RTU-4000 Remote Test Unit
RTU-4100/4113 Optical Modules

Remote Fiber Test System (RFTS)

The RTU-4000 platform equipped with RTU-4100/4113 optical test module is a rackmount OTDR designed to monitor both dark or in-service optical fiber infrastructures to reduce Mean Time to Repair (MTTR).

Key Platform Features

RTU-4000 Hardware

- Rackmount 19, 21 or 23-inch options; 1U or 2U chassis
- Field serviceable modular design
  - CPU/Dual power supply option with dual cooling fans
  - RTU-4100/4113 optical test module
- Local alarm relay contacts on rear panel
- Optional microSD card up to 256 Gbyte for data storage
- Connectivity via 10/100/1000 Base-T Management interface
- Supports dual input AC/DC or -48V DC powering options
- Compatible with OXA-4000 and OXC-4000 optical switch
  - OXA-4000 switch powered and controlled via serial cable
    -- Factory configurable from 8 to 128 ports
    -- With or without FWDM filtering

RTU-4000 Software

- Web browser access for standalone operation and monitoring
  - User restricted Login mode
- Mobile view for database population during construction
- Email alarm notification
- Supports VeSion® centralized server integration
- Software programming and application support
- IPv4/IPv6 support
  - HTTP+JSON API (language and framework)
  - HTTP API operation using embedded HTTP server

Key Optical Performance

RTU-4100/4113 Optical Test Module

- CWDM, DWDM or L-band OTDR monitoring and on-demand testing
  - CWDM 8/10/18 per ITU-T G.694.2
  - DWDM tunable C-band 1527.99 to 1563.86 nm; 50/100/200 GHz steps per ITU-T G.694.1
  - L-band testing using 1625 nm or 1
  - In-service testing using filter
- Dynamic range from 39 dB to 50 dB (module dependent)
- Event dead zone <1 m, Attenuation dead zone <4 m
- Resolution from 3 cm up to 64 m
- Distance Range up to 400 km
- Telcordia® SR-4731.sor trace format
- OTDR test ports fitted with fixed or universal connector
- Built-in G.657A2 launch fiber
- Monitor for breaks or proactive monitor network fibers in real-time, 24/7 with 1625 nm out of band

Hardware Architecture

Remote Fiber Monitoring and On-Demand Testing

The Remote Test Unit (RTU) is a self-contained, scalable 1U or 2U rack mount solution. A state-of-the art modular design, ensures the RTU can be easily re-configured, upgraded or serviced in the field.

Connectivity and Powering Capabilities

Front Panel - The CPU/power supply module is equipped with RJ-45, USB-A, and RS-232.

- RJ45 network port is used for LAN/WAN communication between the RTU and the Server and/or Optical Switch. If communication between VeSion RTU server and RTU probe is disrupted for any reason, the RTU will continue to function in “offline” mode saving measurement results to the internal SD card until communication with server is restored at which time, the results will be uploaded to the server.
- RS-232 Console port supports local low level control of the RTU via special null-modem cable connected to a PC. The Probe Configuration Tool software can be used to configure the RTU-4000 platform, change IP address and upgrade software.

Rear Panel – Grounding, cooling fans, switch control port, alarm connector and power inputs are located on the rear panel.

- Grounding screw provides connection to an isolated DC return.
- Dual, cooling fans maximize heat extraction. Thumb screws allow the fans to be removed easily for servicing
- Alarm connector provides “dry contact” relay connection for local monitoring of power outage.
- Dual, +15 Volt DC power inputs via AC/DC adaptors provided for redundancy
- Dual, -48 Volt DC inputs for telecom/wireless networks operating from a -48 Volt DC power source.
- DB-25 style control port is used to power and communicate between RTU and OXA-4000 Optical Switch.

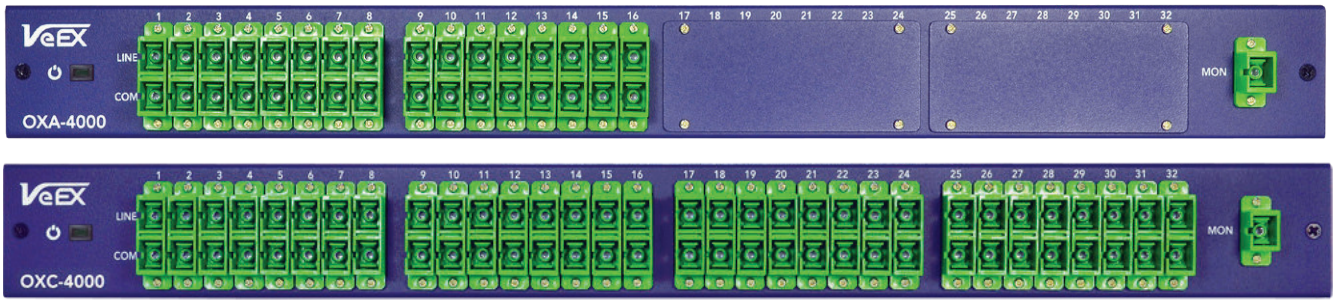
Optical Switches

Optical switches allow repeatable connection between the RTU-4100/4113 optical test module and the fiber under test. Optical switches are typically used to monitor multiple dark fibers or used in conjunction with external FWDM passive component devices or test matrixes for in-service fiber monitoring. The RFTS can be configured with one or more optical switches: OXA-4000 and OXC-4000. Refer to the specific optical switch to learn more about features for each available model and port counts that can be supported.

