tellabs™

Optical LANs Deliver High Availability for Critical Services and Improved Employee Productivity

Today's high-performance local area networks (LANs) deliver real-time services such as voice and video, and critical business services. Enterprises rely on LANs to be the lifeline of their operations, delivering dependable connections for cloud networking, big data, Internet of Things, virtual desktops, remote employees, regional offices and international locations. Real-time and critical services demand high availability, stability, uptime and security from the networks. Unplanned LAN outages result in lost employee productivity and lost connectivity to corporate resources and data centers, raising security concerns.

Tellabs™ Optical LAN Solutions

Tellabs Optical LAN Solutions provides Enterprise LANs with superior stability, high availability and industry-leading network uptime **[Figure 1]**. The solution enables a number of key benefits, including:

- Higher network availability for better employee productivity
- Better performance than legacy copper-based active LANs
- Reduced human error with centralized intelligence and management
- Enhanced redundancy with equipment options

Optical LANs deliver higher network availability and uptime, which provides:

- 90% reduction in network downtime and related costs
- 30 seconds of annual downtime with optical plant redundancy options
- A better, more productive work environment for employees
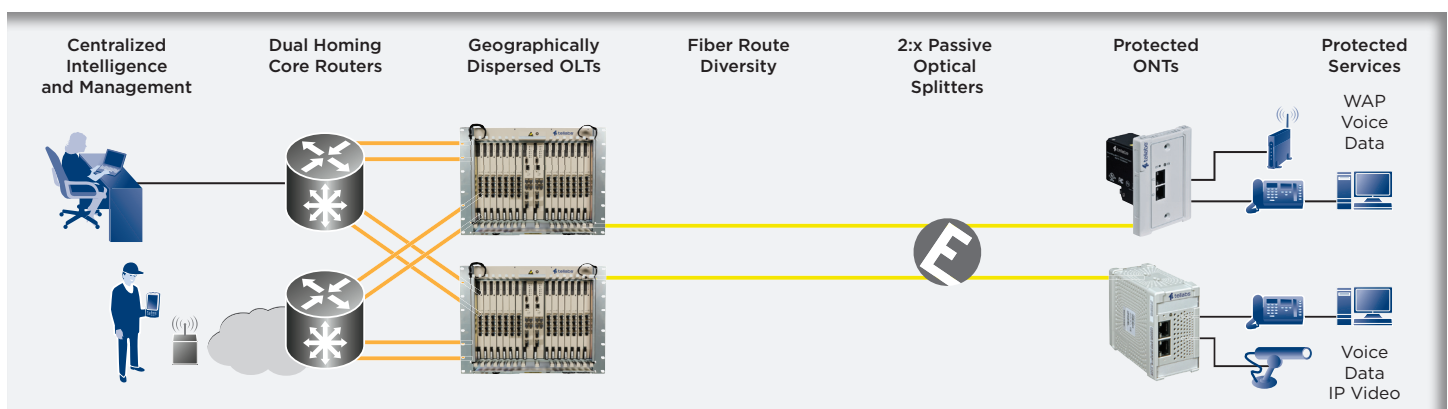- Ideal support for machine-to-machine actions to reduce human error

Figure 1: Tellabs Optical LAN high-availability solution features industry-leading network uptime.

Higher network availability for better employee productivity

LAN downtime has a negative impact on both employees and business operations. Lost productivity is one obvious bad outcome of LAN downtime. A tougher impact to measure is the employee frustration and stress that can occur when connectivity is lost.

