Remote Fiber Testing and Monitoring (RFTM)

Testing

EXFO

New opportunities, new challenges in building out and turning up fiber networks

To deliver the bandwidth required to meet the network densification and backhaul requirements of 5G mobile networks, the ongoing need for digital transformation of network infrastructure and to effectively respond to lasting changes in consumer behavior (i.e., remote working, remote learning, video streaming) in the wake of the pandemic of 2020-2021, communication service providers are deploying fiber networks (FTTx, PONx) on a massive scale.

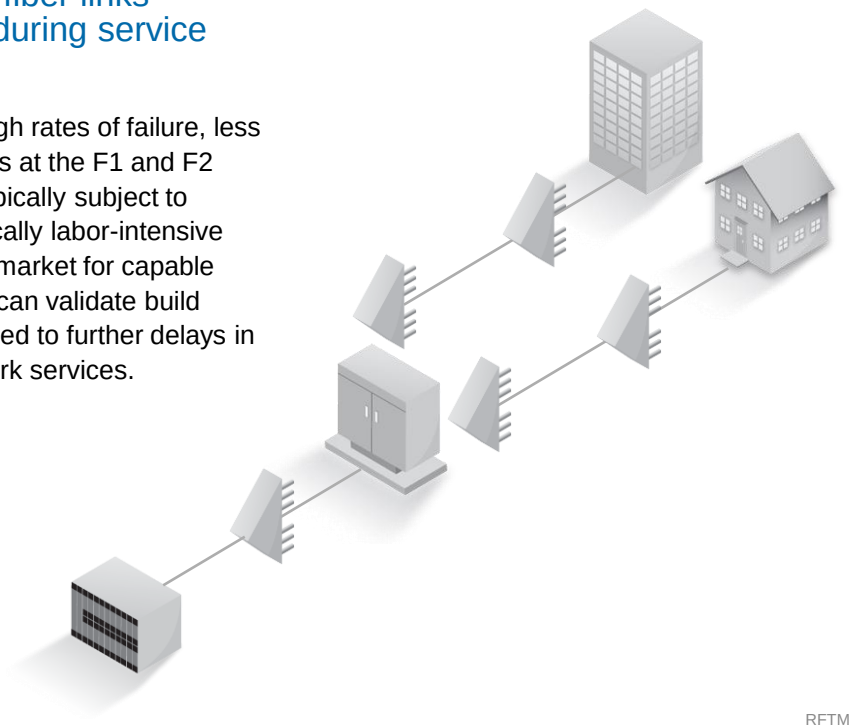
Delayed by the pandemic, many service providers are racing to catch up with previously announced projects for nation-wide fiber deployments, buoyed by new demands from all levels of government for super-fast network access for all.

The challenge for many service providers is maintaining the pace of network buildouts and turn-ups at scale. This is particularly difficult when laying fiber is already fraught with difficulties, with the percentage of initial fiber failures often measured in double digits.

10%-30% of fiber links typically fail during service activation

Despite these high rates of failure, less than 1/8th of links at the F1 and F2 segments are typically subject to testing, a historically labor-intensive process. A tight market for capable technicians that can validate build quality has also led to further delays in turning up network services.

These defective links require expensive truck rolls, re-work and additional testing, increasing OPEX costs, delaying the monetization of new infrastructure and ultimately impacting profitability and the ability to fund new network investment.



Building quality into fiber network deployments

Test early, test often to accelerate build-out and turn-up

There's another way to construct fiber networks that accelerates build-out, provides reliability at all stages of deployment, reduces the need for truck rolls and re-work and delivers paying customers sooner. It's an approach that enables service providers and their contractors to get it right the first time, a proven approach to improving the bottom line, and it reduces the need for highly qualified personnel.

This approach to deploying a fiber network involves testing 100% of the links at each segment, reducing defective links by an order of magnitude as well as virtually eliminating unnecessary movement of assets and personnel.