OXA-4000 or OXC-4000 Optical Switches

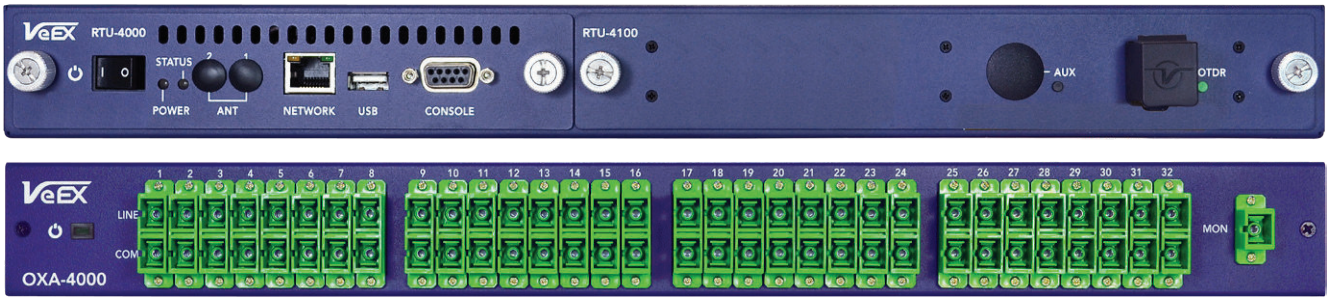
OXA-4000 or OXC-4000 with Built-in FWDM series

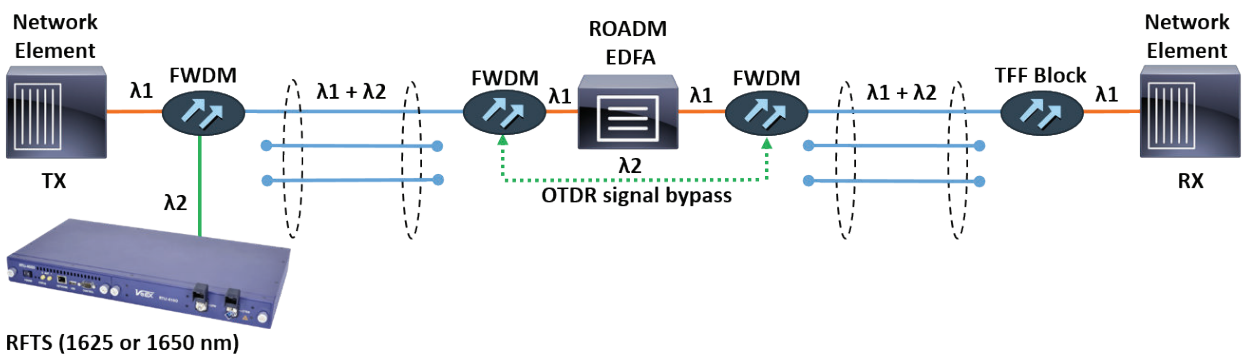
VeEX offers the industry's first optical switch with integrated FWDM to test fibers that are in-service or carrying live traffic. By combining the switch and FWDM in a single unit, external optical patch cords can be eliminated thereby reducing cost and installation time. Fewer external optical connections reduces reflections and patch cords reducing potential failure and cabling mistakes. The out-of-band OTDR test signal (1625 or 1650 nm) is combined with the live traffic signal using a Filter Wavelength Division Multiplexer (FWDM). Since the optical switch and FWDM offer low insertion loss and a flat passband, both OTDR and live traffic signals traverse with little power penalty. Bypass versions of FWDM are available when the OTDR range covers more than one fiber span or when active devices such as Erbium-Doped Fiber Amplifier (EDFA) or Reconfigurable Optical Add-Drop Multiplexer (ROADM) are present on the fiber span.



RTU-4000 & OXA-4000

When used together, both RTU-4000 and OXA-4000/OXC-4000 will only need 2-3U of rack space depending on the bands that need to be monitored. This form factor offers customers the highest density, RFTS in-service monitoring system available since competitive solutions can require up to 5U space for the same configuration.





