Product Introduction

Anritsu envision:ensure

Network Master Flex
MT1100A

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- Instrument Views
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- Carrier Class Ethernet Installation and Troubleshooting
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- Mobile Backhaul Installation and Verification
  - Synchronous Ethernet Test
- Mobile Fronthaul Installation and Verification
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- Powerful Storage Area Networking (SAN) Testing
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  - One Button Testing

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- Redefining Transport Testing

Market Situation—Historical

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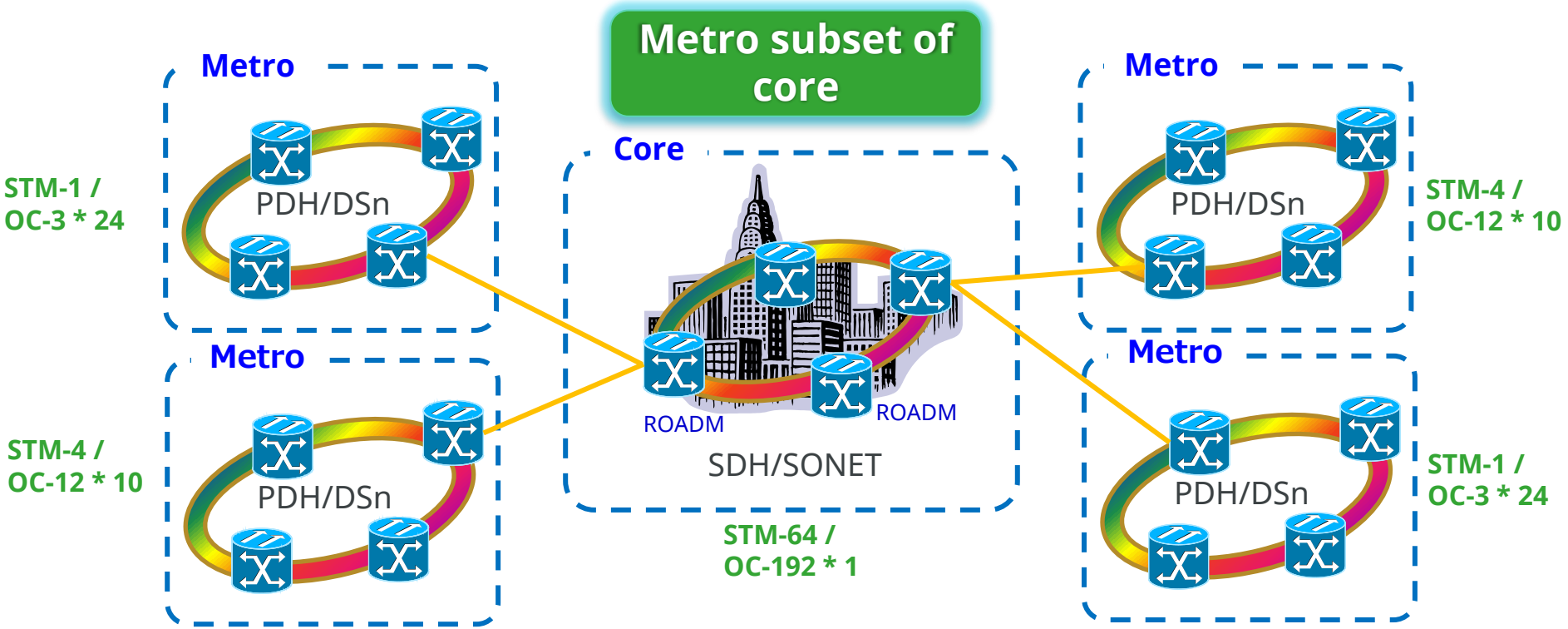
- Core network had multiple metro/access network subsets
  - Much of the network coming to the access network was muxed up to a larger metro network which was muxed up to the core network.
    - Not all traffic was transferred to the core, but a large percentage was.
    - To a large extent, the core was the size of the combined metro networks.



Market Situation—Current and Future

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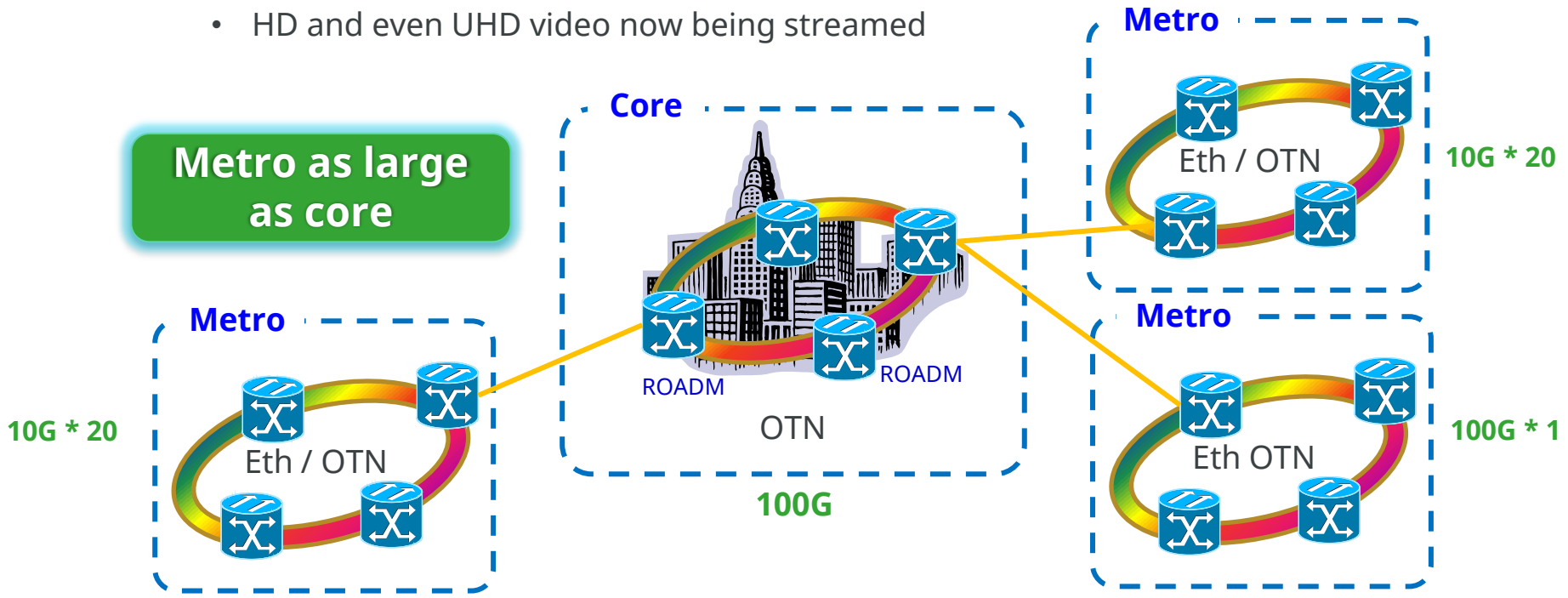
- Metro networks becoming same or larger size than core
  - Many services now require “near” real-time response (simultaneous multiple access to data)
    - Transferring data long distances to server not ideal
  - Many services to many millions of users (apps) now truly global (apps)
    - A single or even two servers (back-up) isn’t good enough to handle data
  - Many services require very large data from millions of users (video)
    - HD and even UHD video now being streamed



Market Segmentation

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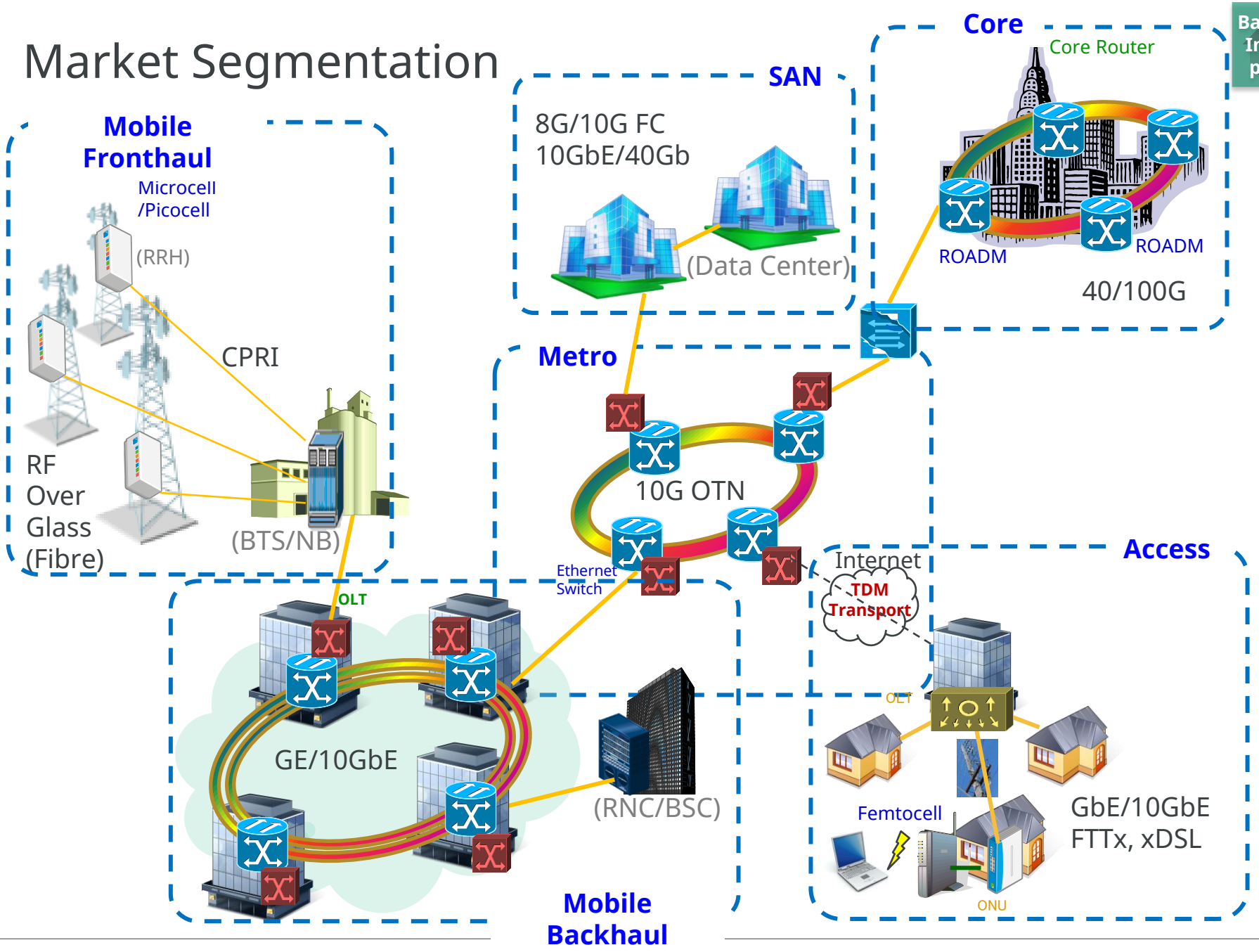

Where to Use MT1100A

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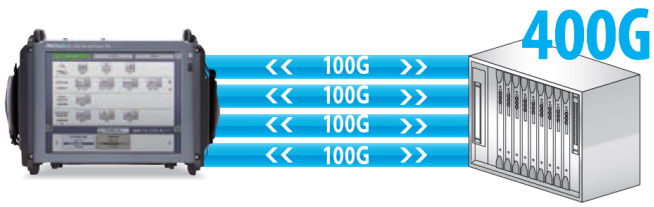
R&D on 400-Gbps Networks

* 4 x 100G client testing with all-in-one tester
* OTN multi-stage mapping and ODU-flex