A Dun & Bradstreet study finds that 59% of Fortune 500 companies experience a minimum of 1.6 hours of network downtime per week. Dun & Bradstreet speculates that if an average Fortune 500 company has 10,000 employees who are paid an average of $56 per hour, just the labor component of downtime costs equals $896,000 weekly; more than $46 million per year of lost productivity.[1] A Gartner Research study calculates that the cost of network downtime for large corporations is $42,000 per hour, with a typical business experiencing an average of 87 hours of downtime a year. That's a cost exceeding $3.6 million.[2] Even more astonishing is a Ponemon Institute study that shows that the average cost of data center downtime per minute across industries is approximately $7,900.[3]

An even greater risk during LAN downtime events is the loss of data, files and records, which is very expensive for businesses and organizations. In 2014, a data breach cost a U.S. enterprise an average of $201/record lost. Healthcare experiences the highest cost at $358/lost record, followed by Education at $294/lost record.[4] Then add security issues. For example, when a health facility's LAN is down, data, files and records can be lost because doctors, nurses, technicians and administrators collect information in real time. Healthcare organizations recognize the problem and are making significant investments to transform IT infrastructures and ensure that patient information is secure, protected and highly available.[5]

The root cause of network downtime is attributable to a number of sources. Gartner Research finds that people and process issues cause 80% of mission-critical outages, and more than 50% of outages are caused by change and configuration management issues.[6] Infonetics finds that human error is the main cause of network downtime, reporting that large businesses lose ~3.6% of annual revenue due to LAN downtime and that humans are the biggest contributor, responsible for 50% to 80% of outages.

Ponemon Institute's cost of data breach study finds that the root cause for outages is 42% malicious/criminal attacks, 30% human error and 29% system glitch.[7]

LAN uptime is also used as a means to measure CIOs' and IT professionals' work performance, compensation packages and year-end bonuses. A few common CIOs' and IT professionals' key performance indicators[8, 9] are:

- Dollars saved due to productivity improvement initiatives
- Uptime percentage for business-critical systems
- Number of production incidents by severity
- Business time lost due to unscheduled downtime

High availability for the LAN is the desired goal with the ultimate outcome for businesses being a less stressful, more productive work environment for employees. Tellabs Optical LAN can help businesses achieve that goal with superior stability and industry-leading LAN uptime.

Better performance than legacy copper-based active LANs

Legacy copper-based LANs' traditional configurations achieve only 3-9s, 99.9% availability at best. This is because a legacy LAN was born from a "best-effort" data-only world. The services they supported were predominately nonreal-time data, such as file transfer, email, backup and Internet access. CIOs' and IT professionals' accepted policies and procedures for configuration changes, upgrades and MACs are that they are done after business hours or over weekends. As a result, traditional commoditized Ethernet switches were manufactured using lower-grade components because the reliability expectations and the ramifications of LAN downtime were low.

An Optical LAN-based configuration can achieve 99.999%, 5-9s availability. This is because Optical LAN is born from the telecommunications service providers' world. Services delivered include E911, Lifeline Voice and Real-Time Video. These 7/24/365 services require 99.999% network uptime, mandated by law and enforced by the FCC. Thus, "carrier grade" means that Tellabs Optical LAN equipment is built upon higher-grade componentry and is designed to legendary Bell Laboratory engineering criteria. This is the genesis of "carrier class," "carrier grade" and "five-nines" reliability terms.

[1] http://www.businesscomputingworld.co.uk/assessing-the-financial-impact-of-downtime/
[2] http://www.zdnet.com/blog/itfacts/average-large-corporation-experiences-87-hours-of-network-downtime-a-year/268
[3] http://www.emersonnetworkpower.com/en-US/About/NewsRoom/NewsReleases/Pages/Emerson-Ponemon-Cost-Unplanned-Data-Center-Outages.aspx
[4] Ponemon Institute, May 2014 http://public.dhe.ibm.com/common/ssi/ecm/en/sel03027usen/SEL03027USEN.PDF
[5] *Healthcare News*, February 2014 — http://www.healthcareitnews.com/news/healthcares-slack-security-costs-16b
[6] http://www.evolven.com/blog/downtime-outages-and-failures-understanding-their-true-costs.html
[7] Ponemon Institute, May 2014 — http://public.dhe.ibm.com/common/ssi/ecm/en/sel03027usen/SEL03027USEN.PDF
[8] "A CIO's Voice," General Article about CIO performance: http://arunmanansingh.wordpress.com/2011/09/13/key-performance-indicators/
[9] *Future of CIOs* (publication): http://futureofcio.blogspot.com/2013/03/four-views-of-it-kpis.html