Software Support

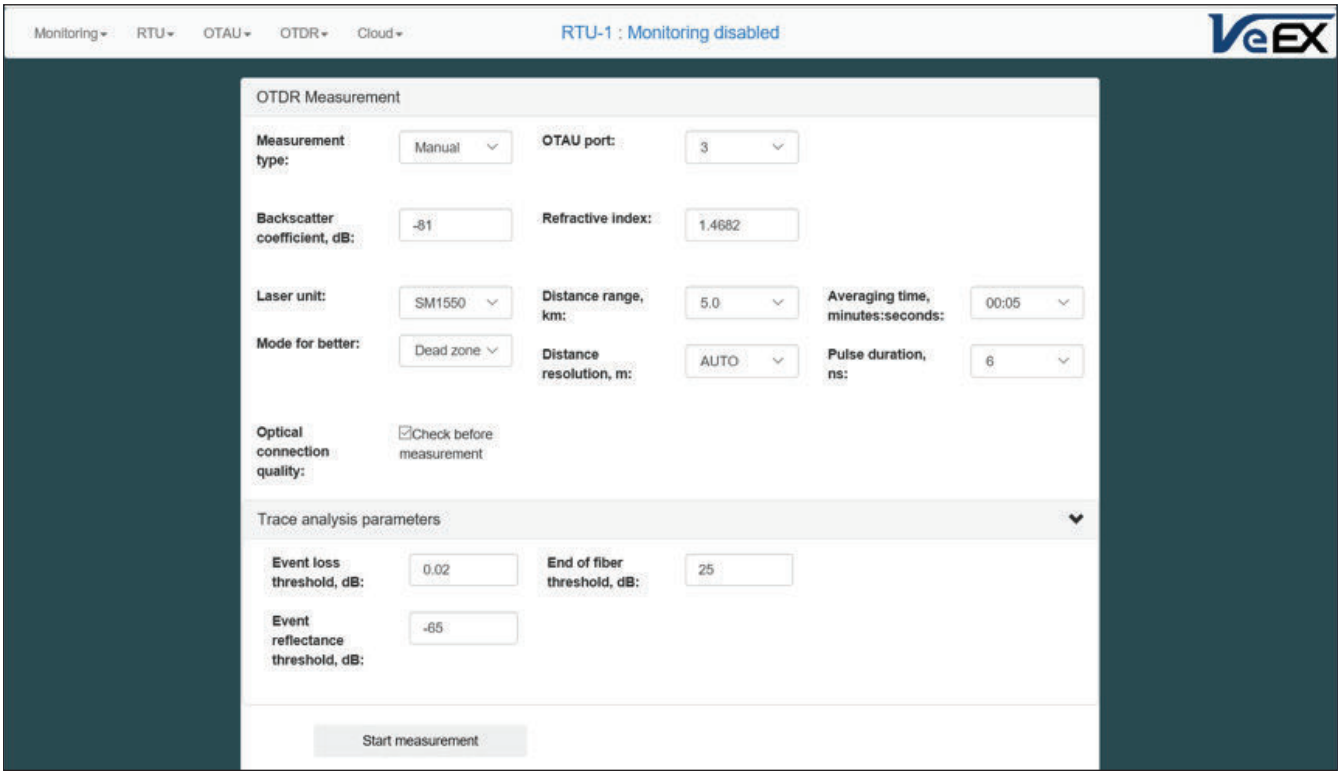
Overview

The RTU runs an embedded Linux Operating System which is highly stable and perfectly suited for 24/7 monitoring and on demand testing. The Remote Test Unit (RTU) can be operated in Standalone, VeSion, or custom applications.

Standalone Operation

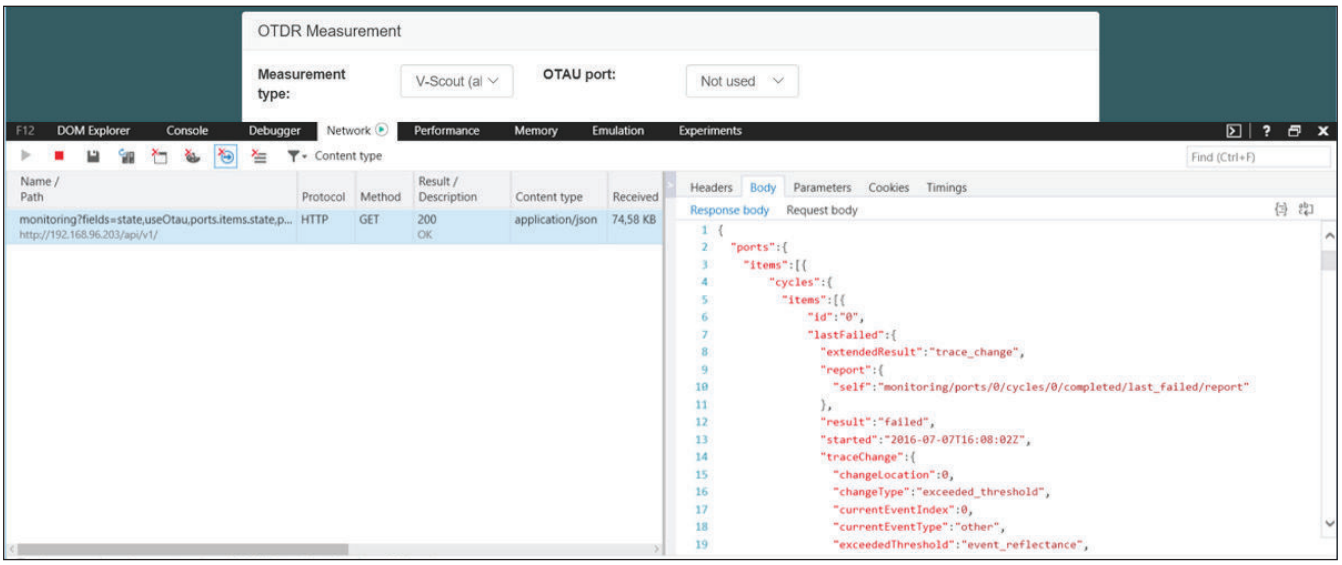
Web Access (HTTP)

The RTU-4000 platform comes with pre-installed software and built-in web server offering simple Out-the-Box, Plug-and-Play operation. Using a LAN/WAN connection and a PC web browser for access, Novice or Expert users can start to test almost immediately. The user simply points the browser to the RTU's IP address to configure, test and monitor a fiber. No RFTS client-server application is required. For standalone fiber monitoring, the RTU-4000 can be setup to interface with an Optical switch to monitor many fibers and alarms details will be emailed.