Manufacturing 100-Gbps Transport Equipment

* CFP, CFP2, CFP4, QSFP28, CXP, QSFP+, SFP+, SFP, CAUI, XLAUI interface
* MDIO control
* VOD, Pre-Emphasis, Rx Equalizer
* Multi-users log-in

Network Commissioning Tests

* 100G core network to CPRI/OBSAI mobile fronthaul
* GPS-synchronized one-way latency test
* OTN-mapped client protocol testing
* Y.1564, RFC 2544, RFC 6349

Troubleshooting

* Simultaneous two-way monitoring
* Channel statistics and Ethernet capture
* Long-term monitoring including remote boot, operation, file transfer and firmware update

Where to Use MT1100A

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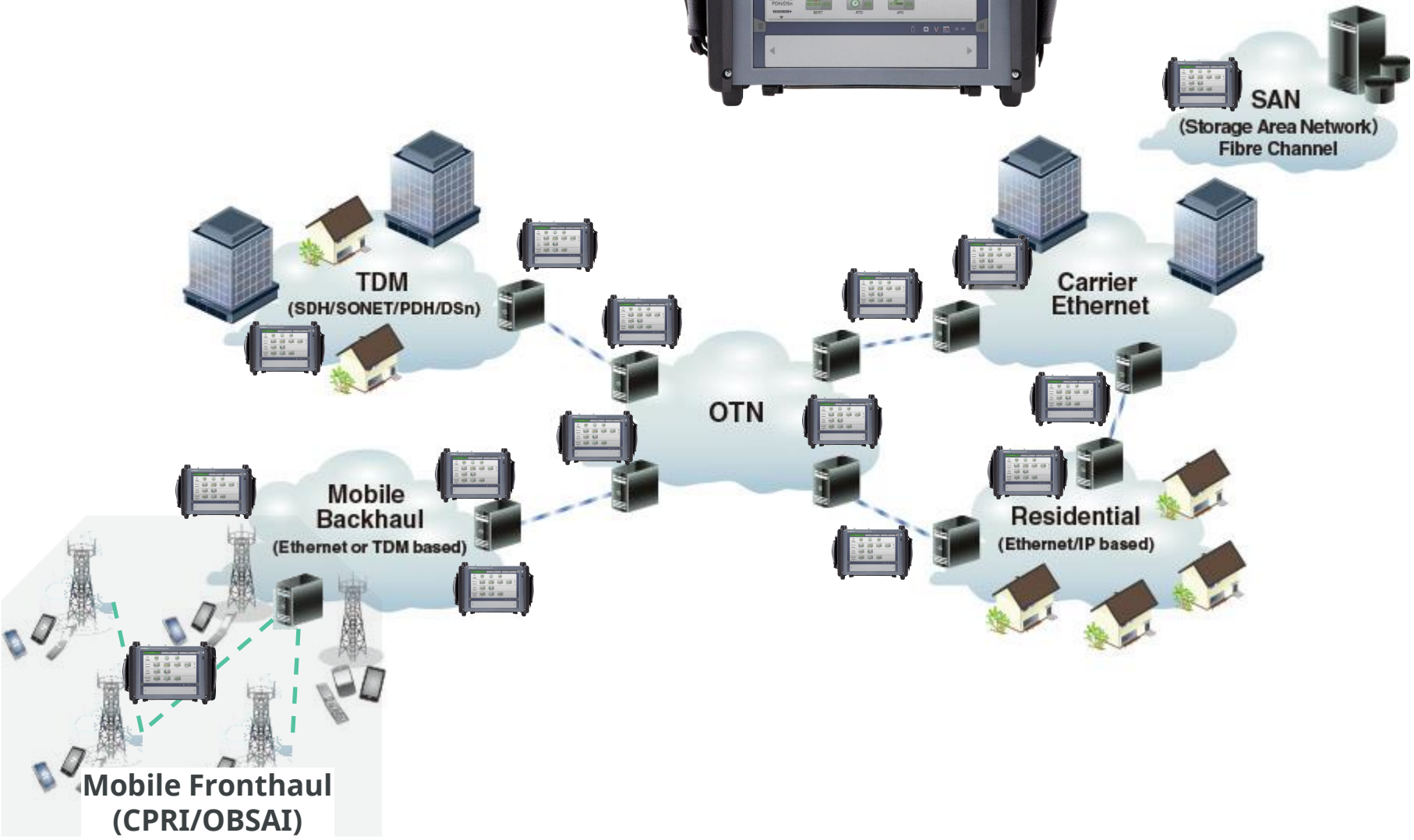

Testing Network Equipment for R&D and Manufacturing

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- Supports performance and functional tests of network equipment from 1.5M to 100G
  - All-in-one support for both latest technologies (such as 100GbE) and existing I/Fs, such as PDH/DSn
  - CFP, CFP2, CFP4 (CFP2/CFP4 adapter required), QSFP28 (CFP2/QSFP28 adapter required), CXP, QSFP+, SFP+, SFP, electrical interfaces including CAUI, XLAUI
  - Multi-user log-in to one instrument using each port independently
- Supports future 400G tests
  - Four 100G ports support 400G client signal (4 x 100G) tests

Out-of-Service Installation Testing

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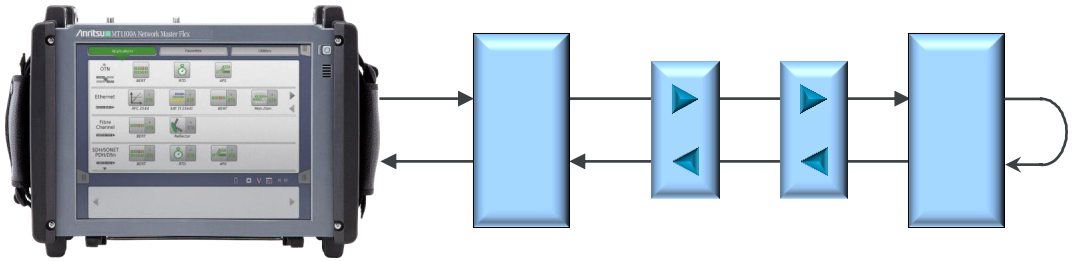
- Installing and commissioning new lines
  - Verify new-line quality/performance before service commissioning
- Troubleshooting with test traffic
  - Test network functions under different loads
- Testing line quality
  - Perform far-end loopback tests using cable or special configuration (protocol dependent)



MT1100A

Out-of-Service Installation Testing (2/2)

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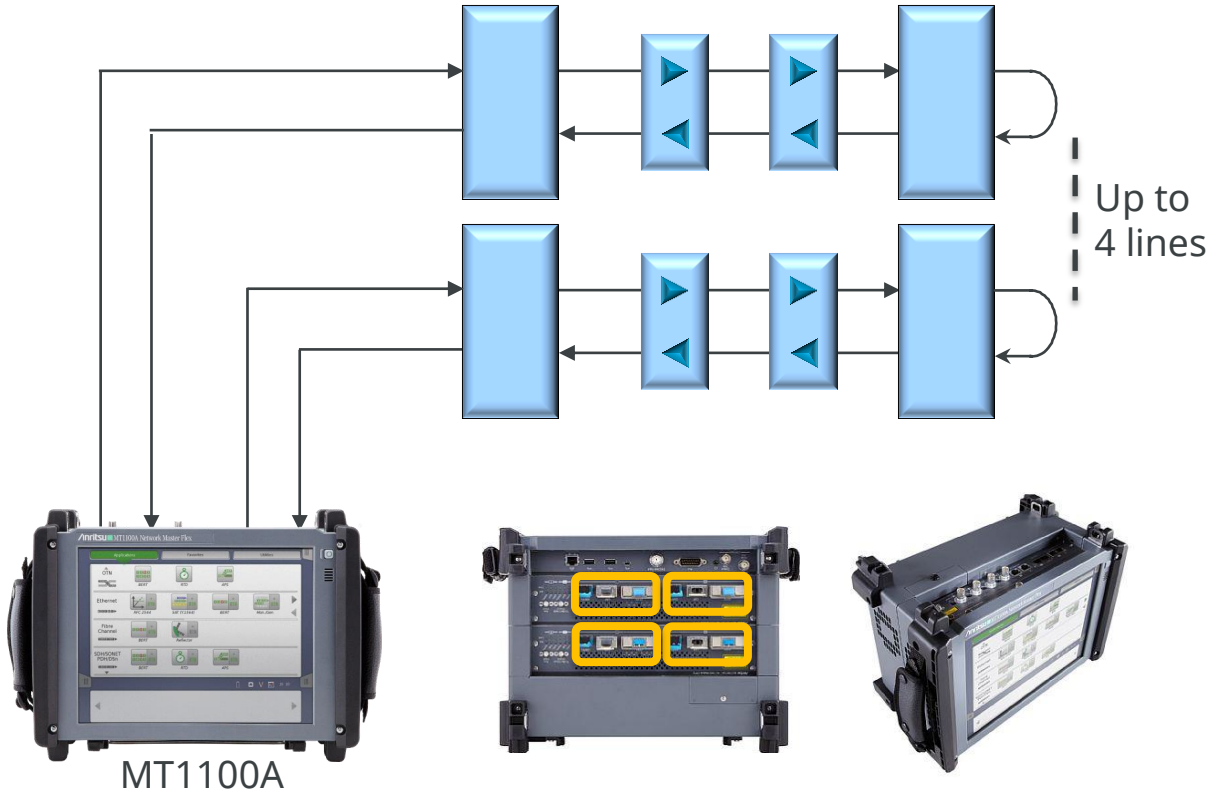
- Efficient simultaneous out-of-service testing of one to four lines
  - Supports up to four fully independent ports at all rates



In-Service Troubleshooting and Analysis

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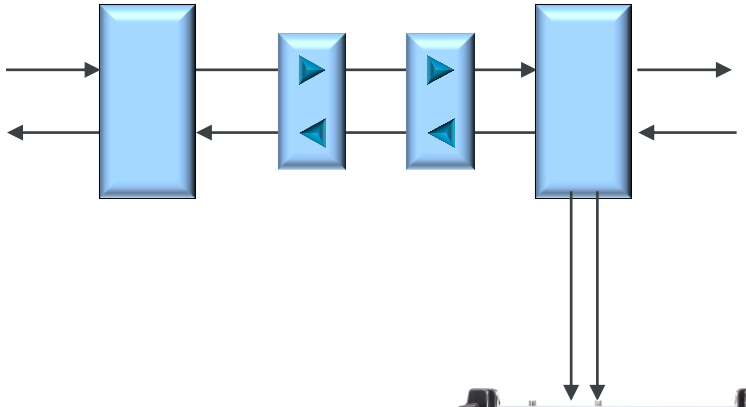
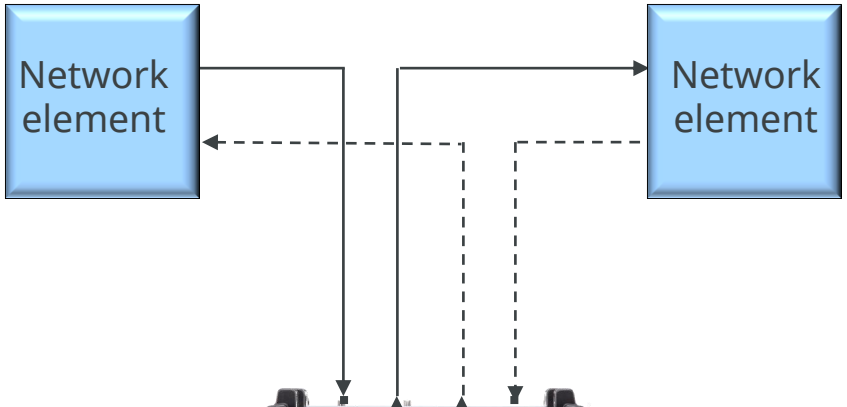
- Monitoring both line directions simultaneously to troubleshoot communications path problems
  - Optimum communications requires smooth data transport in both directions



