholesale wavelength customers and their end users.

In the context of wholesale and retail networks, an OTN-switched infrastructure can act as a service platform for high-bandwidth, private-line connectivity. With an intelligent control plane, these private lines may be offered with varying classes of connectivity service, including multiple software-enabled protection and restoration schemes that provide different degrees of survivability and availability.

One such class of service is mesh restoration.

What is OTN?

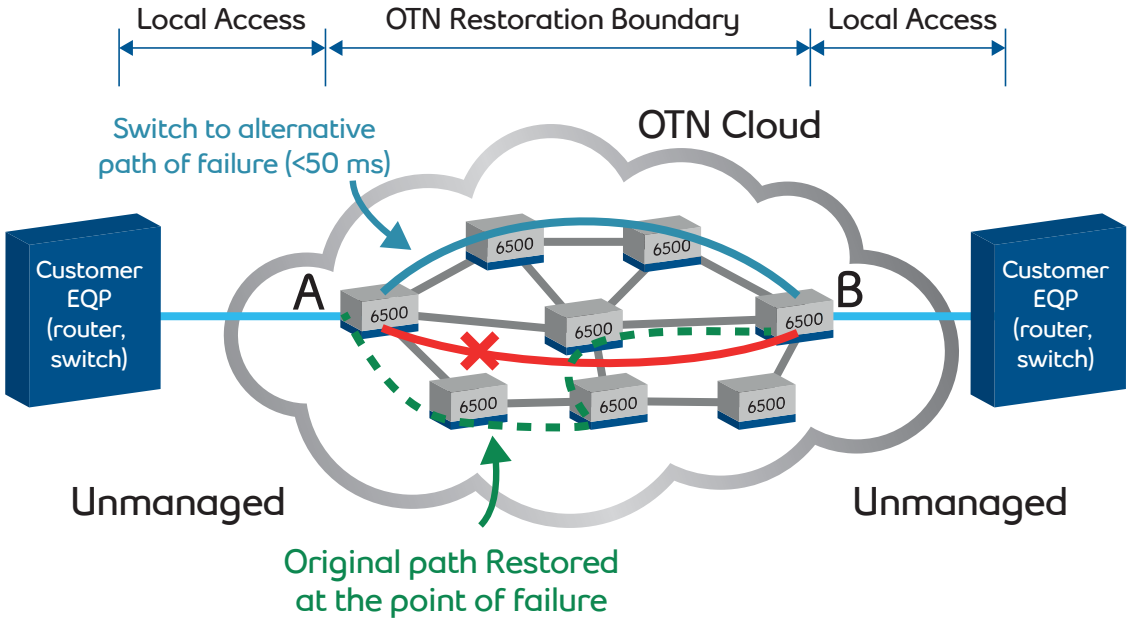
An optical transport network (OTN) refers to a set of optical network elements, connected by optical fiber links, that can provide functionality of transport, multiplexing, switching, management, supervision and survivability of optical channels carrying client signals.

OTN allows a number of different services to be carried over a wavelength, with OTN switching providing the capability to switch services to meet the needs of different users.

Mesh restoration

While ring-based SONET/SDH networks typically offer some type of path redundancy and a failover time of less than 50 milliseconds, they cannot survive multiple or simultaneous failures. In contrast, a mesh-based network managed by an intelligent control plane can provide that level of survivability by rapidly rerouting connections around network failures – helping to minimize the risk of disruptions without the need to assign a dedicated protection path for each end user. A properly designed mesh network can help to improve availability over traditional ring-based networks.

As illustrated below, the intended working route through the network is depicted as the red line from point A to point B. If the working route fails at any point (indicated by the red 'X'), a path is automatically calculated at the time of the failure from the shared pool of available (i.e., unused) bandwidth – and the traffic will then be routed through that dynamically computed path (as illustrated by the green dotted line). The intelligent control plane makes the decisions on where to redirect the traffic based on its awareness of the network resources and the attributes assigned to the end user's service options.



Restoration of the failed circuit will continue until the original working route has been repaired. Without OTN-enabled restoration, the customer's service would remain completely down until the original outage is repaired.