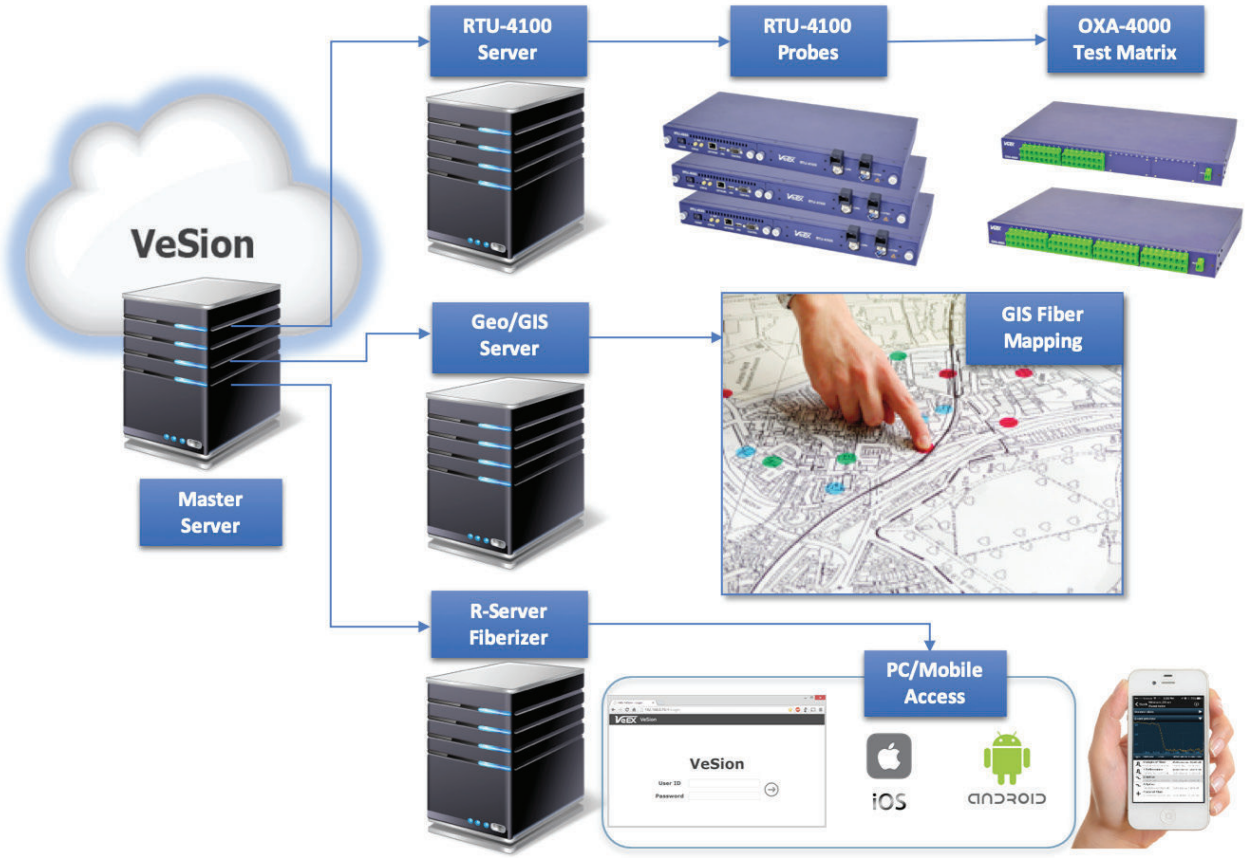
Application Programming Interface (HTTP API)

For custom monitoring applications, Users can configure, control and obtain measurements from the RTU using any programming language that supports sending HTTP requests and receiving HTTP responses. Since the API is already used by the RTU's Web User Interface, it is available simply by pointing the browser to the RTU's IP address. This functionality and flexibility is appreciated by developers who want to integrate the RTU into a 3rd party solution or eco-system using the on-board HTTP+JSON API.