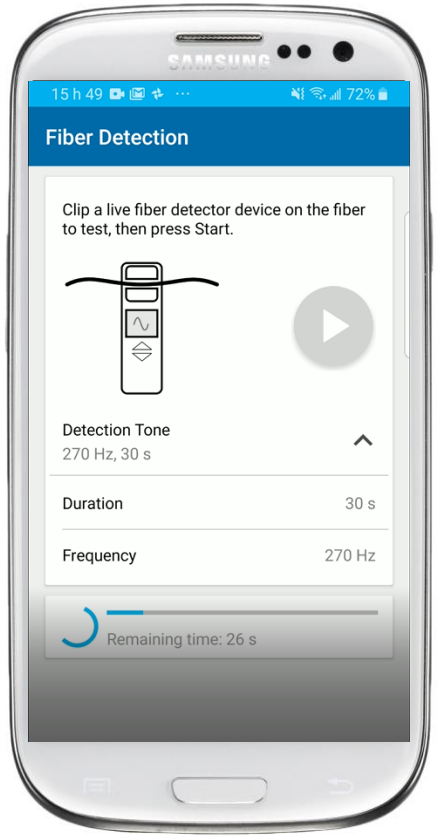
By integrating testing during build-outs, service providers build quality into the build process and the end results, delivering reliability up and down the line, from contractor to customer.

Through a combination of automated and on-demand testing, leveraging low-cost optical hardware, smartphones and mobile applications, service providers can test all their fiber links while delivering network build-outs faster than before.

More effective testing results in faster network build-outs

Thanks to such testing, service providers can compress build time, eliminate unnecessary re-work, turn up network service earlier and get paying customers sooner.

Extensive testing at all steps in the network path offers peace of mind, enabling service providers to audit the work of their contractors as work progresses. A centralized dashboard for test results provides a one-stop view of contractor progress, link status and work to come.



Remote Fiber Testing and Monitoring (RFTM)

RFTM is the remote fiber testing system that enables testing at all phases of network deployment. It provides end-to-end link testing and diagnostics for any type of fiber network, including mobile backhaul and passive optical networks in a FTTx context, whether P2P or P2MP.

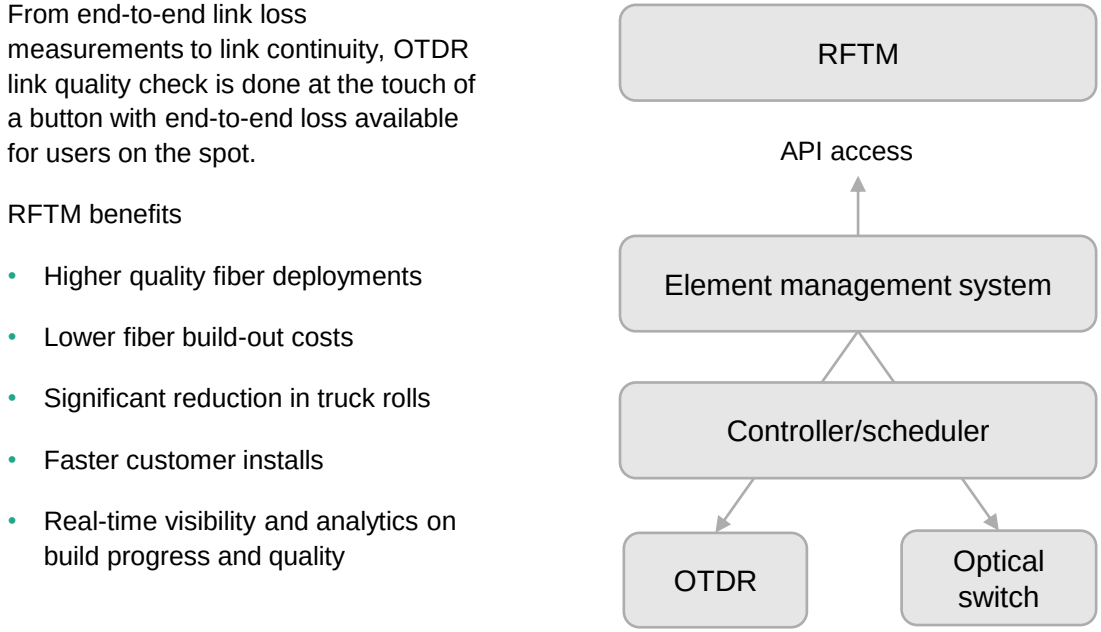
Automated tests are orchestrated at scale via a cloud-native application server. These tests are executed via the remote test units (for P2P and PON) that leverage EXFO's state of the art OTDR technology and its innovative, proprietary iOLM™ algorithms.