Annual LAN Percentage Uptime	Common Written Form	In Plain English	Annual LAN Downtime in Minutes	LAN Downtime Cost per Minute	Annual LAN Downtime Cost per Year
99.9%	3-9s	*Three-nines*	525	$7,900	$4,147,500
99.99%	4-9s	*Four-nines*	52.5	$7,900	$414,750
99.999%	5-9s	*Five-nines*	5.26	$7,900	$41,554
99.9999%	6-9s	*Six-nines*	0.526	$7,900	$4,155

Figure 2: A comparison of 99.9%, 3-9s reliability to 99.9999%, 6-9s reliability and associated costs.

Let's apply the cost of LAN downtime to the known calculated duration of downtime in minutes. As stated earlier, Ponemon Institute's average cost of data center downtime/minute is $7,900. We also know the corresponding numbers for network downtime in minutes calculated for 99.9% or "3-9s," 99.99% or "4-9s," 99.999% or "5-9s" and 99.9999% or "6-9s" reliability figures **[Figure 2]**. The math proves that a LAN network with 3-9s reliability can cost a business more than $4 million over the course of a year due to its 525 minutes of lost connectivity to the data center and other corporate resources. A LAN network with 6-9s reliability would only lose $4,155 over the course of a year with only 30 seconds of lost connectivity.

Now let's look at network availability numbers for a legacy copper-based active LAN system. Based on information gathered directly from a design guide of an industry-leading legacy copper-based active LAN, a base configuration would only achieve 99.9%, 3-9s reliability **[Figure 3]**. For a legacy copper-based LAN to achieve 99.999% or 5-9s reliability and greater, enterprises need to rack, stack and cable more switches[10] that would need to be fully redundant and have meshed cabling between them. All of these electronics and associated materials add unnecessary capital costs, operational costs, power, thermals, A/C, ventilation and space burdens to the network. Adding all these electronics and associated material to achieve 5-9s or even 6-9s reliability is neither sustainable nor smart.
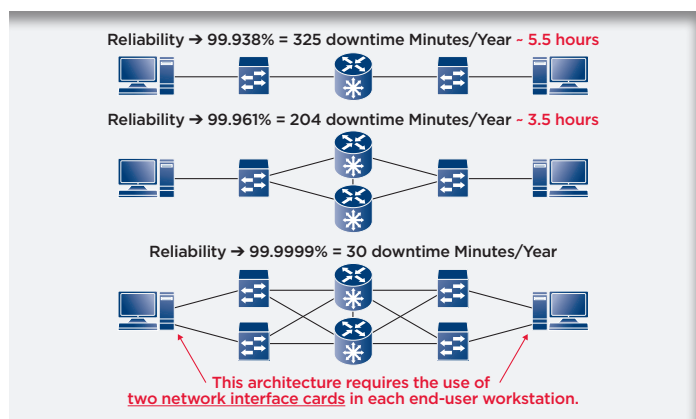

Figure 3: Legacy copper-based active LAN design guidance for 99.9%, 3-9s to 99.9999%, 6-9s availability.

Smart CIOs and IT professionals who seek the benefits of industry-leading network uptime can take advantage of Tellabs Optical LAN's superior stability. Optical LAN delivers greater reliability with far fewer ports, fewer modules/cards and fewer points-of-failure. It does it with less equipment and less cabling, which leads to less complexity, thus easier ongoing year-over-year operations. This all leads to better network uptime **[Figure 4]** with better sustainability attributes and lower costs.
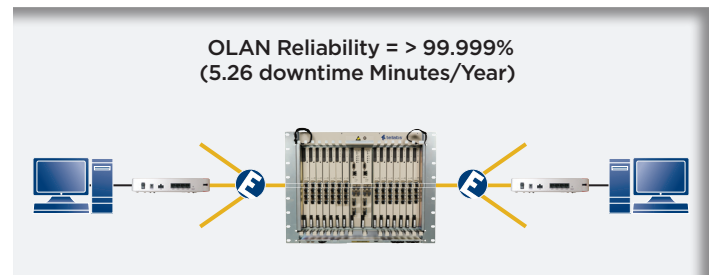

Figure 4: Tellabs™ Optical LAN solution achieves greater stability with fewer electronics and less associated materials.