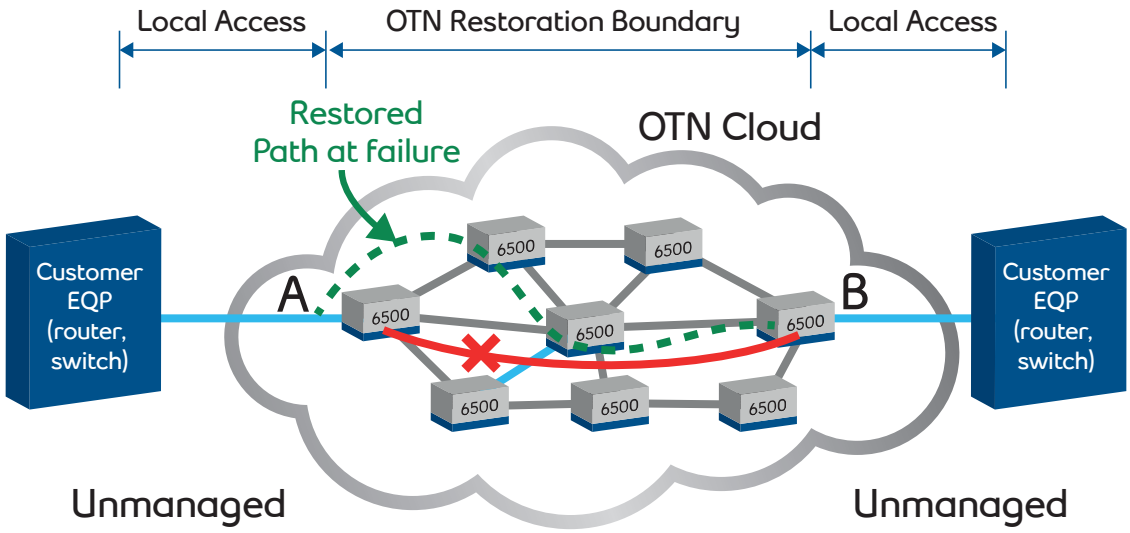
Although recovery does take slightly longer than a pre-provisioned protected path (where the transition from the working route to the protection route is designed to be less than 50 milliseconds), mesh restoration can cost-effectively protect against multiple network failures at the same time.

Mesh restoration with protection

For maximum survivability, OTN switching also allows service providers to combine mesh restoration with pre-provisioned protected paths, creating a more resilient service offering than can tolerate multiple failures while also offering switch times of less than 50 milliseconds.

As illustrated below, if the working route (indicated in red) fails, traffic will automatically switch over to the user's pre-provisioned protected route at the time of failure (indicated in blue). At the same time, the working route will be dynamically restored (indicated by the green dotted line), effectively serving as the new protected path in the network. This means if there's a failure in the protected path, the end-user's traffic can be switched over to the restoration path (with a maximum restore time defined by the network operator's SLAs), with the original protection route then restored along a different route.

Protection switching of the traffic, followed by restoration of the failed route, will continue until the original working route is restored.



In short, this approach provides users with a double layer of protection: if the working route fails, traffic shifts over to the protection route. If that route fails, it moves over to the dynamically calculated restoration path. In this way, mesh restoration provides a clear advantage over non-OTN static restoration, where a fault in the secondary path would result in a total service outage for the end user.

Mesh restoration from Bell

As the market changes, Bell must continuously evolve its ultra high-bandwidth wavelength services to meet the needs of its wholesale customers and their end users. We're always working to make our networks even better, investing more than $4 billion last year on upgrades and improvements. For example, Bell was the first to offer 100 Gbps wavelength service in Canada.

We have migrated our network to a modern optical transport infrastructure with OTN switching and an intelligent control plane. As a result, our wavelength offer to wholesale carriers and service providers now includes a wider selection of protection and restoration options at a variety of different price points, delivering an added level of survivability and resiliency to our already highly dependable network.

Bell's intelligent control plane, the brain of our OTN-switch network, can automatically react to network changes such as multiple simultaneous failures (e.g., fibre cuts, hardware failures), changes in network topology or an increase in latency in some of the network's critical spans, all in real time.

A summary of our wholesale wavelength offers is as follows:

Class of service	Restoration time
Unprotected No restoration is provided.	N/A
Restorable* Restoration to an alternate route across our parent company, Bell Canada's, network will be provided in the event of an interruption of an established working path, subject to availability.	Base (standard priority): < 10 seconds Premium (high priority): < 1 second
Protection only A protection path and a working path are provisioned with no restoration capability on either. In the event of a service interruption on the working path, connectivity will be maintained on the protection path. The working path will be offline until the cause of the interruption is corrected.	< 50 milliseconds
Protection with restoration* A protection path and a working path are provisioned with restoration capability on both. In the event of a service interruption on the working path, connectivity will be maintained on the protection path, which becomes the new working path. A new protection path will automatically be established to ensure constant circuit protection.	Base (standard priority): < 10 seconds Premium (high priority): < 1 second

* NOTE: Although Bell's wavelength service offering goes up to 100 Gbps, mesh restoration can be currently applied only to services up to 10 Gbps.

From content providers seeking to improve their customers' experience to telco carriers and Internet service providers who need to differentiate in a competitive market, these offers – enabled by our flexible, dynamic and intelligent network infrastructure – are only the beginning as we continue to evolve its optical services to meet the requirements of the new cloud ecosystem.

About Bell Wholesale

Bell Wholesale provides industry-leading broadband, IP and voice wholesale products and services across Canada and at key points in the U.S. and Europe – helping you grow your businesses and meet the needs of your customers.

As Canada's largest communications company, Bell has more than 270,000 kilometres of fibre and 161 Points of Presence (PoP) across the country, the most in Canada. Our convenient "meet me" points in the U.S. and Europe provide seamless access to the largest network in Canada.

With an extensive team of professional services experts and 24/7 help desk availability, Bell provides high-quality support to interexchange carriers, local exchange carriers, wireless service providers, resellers, Internet service providers, over-the-top providers, system integrators, telcos and cablecos.