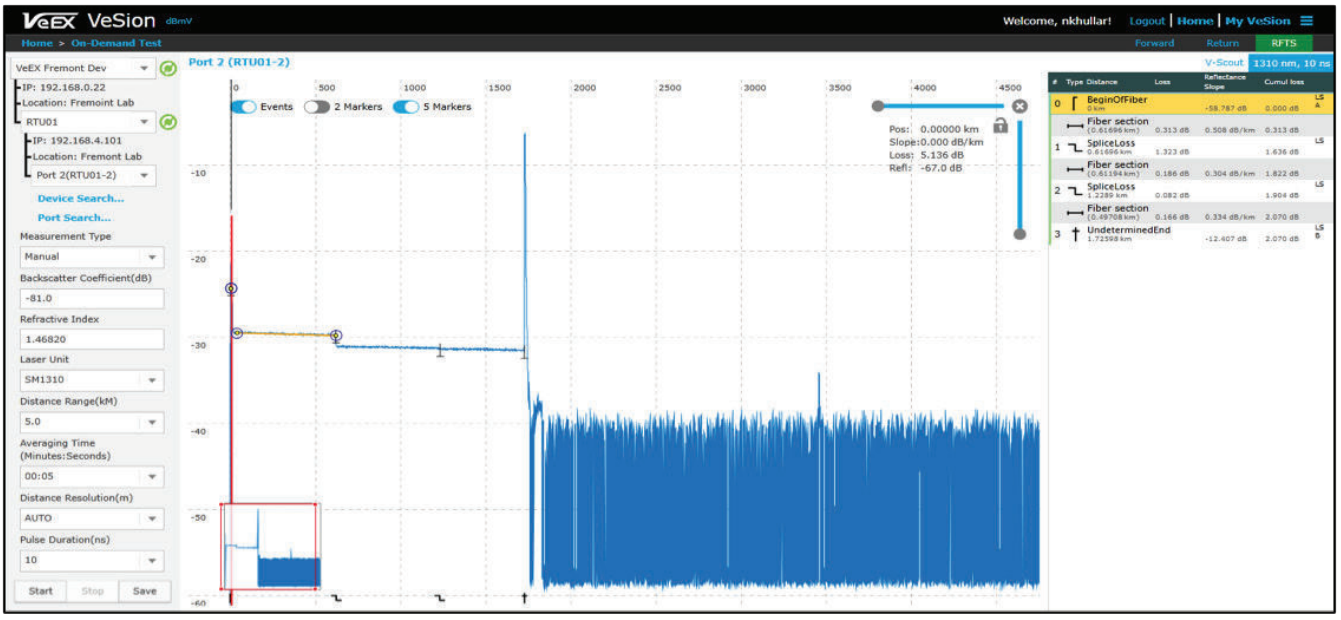
VeSion Server Operation

Depending on network complexity, organizations may prefer to deploy RTUs at strategic points throughout their optical network and have a central server store and manage system information. VeEX's VeSion server architecture is specifically designed for such applications – The Master server continuously polls measurements from the RTUs and compares live test data with baseline traces according to fiber records. Measurement deviations are flagged immediately, triggering powerful alarm management functions and alerts. Precise distance to fault information based on fiber plant documentation (mapping) is available to field engineers for troubleshooting and restoration purposes. VeSion improves network troubleshooting, streamlines workflow and reduces resolution time significantly.



Scalability and Connectivity

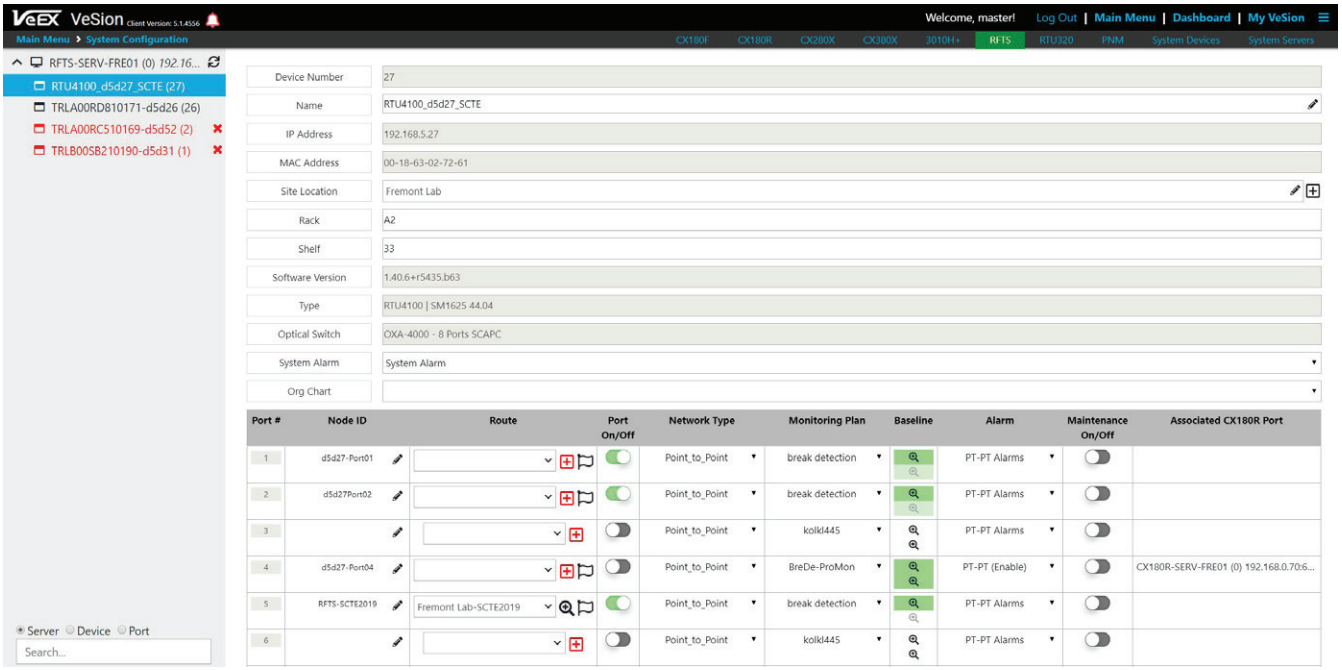
VeSion scales easily reducing initial startup cost and ongoing ownership. The system can start out with a few RTUs to monitor critical links and be expanded later to monitor an entire network. The system is accessible anytime, anywhere, using a common web browser on a PC or mobile device operating iOS or Android. Users can review uploaded test results, system alarms, live traces, and perform on demand tests as required.