What is the impact on a midsize Enterprise LAN serving 2,000 employees? In this example, assume that there are phones, computers, WAPs, IP cameras, building automation and other corporate resource end-points served. However, the main focus is on lost employee productivity.

First, compare a legacy copper-based active LAN system 99.9%, 3-9s reliable design against a Tellabs Optical LAN 99.999%, 5-9s system serving 2,000 employees. In order to calculate LAN downtime cost, multiply the total cost of lost productivity per minute for 2,000 employees by the annual minutes of downtime relative to 99.9%, 3-9s reliability **[Figure 5]**. Then compare that number to a similar number for 2,000 employees against the annual minutes of downtime relative to 99.999%, 5-9s reliability (i.e., 5.26 minutes). The bottom-line total shows a net savings of $971,301 for the 2,000-employee Tellabs Optical LAN system.

[10]Cisco Enterprise Campus 3.0 Architecture: Overview and Framework: http://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Campus/campover.html

3-9s to 5-9s Savings for a 2,000-Employee LAN System	
2,000 users	Midrange size deployment for 1150E OLT
$56 per hour	Dun & Bradstreet average employee cost
99.9%	3-9s LAN uptime for Cisco per their Tech Pubs
8.75 hours	Annual lost productivity for 99.9% LAN
99.999%	5-9s LAN uptime per Tellabs' OLAN Tech Pubs
5.26 minutes	Annual lost productivity for 99.999% LAN
$981,120	$56 x (5.26/60) x 2,000 = 99.9% 1-year cost
$9,818	$56 x (.315/60) x 2,000 = 99.999% 1-year cost
$971,301	**Savings for Tellabs™ Optical LAN**

Figure 5: A comparison of 3-9s legacy copper-based LAN to 5-9s Optical LAN savings for a 2,000-employee system.

5-9s to 6-9s Savings for a 2,000-Employee LAN System	
2,000 users	Midrange size deployment for 1150E OLT
$56 per hour	Dun & Bradstreet average employee cost
99.999%	5-9s LAN uptime for Zhone Type-B PON ODN
5.26 minutes	Annual lost productivity for 99.999% LAN
99.9999%	6-9s LAN uptime per Tellabs' Type-B PON ODN
31.5 seconds	Annual lost productivity for 99.9999% LAN
$9,818	$56 x (5.26/60) x 2,000 = 99.999% 1-year cost
$588	$56 x (.315/60) x 2,000 = 99.9999% 1-year cost
$9,230	**Savings for Tellabs™ Optical LAN**

Figure 6: A comparison of 5-9s to 6-9s LAN uptime savings for a 2,000-employee system.

Now compare a Passive Optical LAN system with 99.999%, 5-9s reliability to a Tellabs Optical LAN 99.9999%, 6-9s system serving 2,000 employees. This calculation of LAN downtime costs includes the total cost of lost productivity per minute for 2,000 employees, multiplied by the annual minutes of downtime relative to 99.999%, 5-9s reliability **[Figure 6]**. Compare that number to a similar number for 2,000 employees against annual minutes of downtime relative to 99.9999%, 6-9s reliability (i.e., 31.5 seconds). Both Optical LAN architectures provide fiber route diversity across the optical plant infrastructure and Type-B PON redundancy with 2:x optical splitters. The key difference is that Tellabs Optical LAN 99.9999%, 6-9s system supports Type-B PON redundancy of the optical plant with two geographically dispersed Optical Line Terminals (OLTs) in two unique locations. The bottom-line total shows a net savings of $9,230 for the 2,000 employees utilizing a Tellabs Optical LAN system achieving 99.9999%, 6-9s reliability.