MT1100A connected to monitoring point



MT1100A in pass-through mode

MT1100A Key Applications

- Core and Metro networks I&M
  - OTN up to OTU4 including mapping of Ethernet/SDH/SONET/Fibre Channel client signals, multistage mapping, FEC (Forward Error Correction) and O.182 Poisson error
  - Testing and verification of newer OTN functions: ODU0, ODUflex, ODU2e and ODU4
- Carrier Class Ethernet I&M and troubleshooting
  - Ethernet testing up to 100 Gbps
  - 100GBASE-SR4 FEC Test
  - Include RFC 2544, Y.1564
  - Include RFC 6349 (up to 10 Gbps)
  - Ethernet OAM
  - MPLS-TP and PBB
  - IP Channel statistics (up to 10 GigE)
  - Frame capture for advanced troubleshooting
- Mobile backhaul installation and verification
  - Synchronous Ethernet testing up to 10 GigE (ITU-T G.826x and IEEE 1588 v2)
- Mobile Fronthaul installation and verification
  - CPRI testing up to 10 Gbps
  - OBSAI testing up to 6 Gbps

MT1100A Key Applications

- Powerful Storage Area Networking (SAN) testing
  - Fibre Channel up to 10 Gbps
  - Supports throughput, latency, and buffer credit performance verification
- Quick and easy testing of SDH/SONET, PDH/DSn Networks
  - SDH/SONET up to STM-256/OC-768
  - PDH/DSn (E1, E3, E4, DS1, DS3)
- Fiber end-face inspection using VIP (Video Inspection Probe)
- Four ports at all rates
  - Reduced testing time by simultaneous testing of 2 lines with one unit
  - In-service bi-directional monitoring

MT1100A Key Benefits and Features

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- Easy intuitive GUI
  - Large 12-inch touch screen,
  - Six languages (English, Chinese, French, Russian, Spanish and Japanese)
- WLAN*1/Bluetooth/LAN connectivity
- PDF, CSV and XML report generation for documentation of test results
- Remote operation
  - Using VNC or dedicated GUI operation software
  - Via Ethernet, WLAN
- Remote control (scripting) via Ethernet, WLAN, GPIB
- Portable
- Battery-operated
- High performance in small form factor

*1 Available for certified countries, including USA, Canada, Japan, all EU countries

Network Master Family

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- Transport

MT9090A Network Master GigE	MT1000A Network Master Pro	MT1100A Network Master Flex
Dedicated field test solution for installation and troubleshooting Ethernet links in access network	All-in-one transport tester supporting from 1.5 Mbps to 100 Gbps including OTN, Ethernet, PTP, CPRI/OBSAI, Fibre Channel, SDH/SONET and PDH/DSn.	All-in-one, up to 4-port transport tester supporting from 1.5 Mbps to 100 Gbps including OTN, Ethernet, CPRI/OBSAI, Fibre Channel, SDH/SONET and PDH/DSn

- Optical

MT9090A Drop Cable Fault Locator	MT9090A Optical Channel Analyzer	MT9090A µOTDR
Compact fault locator for easy and accurate verification of drop cable installation	Compact CWDM channel analyzer to verify power levels, drift and channel presence of CWDM networks	Compact OTDR for fully automatic verification of optical networks, FTTH PON, metro and core

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- Instrument Views

MT1100A Instrument Views

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Hand-held rugged design
Easy-to-use GUI

Instrument Views

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MU110010A: 10G Multirate Module

Up to 2 ports: 1.5 Mbps to 10 Gbps
(RJ45, SFP+/SFP, RJ48, BNC, BANTAM)

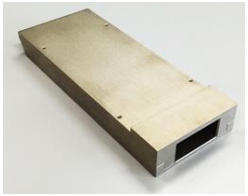
MU110011A: 100G Multirate Module

Single port: 40 Gbps (CFP) or 100 Gbps (CFP)
Up to 2 ports: 10 Mbps to 40 Gbps
(QSFP+, SFP/SFP+, RJ45)

MU110013A: 40/100G Advanced Module

Up to 2 ports: 40 Gbps to 100 Gbps
(CFP2*1, CXP, QSFP+)

*1: CFP4 and QSFP28 can be used by attaching an adapter to CFP2.



J1665A
CFP2-CFP4 Adaptor

J1686B
CFP2-QSFP28 Adaptor

Network Master Flex MT1100A

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- Product Structure

Power Modules and Test Module Combination

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MU110001A: Battery and AC Power Supply Module

		Module 2			
		No Module 2	MU110010A	MU110011A	MU110013A
Module 1	MU110010A	✓	✓	✓	✓
	MU110011A	✓	✓	-	-
	MU110013A	✓	✓	-	-

MU110002A: AC-only High Power Supply Module

		Module 2			
		No Module 2	MU110010A	MU110011A	MU110013A
Module 1	MU110010A	✓	✓	✓	✓
	MU110011A	✓	✓	✓	✓
	MU110013A	✓	✓	✓	✓

✓ Available

- Not available

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- OTN Metro and Core Network Tests

OTN Background

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- ITU-T defines an Optical Transport Network (OTN) as a set of Optical Network Elements (ONE) connected by optical fiber links, able to provide functions of transport, multiplexing, switching, management, supervision and survivability of optical channels carrying client signals.
  - Typical signals carried by OTN are:
    - SONET/SDH
    - Ethernet
    - Fibre Channel
    - CPRI
  - Key OTN functions include:
    - Mapping/demapping of non-OTN signals
    - Multiplexing and demultiplexing of OTN signals
    - Forward Error Correction

OTN Background

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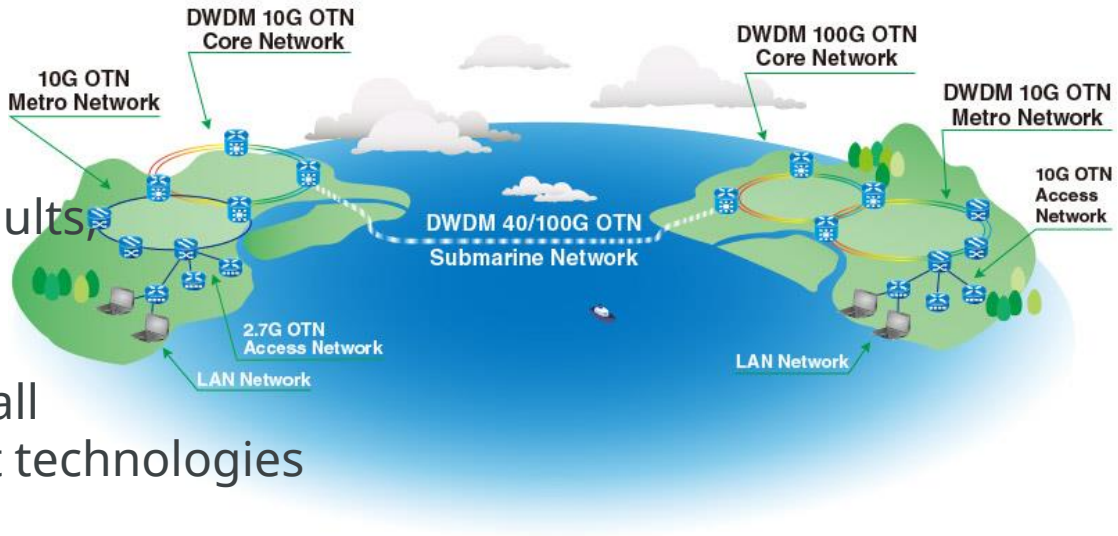
- OTN networks first designed for submarine sections
  - Quickly moved to Core → Metro → Access
    - Operators can implement more services, control and management
- Simplifying network management is key for operators
  - Control customer traffic from access point and across network (single system single management)
  - Greater insight about faults, quick repair and fewer maintenance issues
  - Single management of all legacy and replacement technologies



MT1100A Product Highlights

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- Comprehensive OTN testing for metro and core network I&M
  - OTN tests up to OTU4
    - ODU0, ODUflex, multistage mapping
  - Test Ethernet, CPRI, Fibre Channel and SDH/SONET client signals mapped to OTN signal
  - OTN tests with bulk signals at OTN level
  - Comprehensive OTN error and alarm statistics
  - OTN error performance measurement (G.8201 or M.2401)
  - ITU-T O.182-compliant FEC test
  - Delay measurement
  - OTN header edit and capture
  - OTN TCM monitoring and generation
  - Service disruption analysis using APS application
  - OTN tributary scan

MT1100A Product Highlights

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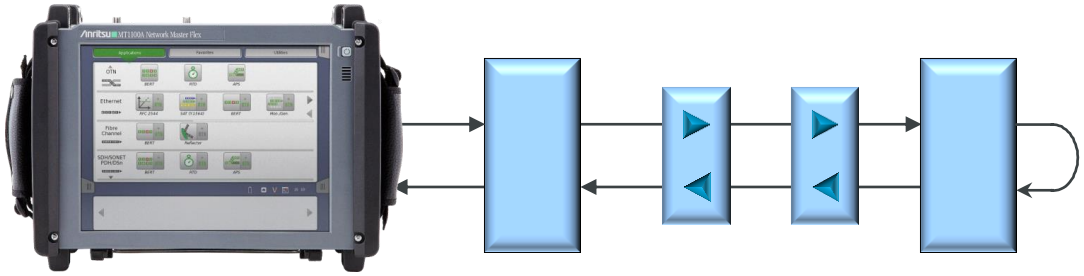
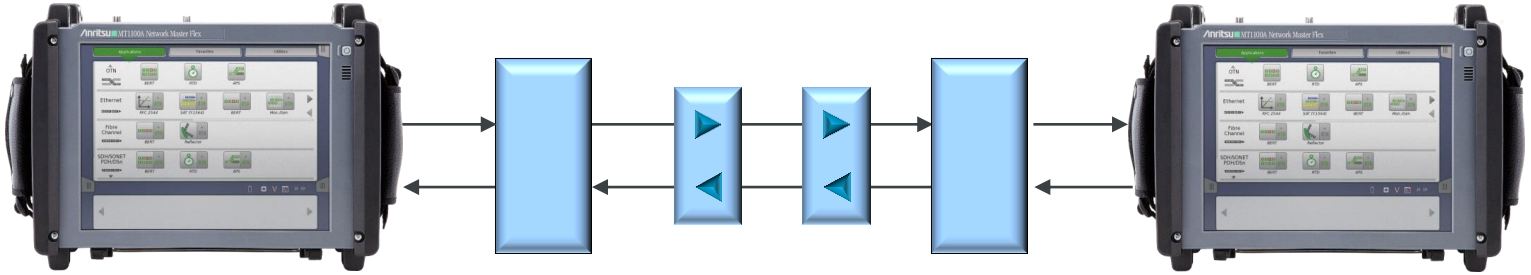
- OTN out-of-service testing
  - For installation and commissioning
  - For troubleshooting
  - OTN testing with far-end loopback