Comprehensive Monitoring Modes

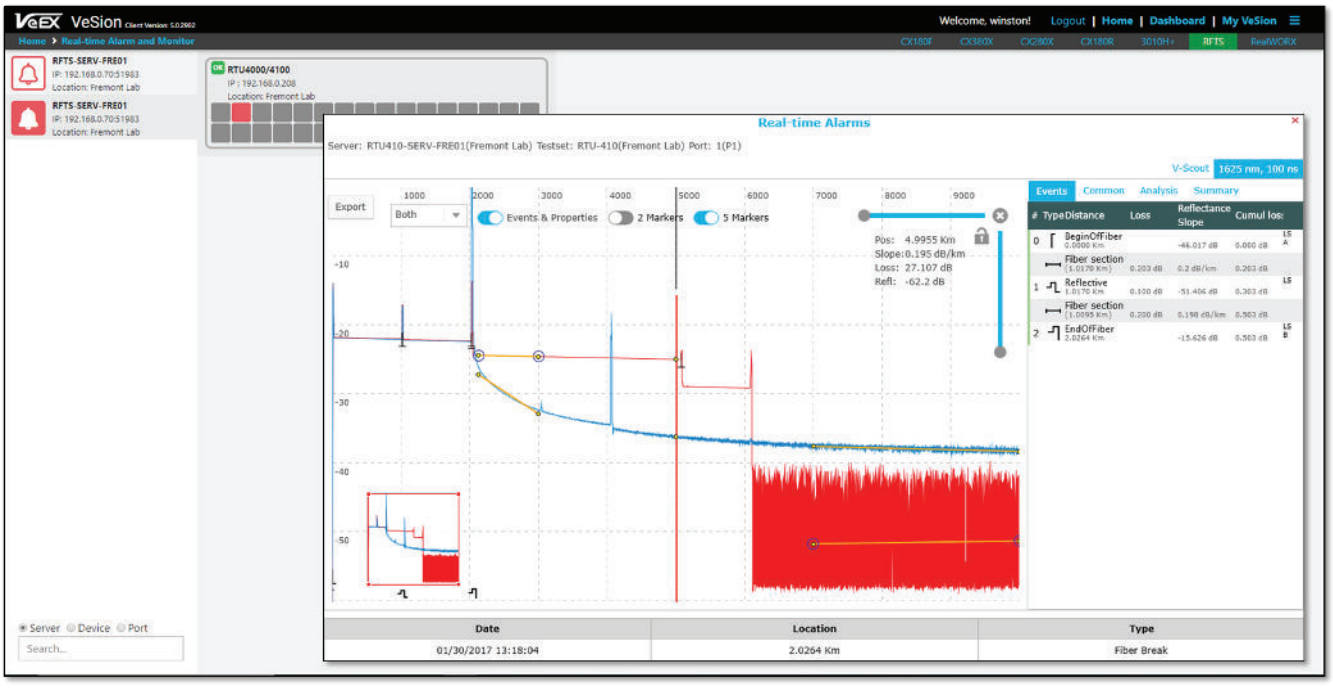
VeSion collects and saves reference trace for each fiber connected to the system. The RTU uses this baseline data to identify critical failures as it routinely cycles through fibers. User defined thresholds identify minor and major deviations from initial test conditions. The types of test modes that can be scheduled and performed include:

- 24/7 monitoring: Continuous test cycles to detect breaks or any other critical deviations. Short-Message Service (SMS) or email is used to notify remote users as to the type of fault and exact location.
- Scheduled testing: Tests predefined at specific times and intervals. Each port can be assigned with up to 2 separate test cycles depending upon SLA requirements.
- On-Demand testing: Tests can be initiated manually via the web UI, or automatically triggered by alarms from companion probes in the VeSion system e.g. RF UCD loss event. Upon completion or termination of the On-Demand test, the system resumes regular monitoring.



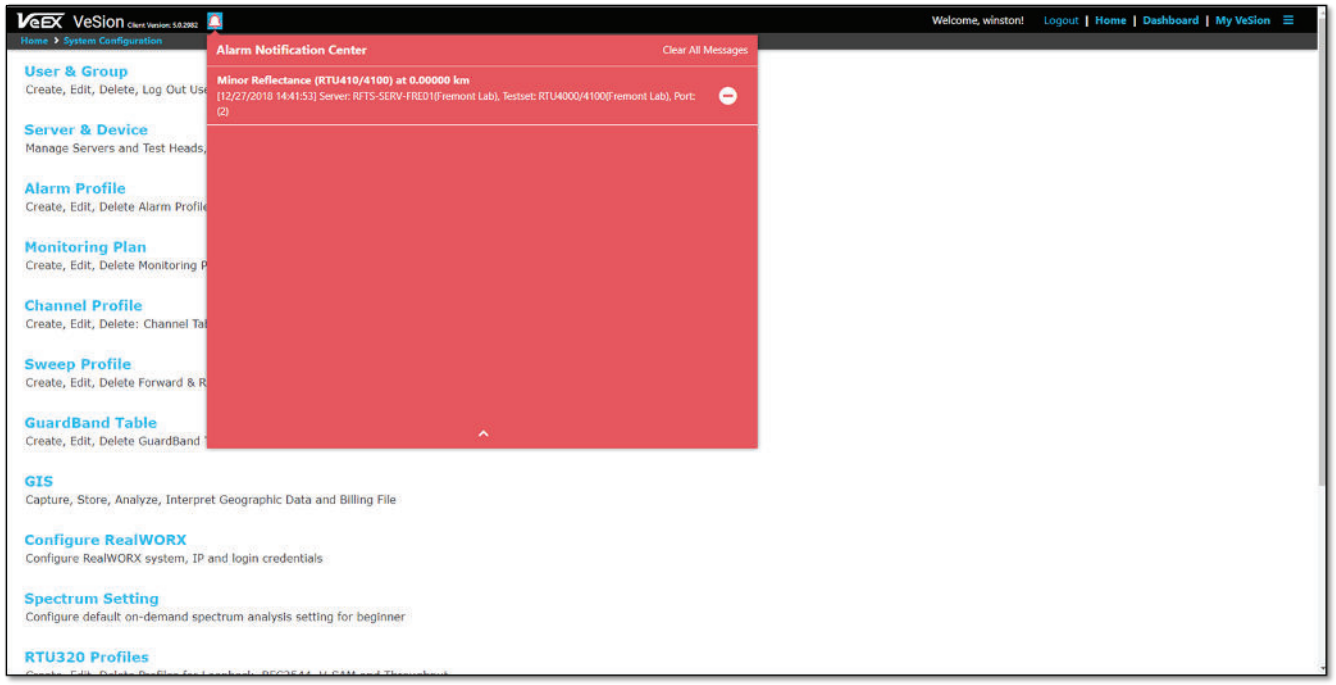
Intuitive Alarm Indication

When a fiber fault is detected, the event is date and time stamped and the exact location (metric or imperial) is displayed in both trace and table format. This information can be integrated with existing trouble-ticket or mapping systems.