Even for a medium-sized Enterprise LAN, the savings associated with better LAN availability are significant. The Tellabs Optical LAN provides superior stability with fewer electronics, less cabling and less associated material. This simple solution provides easier operations enabling CIOs and IT professionals to do more with less, while improving operational efficiencies and LAN security.

Reduce human error with centralized intelligence and management

Stability starts with Tellabs™ Panorama™ PON Manager **[Figure 7]**. LAN system misconfigurations have a major impact on network performance. In fact, 80% of unplanned network outages are due to poor planning and haphazard execution by IT administrators. Optical LAN's centralized intelligence and management reduce human error/misuse by promoting machine-to-machine actions and process consistency.
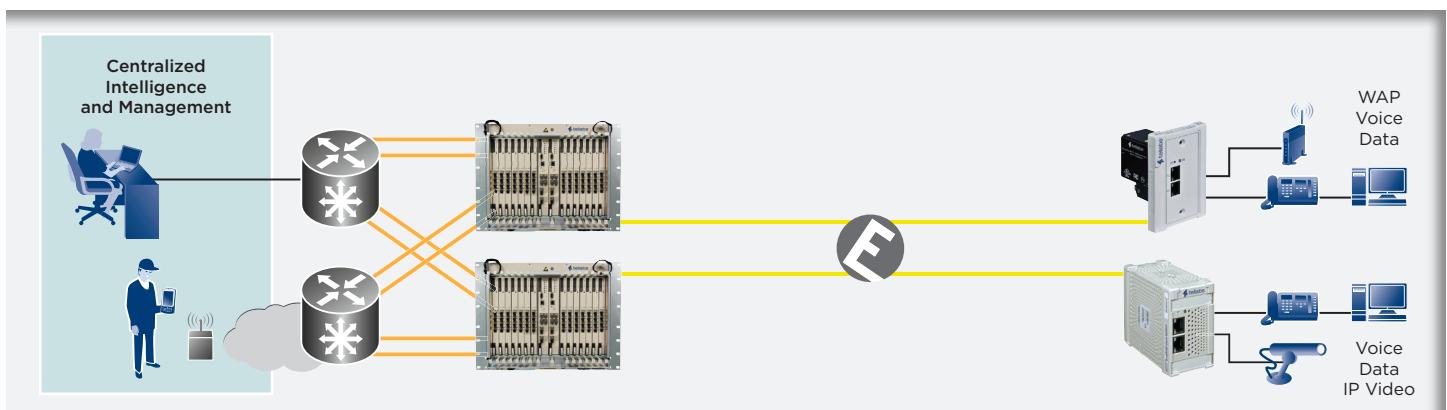

Figure 7: Tellabs Optical LAN centralized intelligence and management enable consistent processes and policy enforcement.
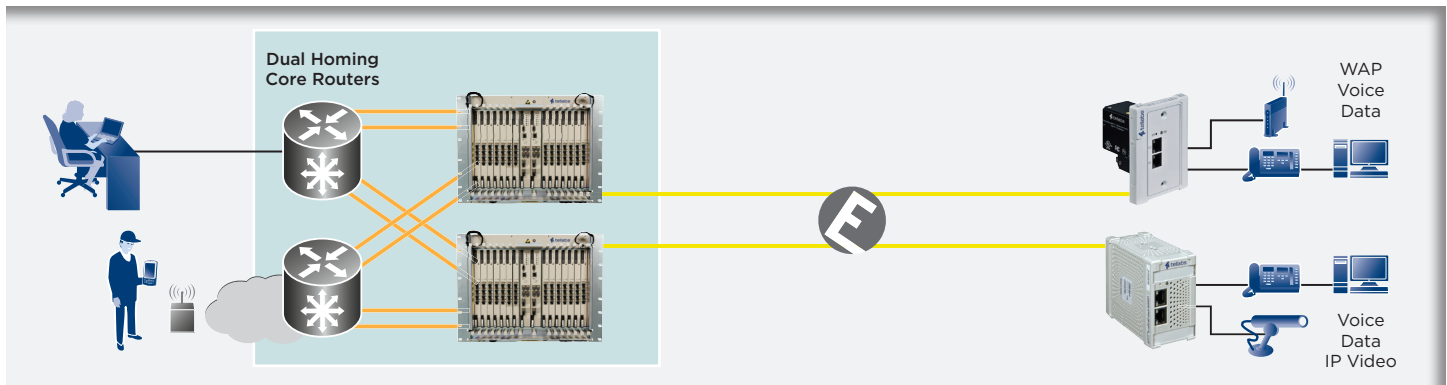
Figure 8: Dual homing core router redundancy options improve network availability.