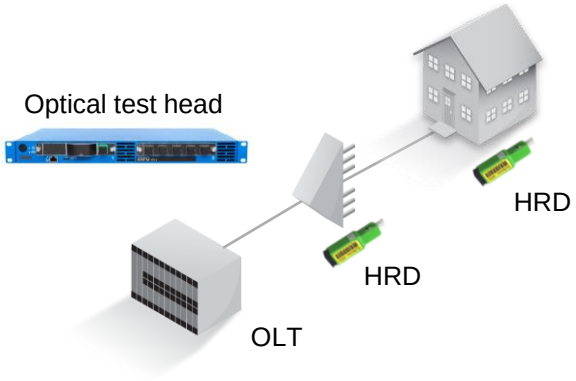
No complex field test equipment is required for manual testing with RFTM. Instead, field technicians use the mobile application running on a smart phone paired with a high reflectance demarcation (HRD) filter device to remotely trigger OTDR tests.

From end-to-end link loss measurements to link continuity, OTDR link quality check is done at the touch of a button with end-to-end loss available for users on the spot.

RFTM benefits

- Higher quality fiber deployments
- Lower fiber build-out costs
- Significant reduction in truck rolls
- Faster customer installs
- Real-time visibility and analytics on build progress and quality





RFTM: going beyond testing to monitoring and troubleshooting fiber networks

In addition to end-to-end link testing and diagnostics, RFTM provides proactive monitoring and extensive support for troubleshooting P2P and P2MP fiber connections.

The same software platform that provides a centralized repository of test results also maintains records of baseline performance for each fiber.

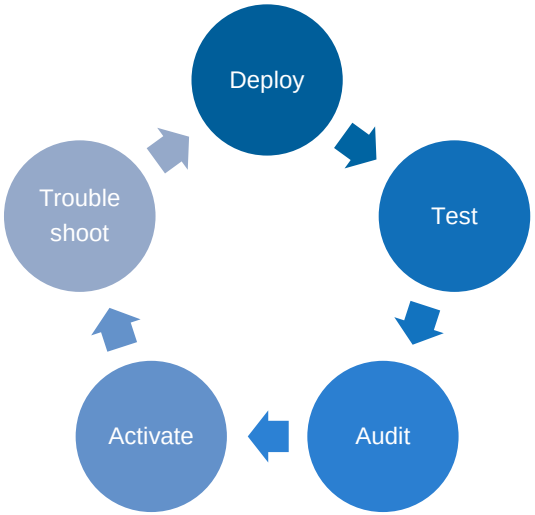
When test results diverge from the baseline by a set amount, RFTM calculates the signal loss and the distance of the impairment. This information is correlated with geolocation data to pinpoint the fault. RFTM leverages information about slack loops, splices, poles, and floor plates to provide full field accuracy.

By monitoring a single fiber per cable, RFTM can detect up to 100% of cable outage events, such as a full cable cut.

Detection of partial cuts can also be improved by RFTM monitoring as little as one fiber per cable. Real-world experience with RFTM and partial cable cuts has shown 80% sudden fault detection probability with one location fiber per cable and 95% coverage with one location fiber per bundle.

RFTM helps operators deploy, audit, activate and troubleshoot fiber optic links remotely across the network lifecycle

RFTM is based on micro-services and features well-documented APIs for integration with other OSS/BSS applications as well as with other EXFO solutions such as SensAI.



Case study:
Tier 1 network deploys fiber on a national scale

As part of its industry-leading Fibre First programme for the UK, Openreach has committed to delivering 25 million homes passed with fiber to the premises by the mid-to-late 2020s.

After 5 years of work, Openreach had deployed 4.5 million homes passed. It wanted to complete the next 20 million homes passed in the same period of time, a monumental task.

Key to the financial success of this initiative is delivering live service and generating revenue at the same time as deployment ramps up. This requires flawless execution, with extremely low defect rates, to ensure that customer activations go right the first time.

To achieve its aggressive goals, Openreach turned to thousands of contractors to build out and turn up the network. However, in moving to a contractor model, Openreach lost visibility of progress in deploying the network and had to rely on others for quality control.

Possessing varying levels of technical expertise, contracting technicians required a solution that was simple and straightforward to use. RFTM's smartphone-based application for on-demand fiber testing fit the bill.

Defect rates are expected to fall from low double digits to low single digits

Thanks to proactive testing with RFTM, Openreach expects to achieve defect levels of less than 1% and reduce the need for costly truck rolls as it meets its target of 75,000 homes passed per week.

Openreach intends to use RFTM for its ongoing fiber monitoring needs as well. RFTM's centralized reporting capability will let Openreach view build-out progress in real time.

As a result of adopting RFTM, Openreach can more confidently deliver "right first time" fiber installations, measure its progress in real-time and make projections about future results.

openreach

This year, our build has been gathering pace and momentum, and we're determined to match that rapid speed of deployment with the highest standards of build quality and customer service.