Fault Localization & Notification

VeSion provides detailed information about the RTU and port where the fiber failure occurred. Multiple dashboards simplify fault location and diagnostics. Alarm notifications can be sent by e-mail, SMS or via SNMP traps for escalation and follow up. RTUs can be segmented by geography or user defined groups, so technicians only see and respond to alarms that apply to them.

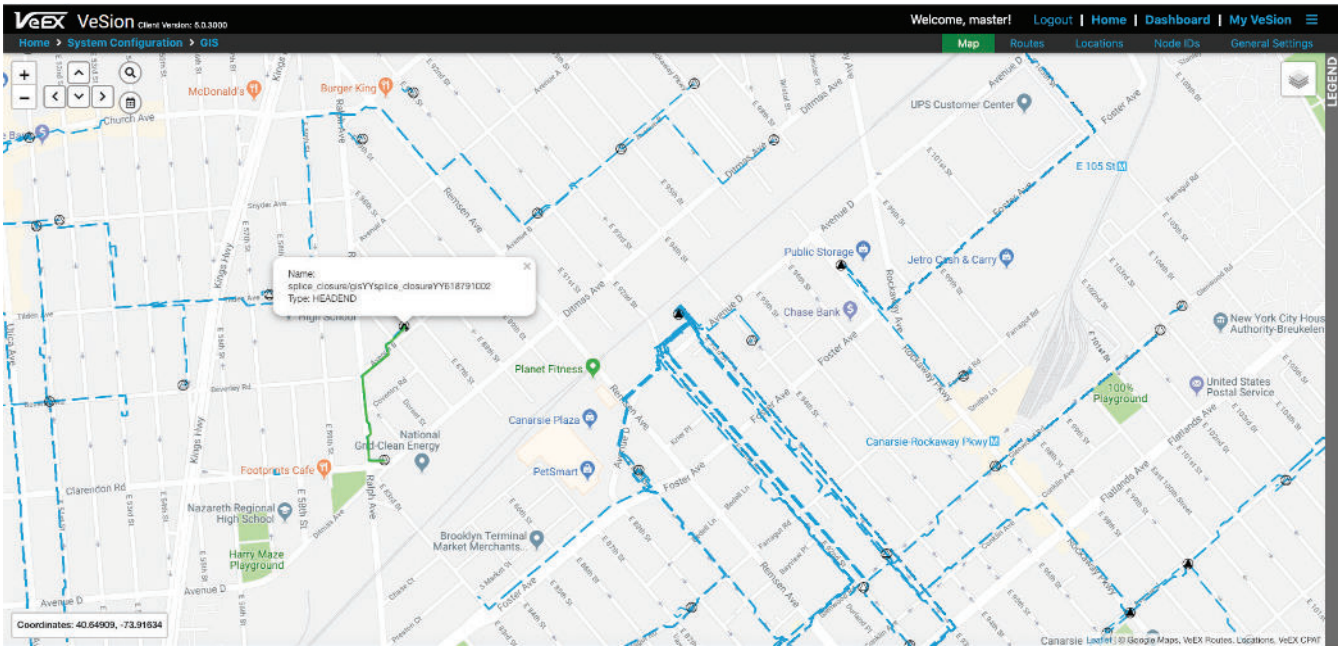


Fiber and Cable Mapping

Geo-Mapping is a valuable software tool to analyze/monitor point-2-point networks or when building new FTTx fiber networks. In either application, GIS fiber planning and mapping provides a powerful geo-based operations platform helping to visualize cable routes, workforce, operational ecosystem, and related resources.

GIS mapping in a remote fiber test monitoring application is typically used to correlate fiber alarms to physical locations so technicians and managers can access a mapping system online using web-enabled smart devices for faster and more effective follow up.

VeSion employs a GeoServer which acts as a gateway to provide bi-directional communication with 3rd party GIS and fiber mapping software. VeSion is a rich collection of HTML5 resources for interfacing with 3rd party software.



RTU-41XX Optical Specifications[1]

Optical Parameters[1]	RTU-4000	RTU-4113 xWDM	
		DWDM	CWDM 8/10/18
Wavelength/Channel	1550, 1625[2], 1650[2]	Tunable Ch17-Ch62 (1528.77-1565)	1271, 1291, 1311, 1331, 1351, 1371, 1391, 1411, 1431, 1451, 1471, 1491, 1511, 1531, 1571, 1591, 1611
Center wavelength uncertainty (nm or GHz)[2]	±20, ±2, ±2 nm	±3 GHz	±3 nm
Optional DWDM Ch tuning range	n/a	Ch14 - Ch62 (1525 - 1566.72)	n/a
Channel Spacing (nm/GHz)	n/a	1.6 (200) to 0.4 (50 GHz)	20 nm
Dynamic Range at 20 µs (dB)[3]	refer to ordering guide	41	39.5
Distance Accuracy (m)[4]	±(0.5 + 0.003% x dist + res)		
Pulsewidth (ns)	3 to 20,000	10 to 20,000	3 to 20,000
Event DZ[5]	<1m refl= -45dBm	<1m refl= -45dBm	0.8 m
Attenuation DZ[6]	3 m	<4 m refl = -55dBm	3 m
PON dead zone (m)[7]	<15	n/a	
Sampling Resolution (m)	0.03 to 64		
Datapoints	up to 500,000		
Group index range	1.2000 to 1.8000 in 0.0001 steps		
Linearity	±0.03 dB/dB		
Loss threshold (dB)	0.0001 to 100.0000 in 0.0001 steps		
Loss Display range	0.1 to 55 dB		
Loss Readout resolution	0.001 dB		
Measurement Time (sec)	Variable or Manual 1 to 300		
Optical interface	APC or UPC		
Optical connector	Fixed or optional universal interface with interchangeable adaptors		