Policy consistency is enabled by Tellabs™ Panorama™ PON Manager templates, wizards and profiles, which can be created by senior staff for initial system provisioning, ongoing equipment reconfigurations and daily moves, adds and changes (MACs). These global templates, wizards and profiles can be shared and distributed to other LANs across a campus, a region, a state, a country or even in international locations. Tellabs PON Manager can improve employee training for junior staff by establishing set privileges, capture actions leading up to an error and provide access to online help. To protect against outside forces causing network downtime through the Tellabs PON Manager, actions can be implemented to block malicious activities and harden the end-to-end operating system of the Optical LAN. By implementing consistent network access control policies enterprisewide at the user and device levels, the Tellabs PON Manager provides further protection against malicious attacks.

Enhanced redundancy with equipment options
Tellabs™ Optical LAN includes a number of equipment options to customize the enhanced redundancy in the LAN based on the specific needs of the organization.

Dual homing core router options
In the main data center of a building or campus, dual homing

to the core router is ideal for high-availability services across campus and at remote buildings, providing aggregation, resiliency and load balancing. In this architecture, a business can achieve equipment and facility protection at the OLT. The OLT can provide this redundancy across 1 GbE and 10 GbE Ethernet uplinks. It can be deployed with any standards-based L2 switches and/or L3 routers **[Figure 8]**. The standards-based dual homing core router protocols are:

- IEEE 802.3ad Link Aggregation Control Protocol (LACP)
- IEEE 802.1w Rapid Spanning Tree (RSTP)
- IEEE 802.1s Multiple Spanning Tree (MSTP)
- Virtual Router-to-Router Redundancy (VRRP)

Equipment redundancy options

In order to achieve 99.999%, 5-9s reliability, enterprises take advantage of the equipment redundancy options of the OLT **[Figure 9]**. The OLT can be equipped with the following duplex components:

- Ethernet Switch Units
- Common Controls
- Timings Source
- Network Uplinks
- Service Module and/or whole OLT with Type-B PON redundancy
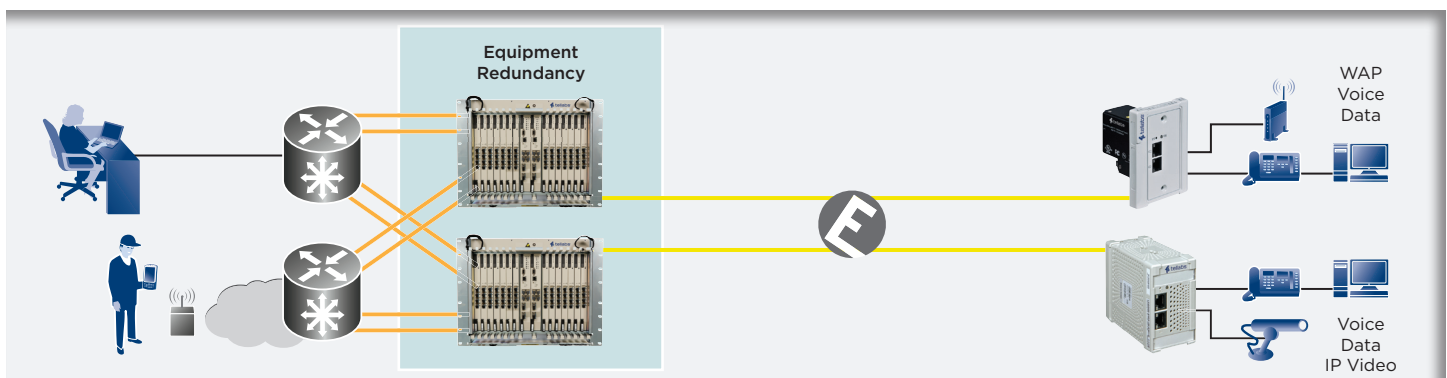- Power Plant
- Fans