  - OTN testing with two instruments
    - Separate results for each side of line



MT1100A Product Highlights

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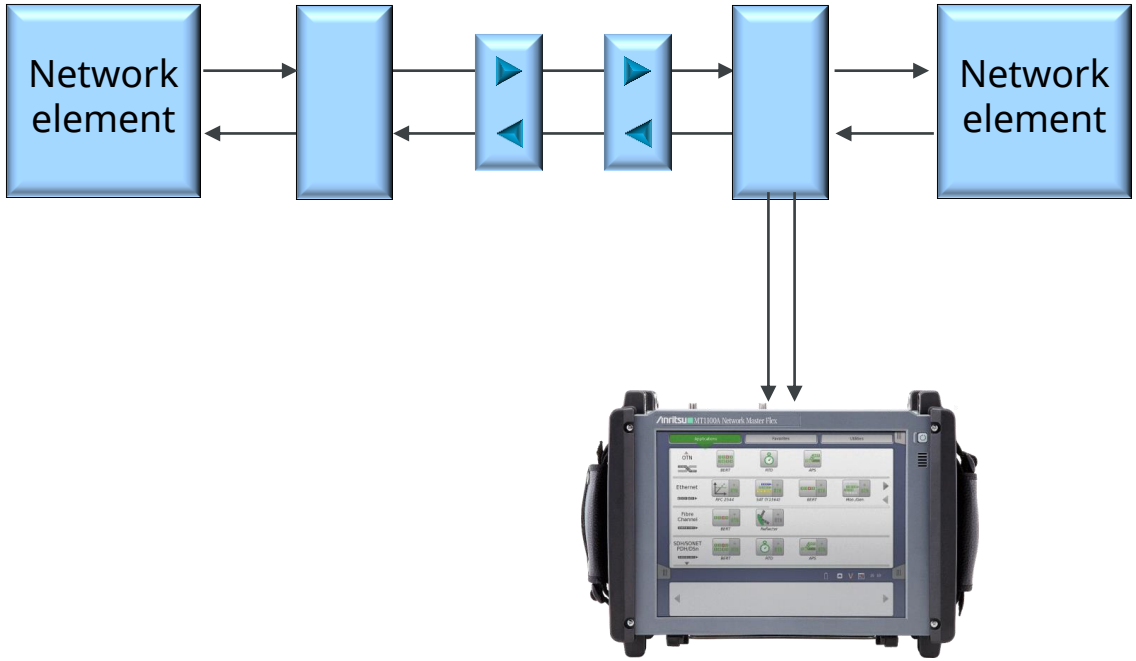
- OTN in-service testing
  - Troubleshooting live traffic
  - Connected at monitoring point



MT1100A Product Highlights

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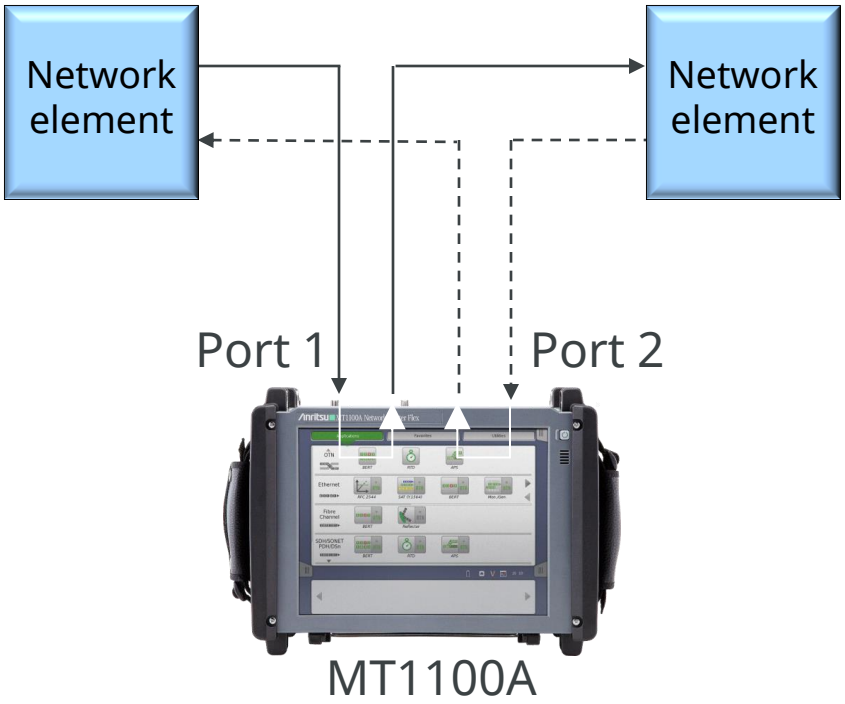
- OTN in-service pass-through testing
  - Troubleshooting live traffic when no monitoring point



MT1100A Product Highlights

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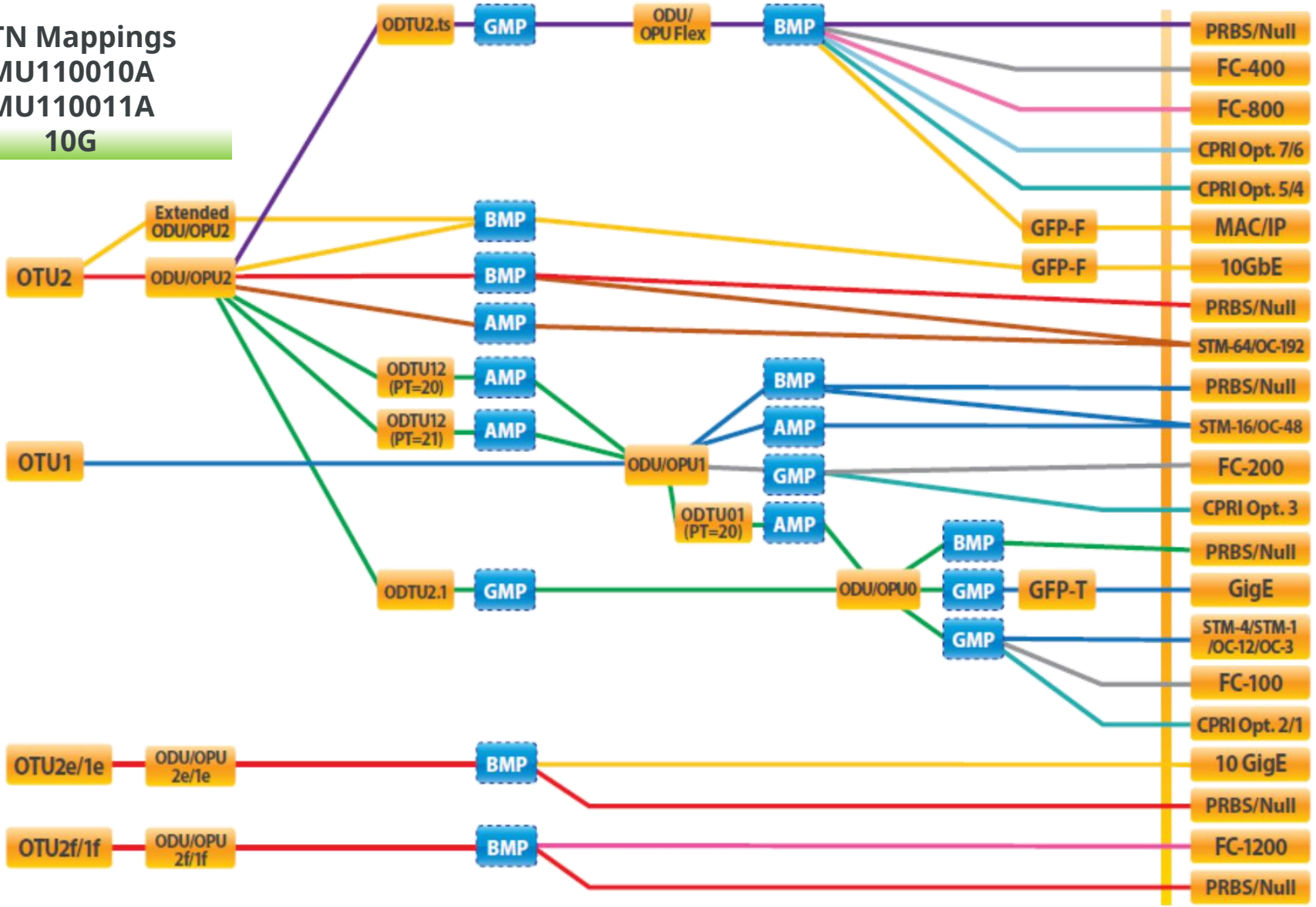
OTN Mappings
MU110010A
MU110011A
10G



MT1100A Product Highlights

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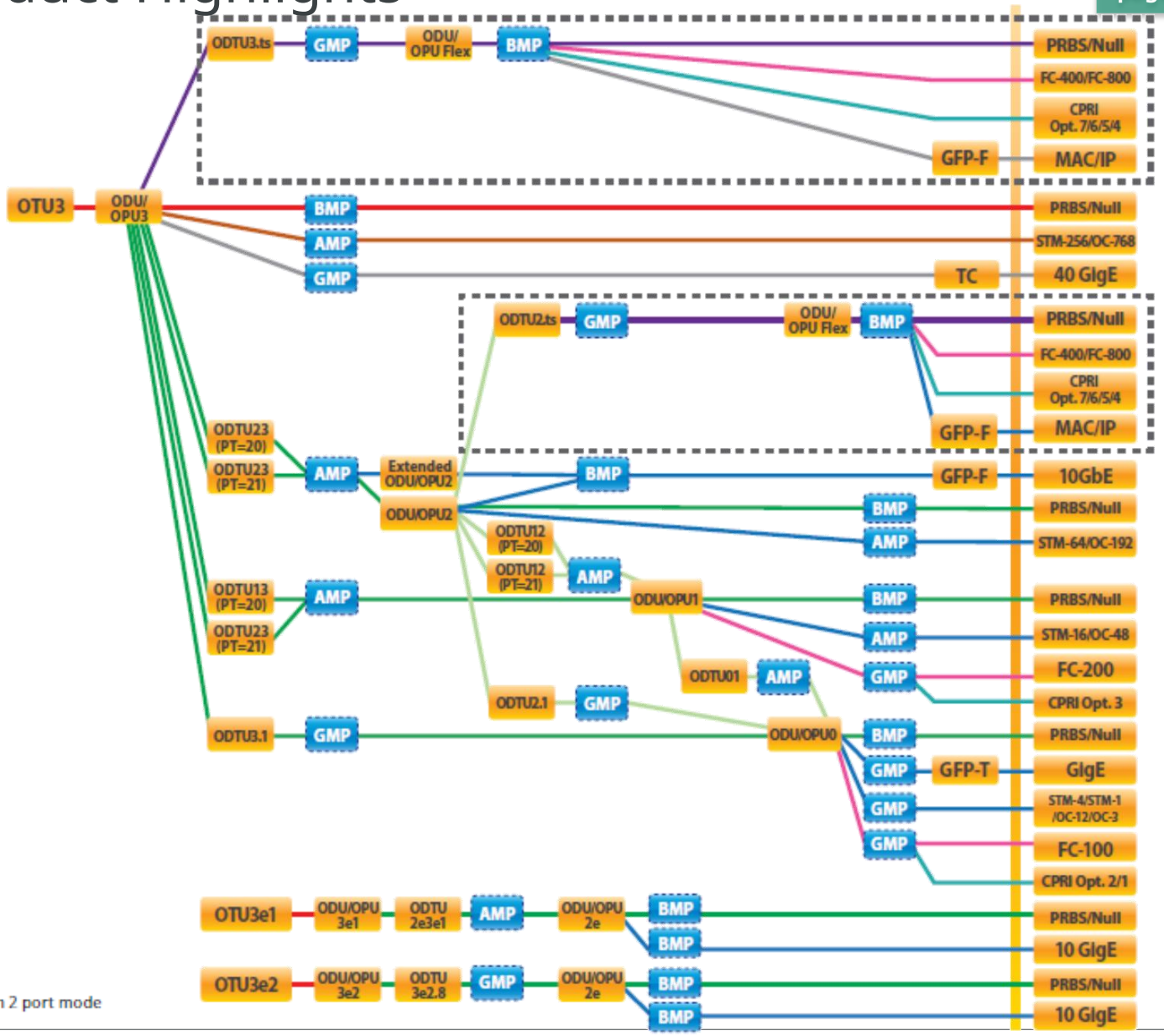
OTN Mappings
MU110011A
MU110013A
40G