Notes

1. Unless noted, all specifications are valid at 23°C ±2°C (73.4°F ±3.6°F).
2. In-service 1625/1650 nm test port with built-in filter - isolation >30 dB.
   - For 1625 nm OTDR test signal, the FWDM pass/reject band is 1610-1680 nm and 1260-1590 nm.
   - For 1650 nm OTDR test signal, the FWDM pass/reject band is 1640-1680 nm and 1260-1620 nm.
3. Typical dynamic range with longest pulse and three-minute averaging is the difference between extrapolated backscatter level at the start of test fiber to SNR = 1.
4. Reflective end; does not include uncertainty due to fiber index.
5. Typical, for reflection -45 dB in singlemode using shortest pulse measured 1.5 dB down from either side of the peak of an unsaturated reflective event.
6. Typical attenuation deadzone <4m; reflectance -55 dB 0.5 dB above linear regression for dynamic range <43 dB; 4.5 m for dynamic range 45 dB or higher (module dependent).
7. Non-reflective Fiber Under Test (FUT), non-reflective splitter, 13 dB loss, 25-nsec pulse, typical value using 39 dB OTDR.

Ordering Information - Optical Test Functions

Model #	Order #	RTU Chassis
RTU-4000	Z06-99-139P	RTU-4000 Remote Test Unit (Dual 15 VDC)
	Z06-99-186P	RTU-4000 Remote Test Unit (Dual -48 VDC and Dual 15 VDC)

			Test Application					
Model #	Order #	RTU Modules	Dark Fiber	Live Fiber (P2P)	FTTx/ PON	CWDM	DWDM	DWDM/ CRAN
RTU-4100[2]	Z22-00-028P	RTU-4100 OTDR 1625 nm (F) 41 dB	●	●				
	Z22-00-030P	RTU-4100 OTDR 1625 nm (F) 50 dB	●	●	●			
	Z22-00-031P	RTU-4100 OTDR 1650 nm (F) 48 dB	●	●	●			
	Z22-00-034P	RTU-4100 OTDR 1550 nm 50 dB	●					
	Z22-00-035P	RTU-4100 OTDR 1650 nm (F) 41 dB	●	●				
	Z22-00-042P	RTU-4100 OTDR 1550 nm 45 dB	●					
	Z22-00-043P	RTU-4100 OTDR 1650 nm (F) 45 dB	●	●	●			
RTU-4113	Z07-22-185P	RTU-4113 18ch-CWDM 1270-1610nm/DWDM OTDR Test Module[1]	●	●	●			●
	Z07-22-186P	RTU-4113 10ch-CWDM 1430-1610nm/DWDM OTDR Test Module[1]	●	●	●			●
	Z07-22-187P	RTU-4113 8ch-CWDM 1470-1610nm/DWDM OTDR Test Module[1]	●	●	●			●
	Z07-22-188P	RTU-4113 18ch-CWDM 1270-1610nm OTDR Test Module[1]	●	●	●	●		
	Z07-22-189P	RTU-4113 10ch-CWDM 1430-1610nm OTDR Test Module[1]	●	●	●	●		
	Z07-22-190P	RTU-4113 8ch-CWDM 1470-1610nm OTDR Test Module[1]	●	●	●	●		
	Z07-22-191P	RTU-4113 DWDM Tunable OTDR Test Module, 50/100/200GHz Tunable CH17 to CH60[2]	●	●	●		●	
	Z07-22-192P	RTU-4113 10ch-CWDM 1270-1450 nm OTDR Test Module[1]	●	●	●	●		

Notes

1. Requires 2U RTU chassis
2. Requires 1U RTU chassis

Additional optical configuration available. Consult factory for more details.

General Specifications

Size	1U: 483 x 300 x 38 mm (w x d x h) 19.00 x 11.81 x 1.49 2U: 483 x 300 x 76 mm (w x d x h) 19.00 x 11.81 x 2.98 in
Weight	>1U: <3 kg (less than 6.6 lbs.) >2U: <7.07 kg (less than 15.6 lbs.)
Power Options (Dual Inputs)	
-AC Adaptor (parallel supply)	Input: 100-240 VAC, 50-60 Hz Output: +15 VDC, 5.33 A
-DC	-48 VDC terminal
Power Consumption	≤20 Watts
Operating Temperature	-10˚C to 50˚C (14˚F to 113˚F)
Storage Temperature	-20˚C to 70˚C (-4˚F to 158˚F)
Humidity	5% to 95% non-condensing
Interfaces	RJ45, 10/100/1000-T Ethernet, RS-232, DB-25, USB
Languages	Multiple languages supported/on demand
System Memory	Optional microSD card, up to 256 Gbyte

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