EXFO will help us get there.

As a long-term Openreach partner, EXFO was selected thanks to its proven ability to provide fast, automated qualification of fibre builds, and for its unique iOLM™ OTDR technology.

Peter Bell,
Director, Network Technology
Openreach

Monitoring

Customer satisfaction and network monetization depend on fiber reliability

As they work to deliver the network densification and backhaul requirements of 5G wireless networks (100x more metro fiber[1]) and build out consumer fiber networks (FTTH) on a national scale, service providers are confronted with the challenges that come from simply having more fiber deployed.

With more fiber in the ground and in the air come more opportunities—small animals, construction, storms—for fiber cuts that disrupt network operations, customer satisfaction and ultimately, profitability.

Large service providers experience several costly fiber cuts per day

Performance impairments due to aging fiber, running multiple services over the same fiber and µ-bends resulting from maintenance can also impact fiber reliability over time.

As fiber-driven ARPU has climbed, the cost of fiber cuts has risen too

When consumer fiber networks go down, the triple play bundle of fast internet access, IP telephony and IP TV that drives higher customer ARPU goes down as well. With residential fiber networks used for 4G and 5G backhaul, even mobility services can go down.

Reliability and low latency are at the heart of the 5G wireless promise, covered by enterprise service-level agreements that pay out when services go down. Fiber cuts to critical mobile backhaul infrastructure damage both services and profitability.

Unfortunately, diagnosing the nature, scope and location of even a single fiber cut is challenging. Physically isolating an impairment is expensive, requiring multiple truck rolls to test the network at different points.

The root causes of fiber cuts

Small animals
Squirrels, rodents, beavers

Construction
Building, excavation

Mother nature
Storms, floods

Accidents
Vehicles hitting poles

1. Optical Networks Daily, June 16, 2019, “Corning: network densification = glassification”

Building intelligence into today’s fiber networks

From reactive to proactive troubleshooting and resolution

While it may not be feasible to eliminate fiber cuts altogether, it is possible to design and equip fiber networks with the technology and intelligence required to rapidly pinpoint and repair fiber cuts, restoring service outages quickly and reducing the impact on profits. Unfortunately, less than 5% of fiber networks are monitored today[1].

These remote fiber testing and monitoring systems significantly reduce the OPEX related to troubleshooting and resolving fiber network impairments, while enabling network connectivity and services to be re-established much faster than was previously possible.

A remote fiber testing and monitoring systems provides:

- Living record of fiber network performance over time
- Regular testing of fiber networks to monitor link integrity and function
- Alerts when performance falls outside of thresholds

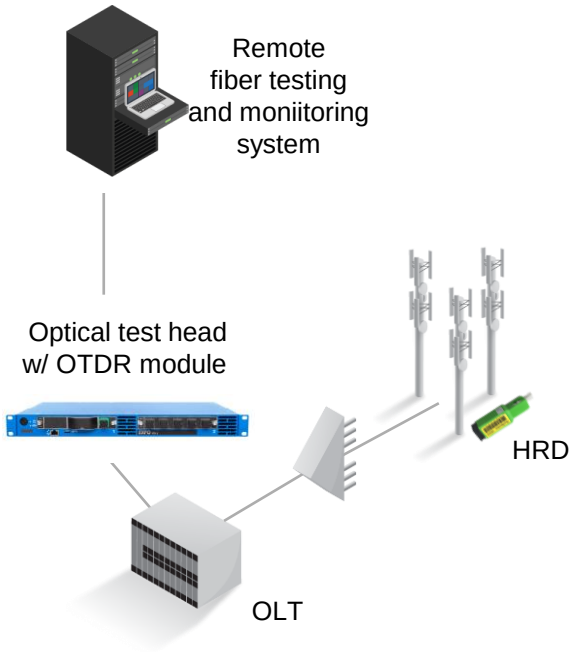
Monitoring a single fiber per bundle can capture 80% or more of sudden fiber events

A remote fiber testing and monitoring system enhances the work of field technicians as well, leveraging OTDRs or low-cost high reflectance demarcation (HRD) devices, smartphones and mobile applications to isolate the fault. Reports from the field are centralized and stored for diagnostics and troubleshooting.

When integrated with a geographical information system (GIS), a remote fiber testing and monitoring system enables location of a fiber fault to within meters, whether along a busy thoroughfare or in a multi-story building.

Accuracy in isolating fiber impairments ultimately reduces the number of truck rolls required to restore fiber service.