Figure 9: Equipment redundancy options include uplink, control, timing, service module, power plant and fans.
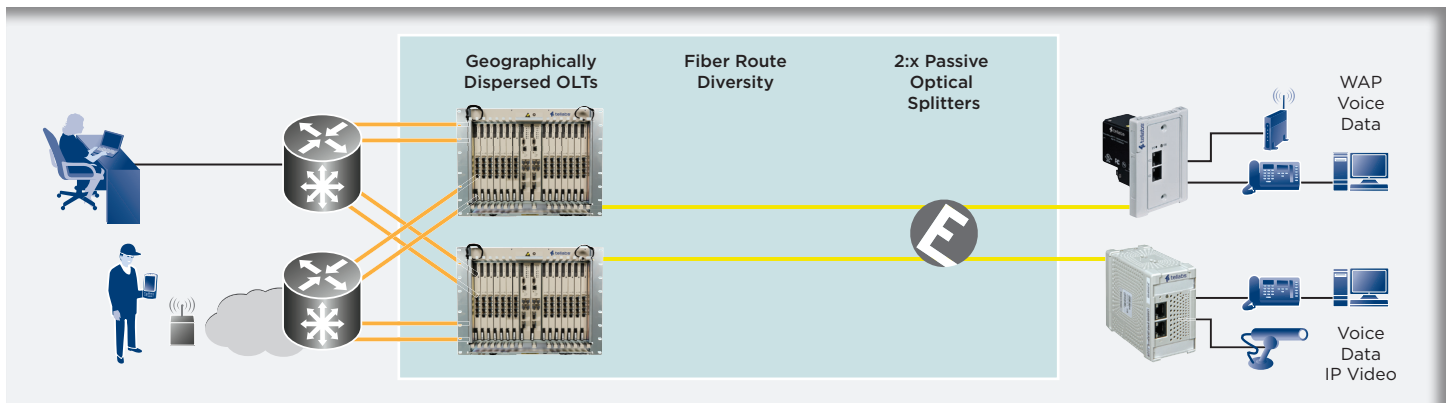
Figure 10: Optical plant redundancy option with Type-B PON architecture using 2:x passive optical splitters.

With a fully equipped OLT, enterprises can benefit from non-service-affecting side switching, fail-over and/or card swapping measured at less than 50 ms. Any fail-over of redundantly deployed cards generates an alarm to the Tellabs PON Manager while service remains intact.

Optical Plant Redundancy Options

In the optical plant, fiber route diversity can be configured using a Type-B PON redundancy option **[Figure 10]**. Type-B PON redundancy is a purely passive solution defined in principle by FSAN ITU standards and is contingent on deploying 2:x passive optical splitters. These highly reliable 2:x optical splitters provide protection, redundancy and splitting functions in the optical plant. CIOs and IT professionals have the flexibility as to where these splitters can be placed in their optical plant infrastructure. For example, the 2:x passive optical splitters can either be positioned in a centralized (i.e., near the data center) architecture or a distributed (i.e., far from the data center) architecture. These 2:x passive optical splitters support a variety of split ratios, such as 2:8, 2:16 and 2:32, depending on the type and number of ONTs being subtended. They can be sourced from major Layer 1 optics manufacturers.

Type-B PON redundancy provides options for fiber route diversity to different PON ports in the same OLT, different PON cards in the same OLT and then different OLTs in geographically dispersed locations. The pinnacle of reliability being 99.9999%, 6-9s network availability is the culmination of all the redundancy options, including dual homing routers, equipment redundancy and Type-B PON redundancy with fiber route diversity and geographically dispersed OLTs.