Not supported mappings on 2 port mode

MT1100A Product Highlights

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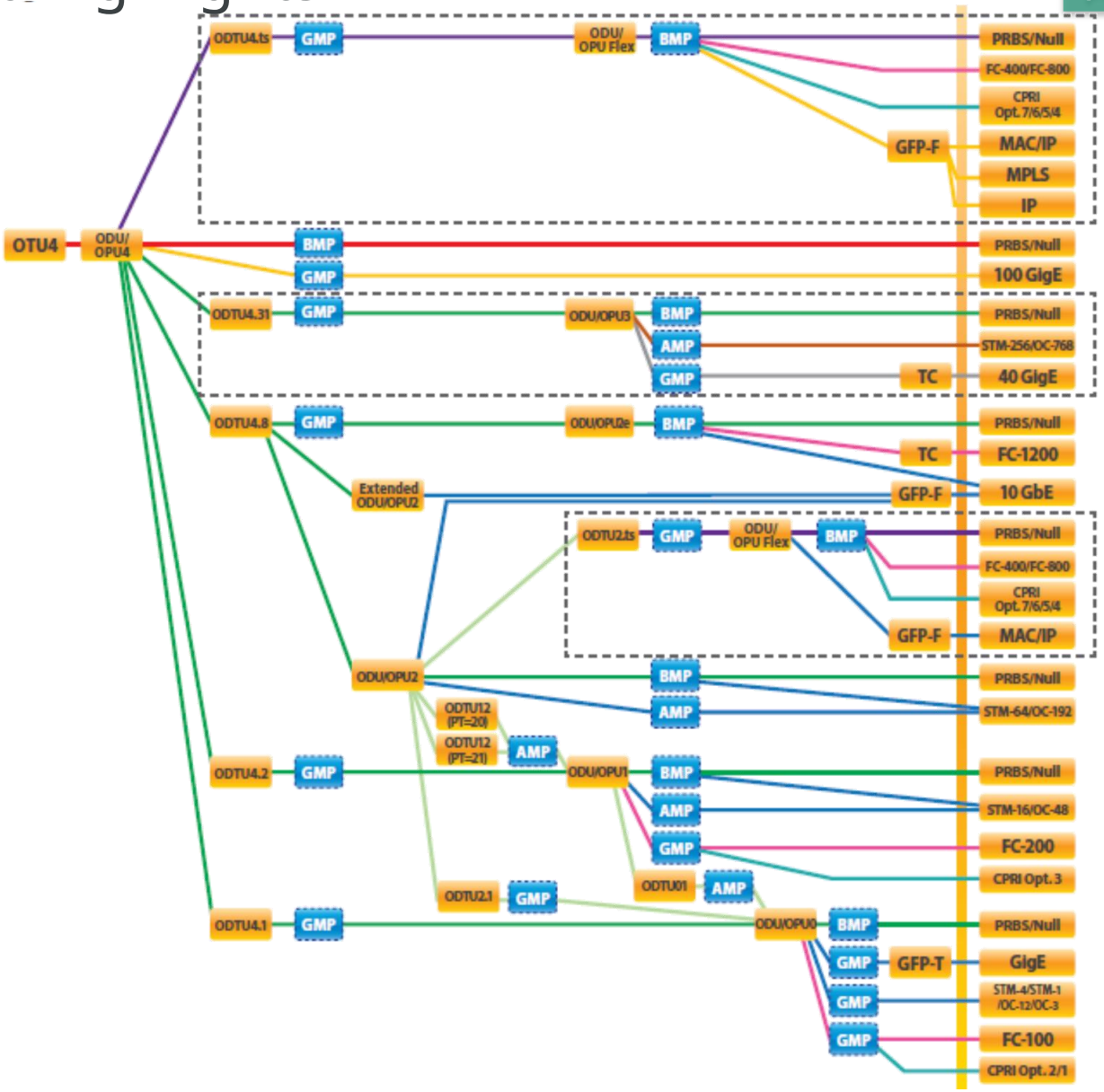
OTN Mappings
MU110011A
MU110013A
100G



Not supported mappings on 2 port mode

MT1100A Product Highlights

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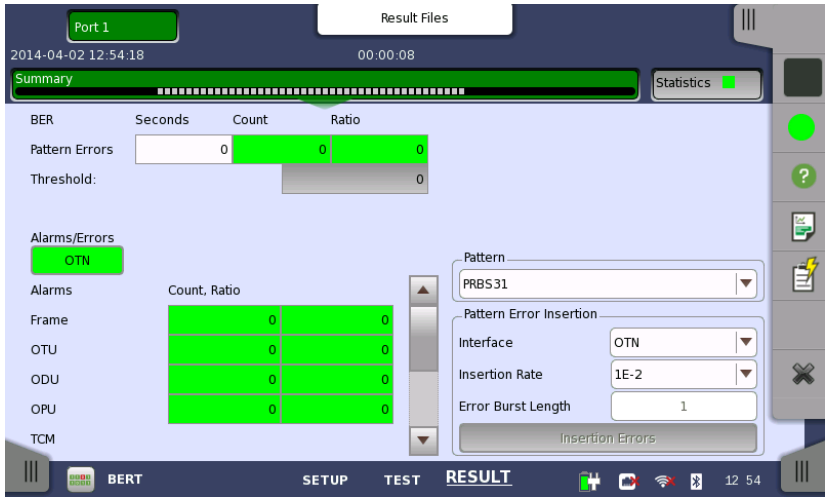
- OTN statistics
  - Summary page with main results
  - Additional pages with detailed statistics
  - GO/NO GO color coding gives easy overview of results



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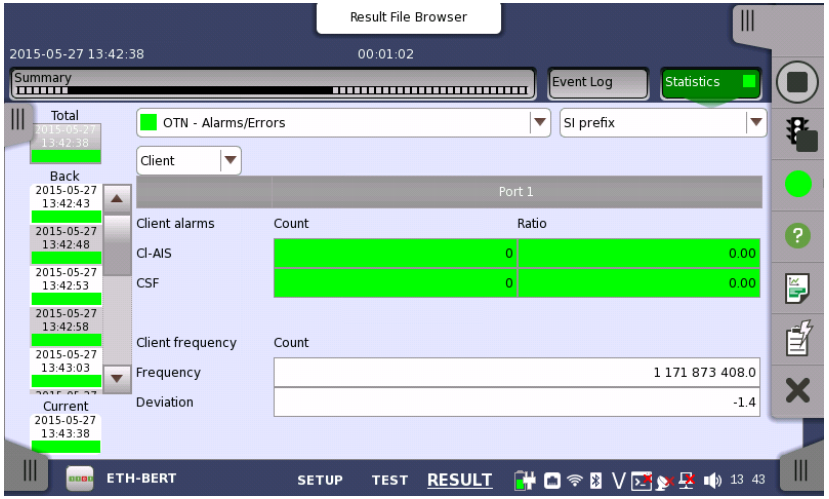
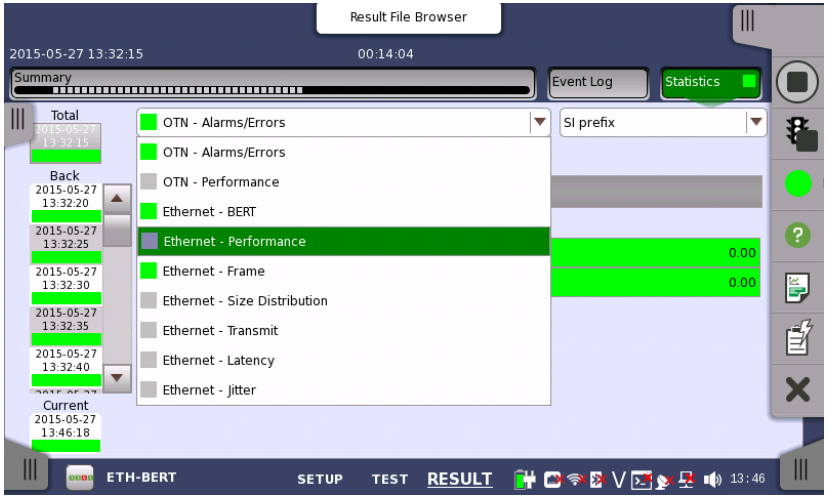
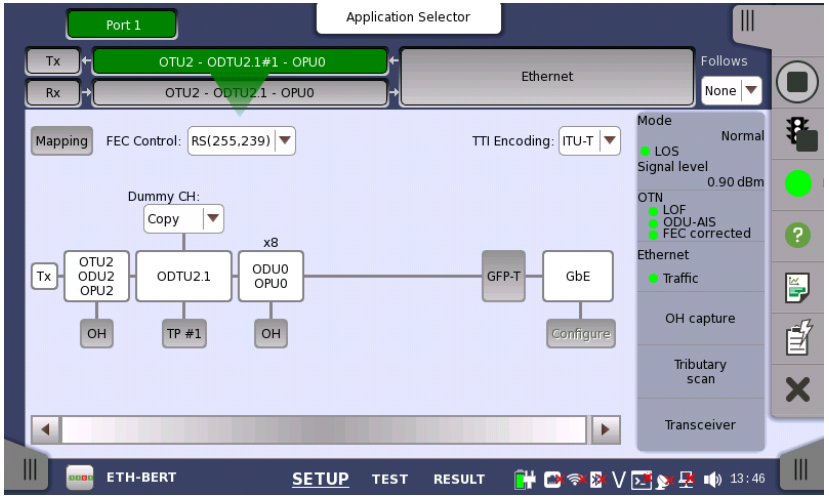
- Ethernet in OTN
  - Statistics for OTN and embedded Ethernet signal in same measurement
  - Client signal frequency
  - Intuitive configuration map







MT1100A Product Highlights

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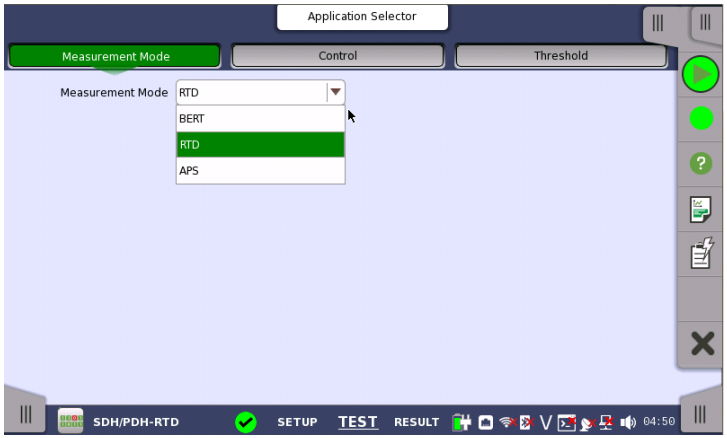
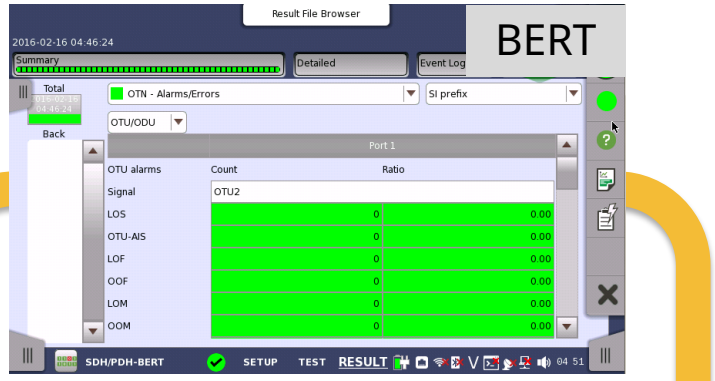
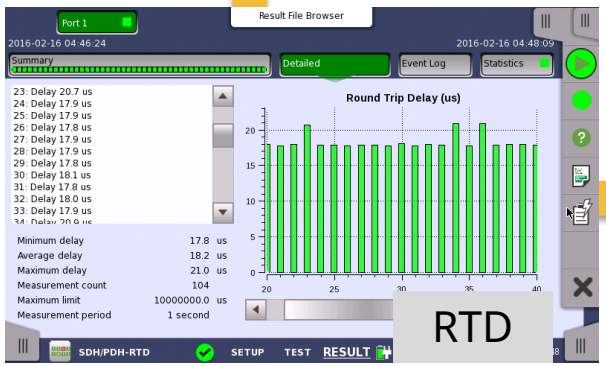
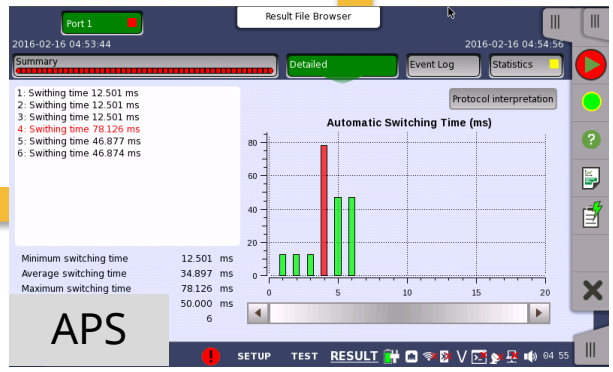
- SDH/SONET/DSn/PDH in OTN
  - BERT applications and upgraded to switch without closing BERT, APS and RTD applications to improve operation efficiency