Remote fiber testing and monitoring system



1. Frost & Sullivan report on remote fiber testing systems, 2020.

RFTM: remote fiber monitoring and troubleshooting solution

EXFO's RFTM solution provides test, monitoring and diagnostic capabilities across the entire build, install, operate and maintain phases of the fiber network lifecycle. It supports both P2P and P2MP architectures delivering complete end-to-end visibility for dark, dim and lit fibers.

The same software platform that provides a centralized repository of test results during network build-out also maintains records of baseline performance for each fiber. It supplements those records over time with regular testing of fiber connections to establish and update a performance baseline. Deviations from this base line, often due to fiber aging, are automatically flagged for investigation and maintenance.

Signal loss and the distance of each fiber impairment are correlated with geolocation data to physically pinpoint a fault, reducing unnecessary truck rolls.

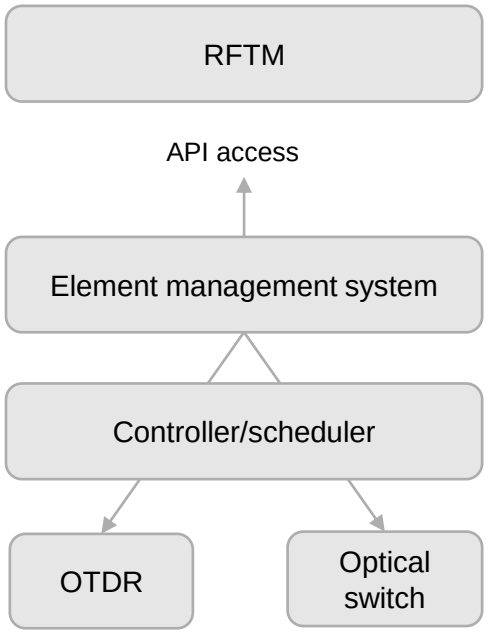
RFTM can even leverage information about slack loops, splices, poles, and floor plates to provide full field accuracy.

Key features

- Single test baselining and on-demand testing for fault analysis
- Automated threshold setting
- Multi-pulse approach (iOLM™) enables automation
- Cloud-native architecture, smallest footprint
- APIs for integration with 3rd party GIS, inventory management and fault management systems
- Compact form factor (high density)

Benefits

- Automated, simplified troubleshooting
- Significant reduction in truck rolls due to geolocation of faults
- Faster customer installations



RFTM is based on micro-services and features well-documented APIs for integration with OSS/BSS applications as well as with other EXFO solutions such as SensAI.

Case study: Wholesale provider monitors fiber on a national scale

Founded in 2009, NBN was established to design, build and operate Australia's national broadband network, bringing high speed Internet access to every corner of the continent-sized country. A dozen years later, NBN's national fiber footprint is 280,000 km (175,000 miles)—the equivalent of 7 times around the Earth. The national fiber backbone, NBN Transit™, is itself over 70,000 km long.

The sheer vastness of Australia poses several challenges to the operation and maintenance of a nation-wide fiber optic network. Locating a fiber fault could take anywhere from 1 day in metro areas to 4 days in the case of the most remote locations. NBN wanted to do better, ultimately turning to EXFO and its remote fiber testing and monitoring solution.

In conjunction with the OTDR-based Fiber Guardian 750 remote test units installed at more than 500 locations around Australia, RFTM enables NBN to monitor more than 80 per cent of the DWDM-based Transit network via the network operations centre.

RFTM monitors 24/7, enabling NBN to track network health in real-time

RFTM is operated remotely via a web-based user interface that regularly triggers OTDR tests and is centrally managed by an element management system.

As a result of adopting RFTM, NBN can identify and isolate faults faster, avoid costly truck rolls, particularly to remote locations, and deliver higher network availability, contributing to increased end-user satisfaction.

nbn™

“With the EXFO Fiber Guardian hardware and RFTM, we can quickly see if a fibre degradation is due to connections within an exchange, or in third-party connecting fibres, making demarcation of responsibility simpler while building trust with our third-party providers that we are only raising genuine faults to them.”

Dan Beaman, Technical Specialist, Operations Support,
NBN Co

Glossary

CSP	communications service providers
FTMS	fiber test management system
FTTx	fiber to the premise
FTTP	fiber to the premise
HRD	high reflectance demarcation
iOLM™	intelligent optical link mapper
OTDR	optical time domain reflectometer
P2MP	point to multi-point
P2P	point to point
PNF	physical network function
QoE	quality of experience
QoS	quality of service
SLA	service level agreement
SP	service provider

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