Highly Reliable Optical Network Terminals

The Optical Network Terminals (ONTs) are the final piece protecting real-time and critical services **[Figure 11]**. An ONT is a basic optical-to-electrical media converter. By design, ONTs are meant to be simple, unmanaged, secure and ultralow maintenance network devices. ONTs have no local user interface and are controlled exclusively by centralized intelligence in the OLT and overarching element management software (e.g., Tellabs™ Panorama™ PON Manager). They do not store user or configuration information locally, thus adding to their secure nature.
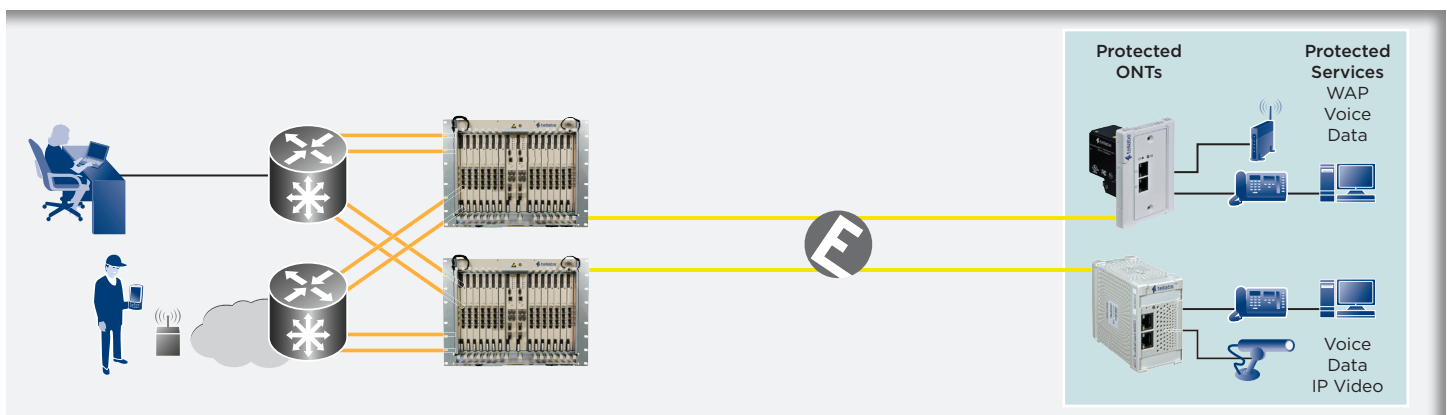

Figure 11: The highly reliable ONT is a simple, unmanaged, secure and ultralow maintenance network device.

How does Tellabs test high availability?

Optical LAN system availability is typically determined with prediction calculations and actual field performance. Tellabs Optical LAN system reliability is determined using two methods:

- Field Reported Data
- Calculation Method

For field reported data, Tellabs tracks this information through our Customer Service group. It includes customer and monitored reported system downtime. The customer's system performance is tracked and reported annually. For the calculation method, Tellabs follows the process defined by the industry-standard Telcordia SR-332 Issue 2 standard. Failures In Time (FIT) rates are calculated for each assembly and are used to determine steady state failure scenarios. Tellabs also uses calculations performed using Telcordia Automated Reliability Prediction Procedure (ARPP) software. There is also a system-level analysis conducted using Telcordia Interactive Markov Analysis Program (IMAP) software to determine availability results. The final results are provided in Mean Time Between Failures (MTBF), Failures In Time (FIT) and Failures Per Billion Hours (FPBH).

Summary

High-performance LANs deliver real-time and critical services that demand high availability, stability, uptime and security. Tellabs Optical LAN is the optimal choice for enterprises because it provides superior reliability with centralized intelligence and PON management, dual homing core router support, equipment redundancy options at the OLT, optical plant redundancy with 2:x passive optical splitters and highly reliable ONTs. Optical LANs can reduce the LAN downtime impact on employees and businesses, eliminating lost employee productivity, lost connectivity to corporate resources and lost connectivity to data centers.

Take the next step. Contact Tellabs today.

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