MT1100A Product Highlights

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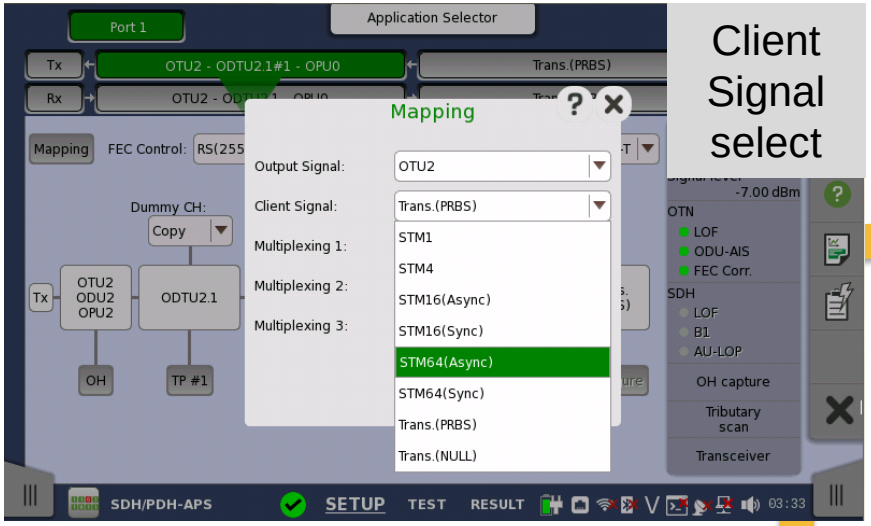
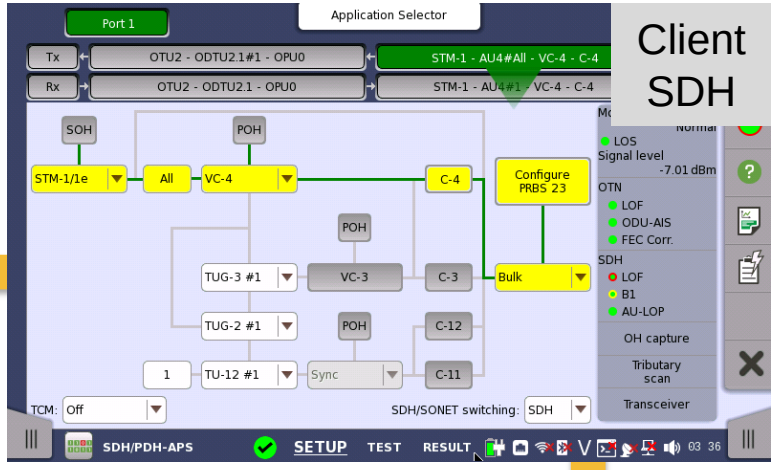
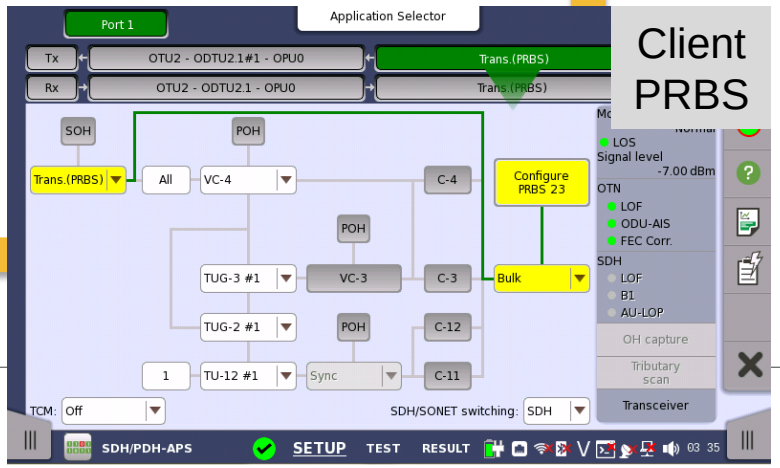
- SDH/SONET in OTN
  - Upgraded Client signal selection method used for ATN mappings at SDH-OTN-BERT application, and enabled Client SDH and Client PRBS signal switching without closing applications to improve operation efficiency







MT1100A Product Highlights

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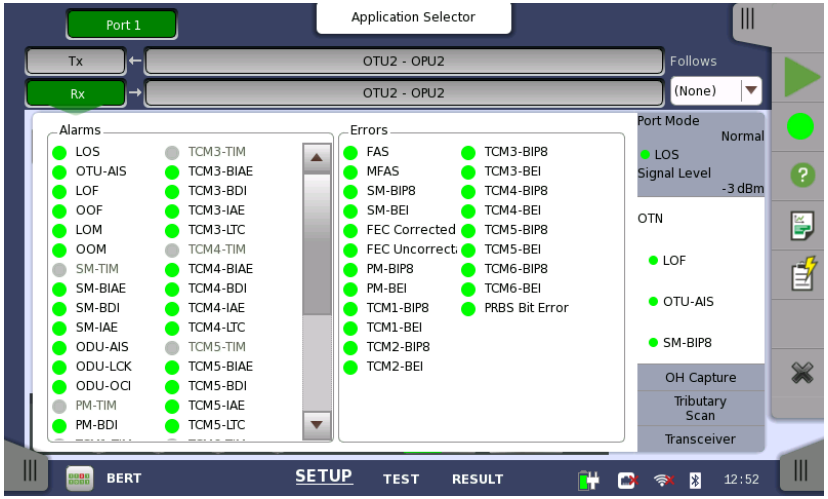
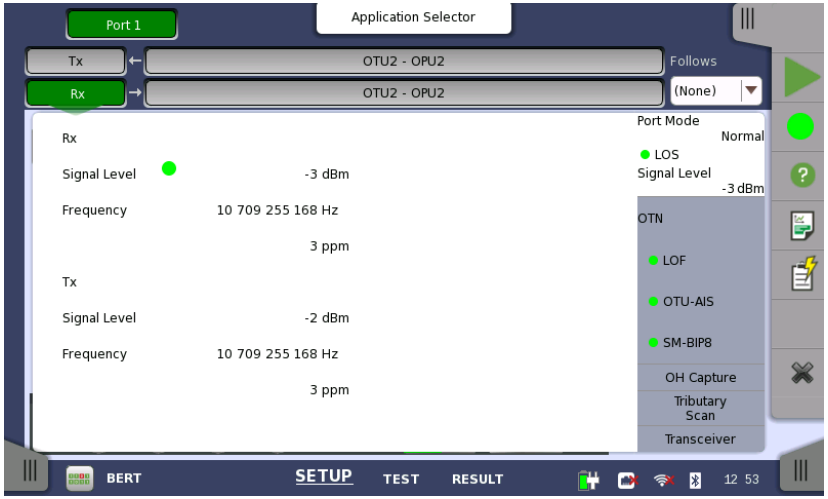
- OTN status information
  - Overview of current status of alarms and errors
  - Optical level and rate information
  - GO/NO GO color coding gives easy overview of line status





MT1100A Product Highlights

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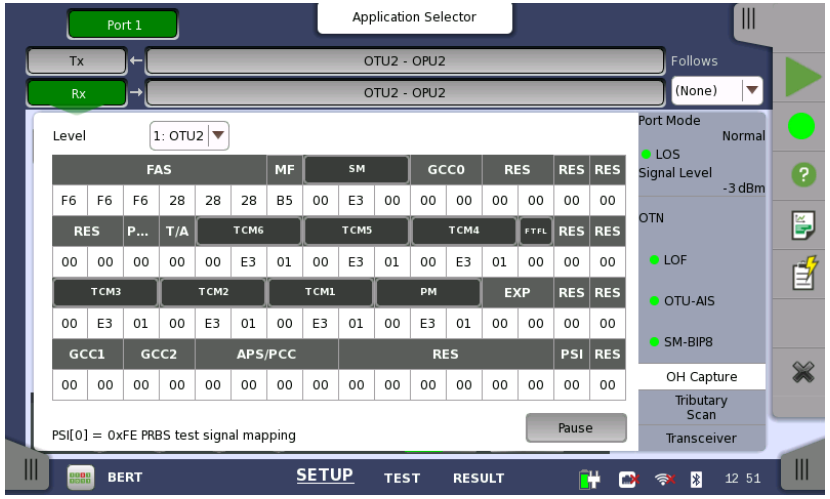
- OTN Over Head (OH) Byte capture
  - Inspect OH bytes for detailed troubleshooting
    - Updates about every 1 second



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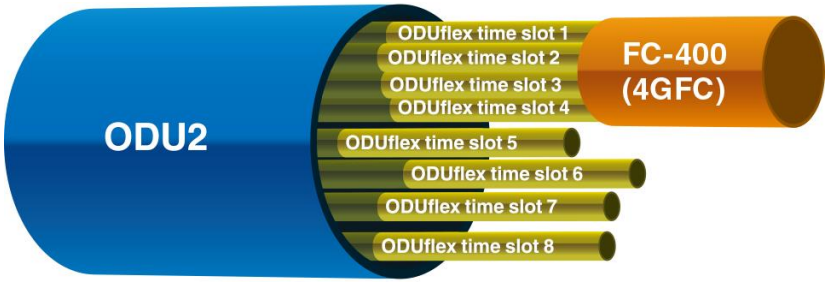
- Comprehensive OTN Testing—continued
  - ODUflex testing
    - ODUflex: New feature of OTN
    - Method for flexible allocation of bandwidth to client signal
      - Makes most efficient use of OTN capacity
    - Capacity of ODU2 split into eight 1.25G ODUflex time slots



    - In above example, FC-400 (4GFC) Fibre Channel signal occupies 4 ODUflex time slots, freeing other four ODUflex time slots in ODU2 for other payloads
    - MT1100A supports ODUflex testing, allowing operators deploying new technology to verify working correctly throughout network

MT1100A Product Highlights

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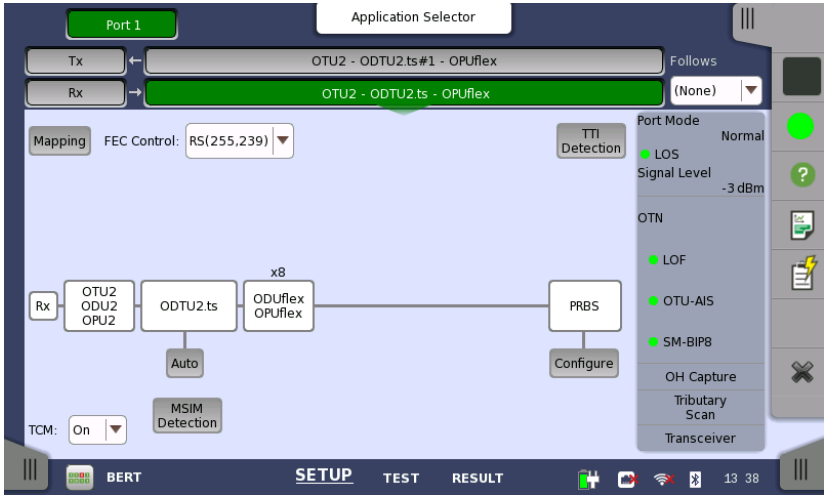
- ODUflex
  - Configuration and results



MT1100A OTN FEC Test

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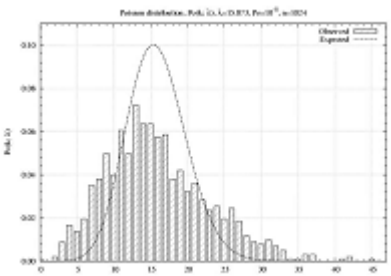
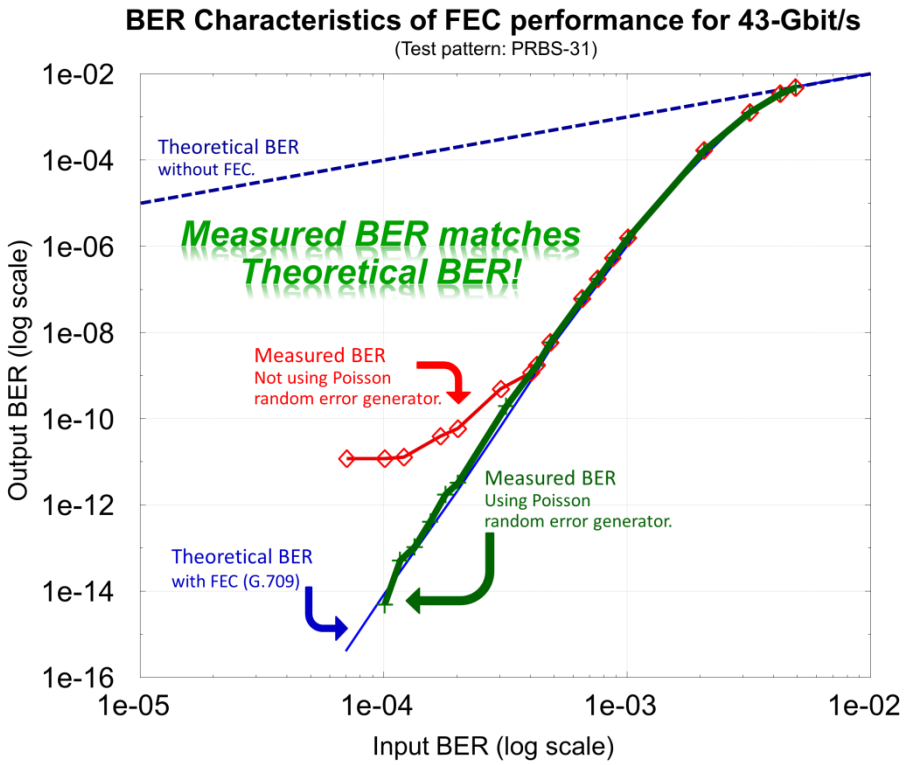
- ITU-T O.182 Compliant FEC Test
  - Anritsu's proposed FEC performance tests using Poisson distribution random errors adopted by ITU-T O.182 in July 2007
  - Reproducible/accurate FEC error correction tests by generating random signal errors (Poisson distribution)



Bad Random Distribution

Good Random Distribution



Error Correction Curve

MT1100A OTN FEC Test

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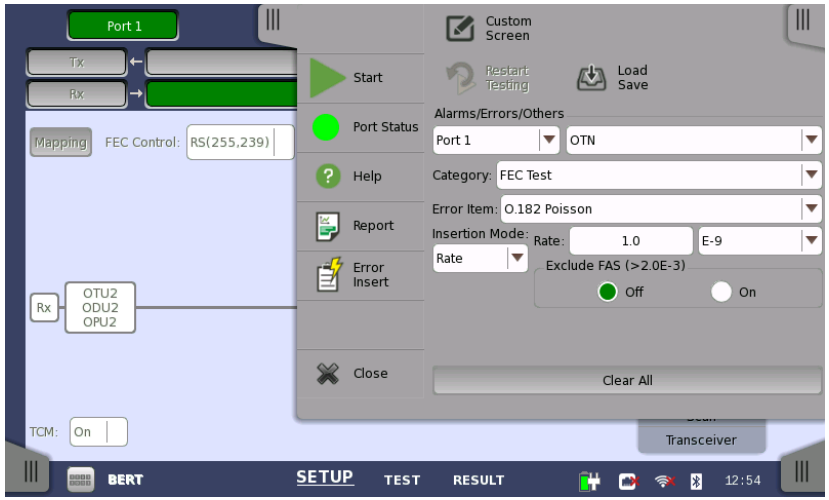
- ITU-T O.182 Compliant FEC Test
  - FEC error insertion with MT1100A



Network Master Flex MT1100A

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- Carrier Class Ethernet Test

MT1100A Product Highlights

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- Easy Ethernet test solution
  - Ethernet testing
    - 100 Gbps, 10 Gbps, 1 Gbps, 100 Mbps and 10 Mbps
    - 400 Gbps client testing with 4 x 100 Gbps configuration
  - Traffic generation up to full line rate
  - 100 GigE RS-FEC Test
  - Supports IPv4 and IPv6
  - Ethernet Service Activation Test (Y.1564)
  - Automated RFC 2544 testing
    - Throughput
    - Frame Loss
    - Latency or Packet Jitter
    - Burstability
  - TCP Throughput option (RFC 6349) up to 10 Gbps
  - BER testing
    - Includes frame loss and sequence error tests
  - Service disruption measurement

MT1100A Product Highlights

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- Easy Ethernet test solution—continued
  - Comprehensive statistics including:
    - Performance (utilization, Throughput, frame rate)
    - Frame statistics (frame types and errors)
    - Burst statistics
    - Frame size distribution
    - Latency and Packet Jitter measurements
    - Transmitted and received frames and bytes
  - Filters – to extract relevant parts of traffic
  - Thresholds – to highlight abnormal situations
  - Simultaneous monitoring of both directions on line
  - IP Channel Statistics to identify error streams, top talkers, network attacks for up to 230 multiflow counters (up to 10 Gbps)
  - Ethernet OAM: IEEE 802.3 (IEEE 802.3ah), IEEE 802.1ag, ITU-T Y.1731

MT1100A Product Highlights

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- Easy Ethernet test solution—continued
  - Synchronous Ethernet Test (G.826x and IEEE 1588 v2) (up to 10 Gbps)
    - For Mobile Backhaul testing
  - Ethernet Multistream: Up to 16 streams per port
    - Information on Throughput, Frame Loss, Packet Jitter and latency per stream
  - Stacked VLAN (Q-in-Q): Up to 8 levels of VLAN tags
  - MPLS/MPLS-TP testing: Up to 8 levels of MPLS labels
  - PBB testing
  - 10G WAN PHY
  - Ping testing
  - Traceroute test
  - Electrical cable test and optical signal level indication
  - Frame capture for protocol analysis by Wireshark®

MT1100A Applications – Out-of-Service Testing

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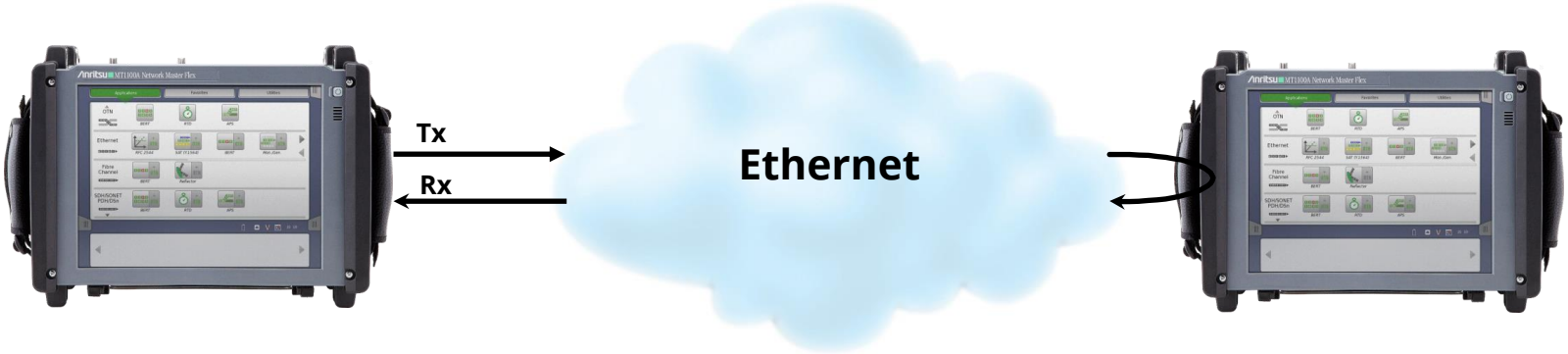
- Out-of-service Ethernet testing
  - Installation and commissioning of new lines
    - Verification of quality/performance of new lines before commercial operation
  - Troubleshooting with test traffic
    - Functional testing and network behavior at different loads
  - Testing line Quality of Service (QoS)
    - Loop-back MT1100A Ethernet test signal using cable or reflector at far end



Ethernet testing with far-end reflector

MT1100A Applications – Out-of-Service Testing

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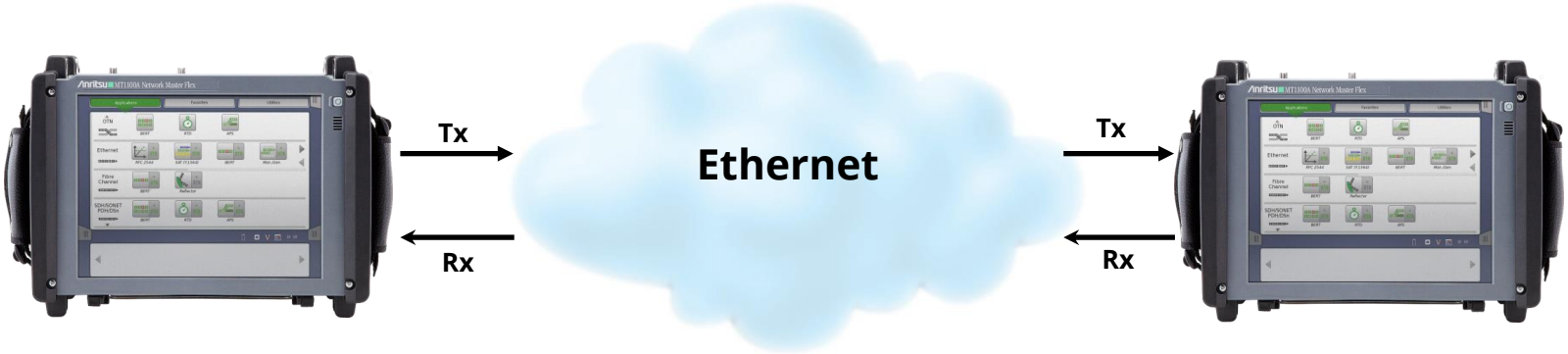
- Ethernet end-to-end testing
  - Due to nature of IP/Ethernet networks key parameters like Throughput, Frame Loss and Packet Jitter may differ in two directions of connection
    - Two instruments needed to capture data for each direction



MT1100A Applications – Out-of-Service Testing

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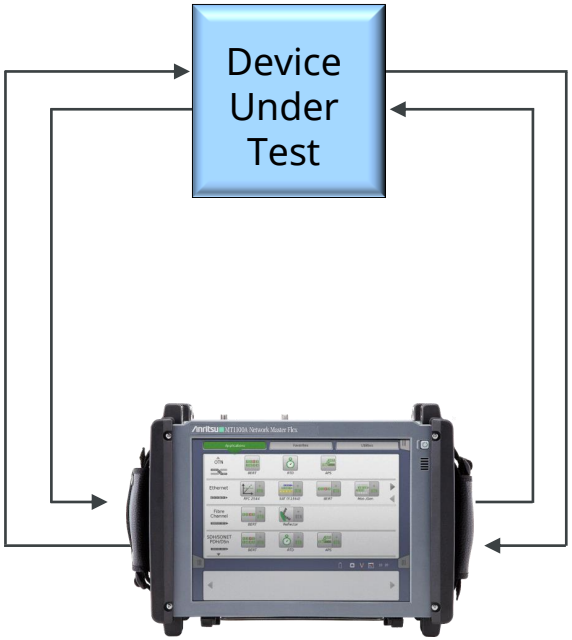
- Typical applications*1:
  - Dual-port testing of networks or network elements
  - One-way latency measurements
  - Router testing
  - QoS verification



*1 Requires 10 Gbps dual-port option

MT1100A Applications – In-Service Monitoring

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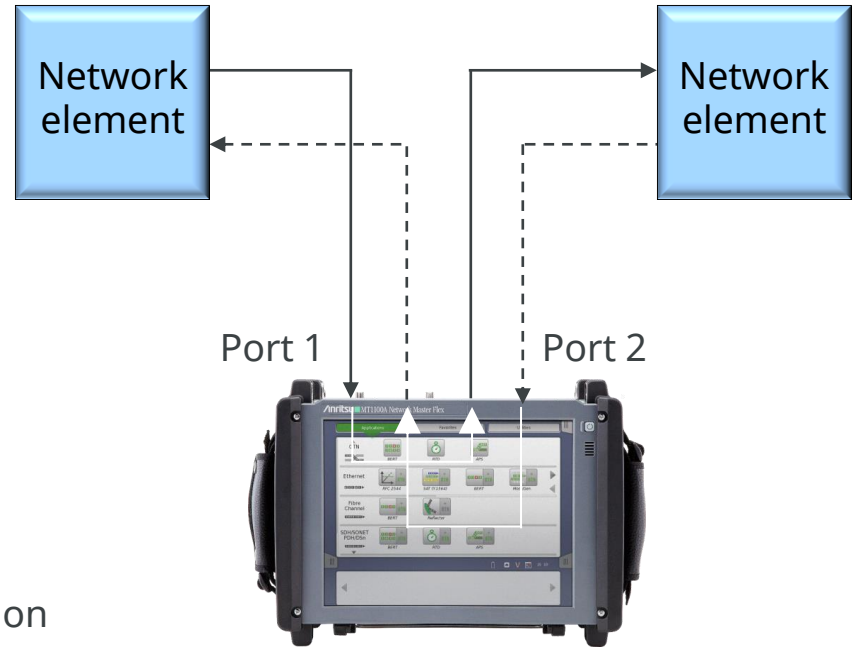
- Typical applications*1:
  - Rapid in-service diagnostics
  - In-service troubleshooting
  - Live traffic analysis and statistics



MT1100A in pass-through mode

*1 Requires 10 Gbps dual-port option

RS-FEC for 100GBASE-SR4 (MU110013A-023)

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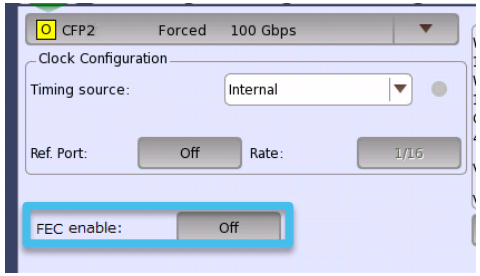
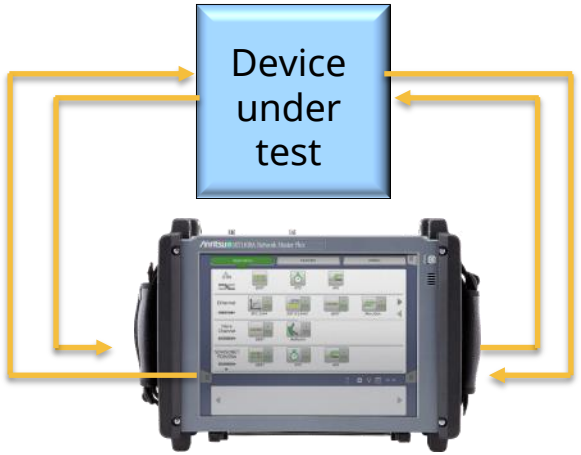
- Added RS-FEC function*1 to MU110013A
  Generate and Measure FEC 100GbE signal
  Supports FEC Code: RS (528, 514, 7, 10)
  - Dual-Port Test: DUT Insertion Test*2
  - Single-Port Test: 100GigE+RS-FEC Confirmation/BER Test
    RS-FEC Error Correction Check
- Set RS-FEC for either CFP2 or QSFP28*3





*1 Operation Results: 100GBASE-SR4, 100GBASE-ER4-lite
*2 Requires Dual-Port Option
*3 Add PCS Error/Alarm and PCS skew selection when RS-FEC enabled

MT1100A IP Channel Statistics (up to 10 Gbps)

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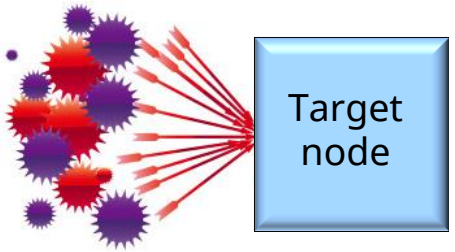
- IP Channel Statistics
  - Typical root causes of network issues
    - Top talker
      - Top talker occupies major bandwidth slowing it down
    - Network attack
      - One node accessed from many sites, occupying network
    - Error Frames
      - Error frames causes re-transmission and wasted network capacity



MT1100A IP Channel Statistics (up to 10 Gbps)

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- IP Channel Statistics
  - Finding top talker, network attack, and error frames quickly decreases downtime and recovers network performance
  - IP Channel Statistics offers simple method to " top talker, network attack, and error frames just by selecting and starting filters
  - Field technicians analyze network easily without training

Analysis	IP Channel Stats Filter
Top talker	Source IP address
Network attack	Destination IP address
Error frames	(any parameter OK)

MT1100A IP Channel Statistics (up to 10 Gbps)

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- IP Channel Statistics
  - Combination of filters
    - IPv4, IPv6 or MAC address, VLAN ID or MPLS label, IP next header (protocol), TCP/UDP ports
  - Monitoring values
    - Frame counts/rate, Throughput, Error frames, Size distribution, IPv4/IPv6 statistics, TCP/UDP statistics, etc.
  - Added value of IP Channel Statistics
    - VLAN scan
      - Throughput per VLAN ID monitored by selecting VLAN ID as filter

MT1100A IP Channel Statistics (up to 10 Gbps)

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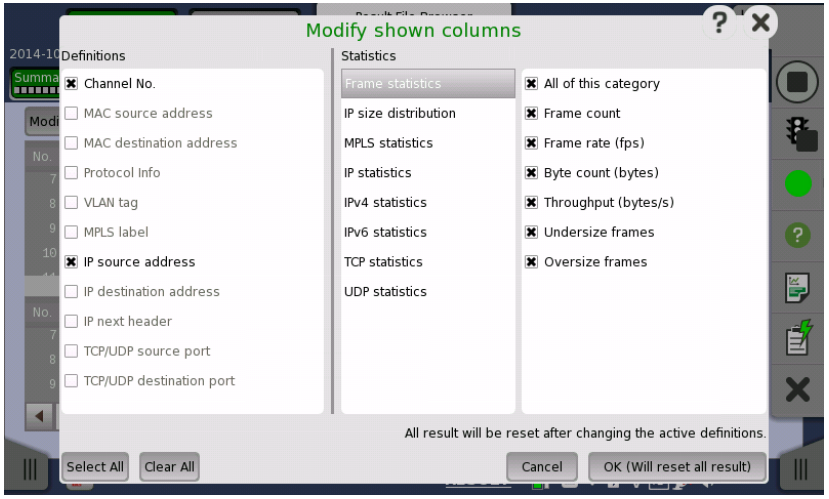
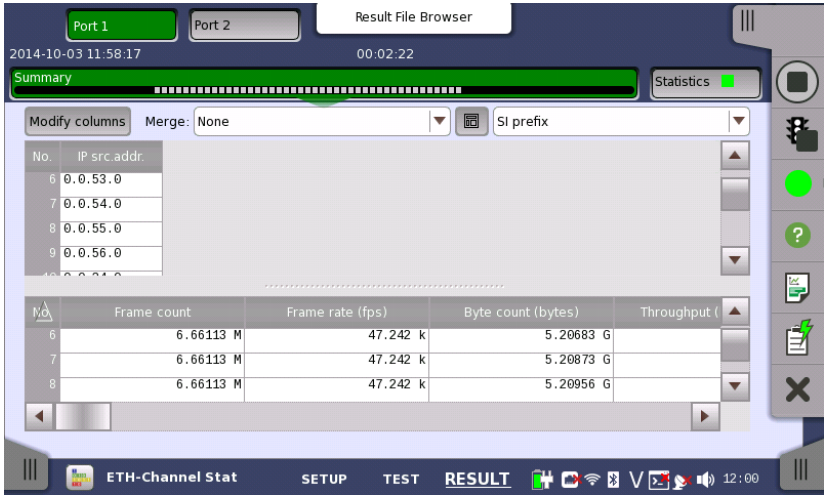
- Setup screen for configuring channel definitions and displayed columns
- Result screen
  - Easy switching between results from two ports





MT1100A Ethernet Line Status

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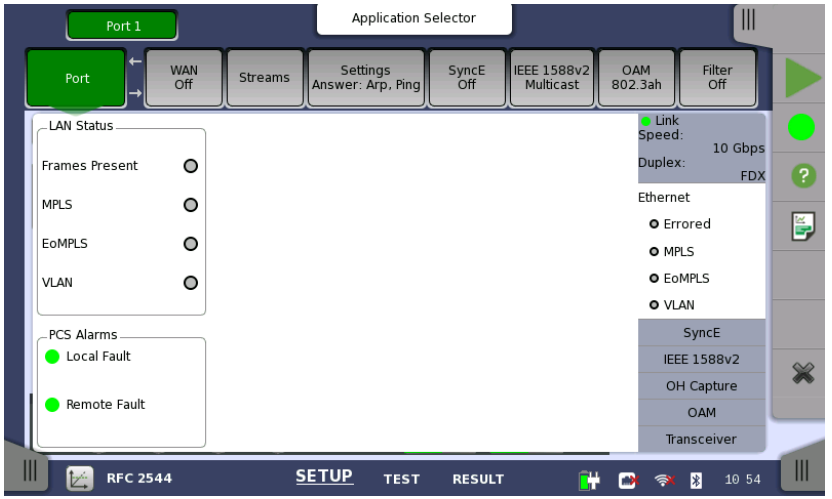
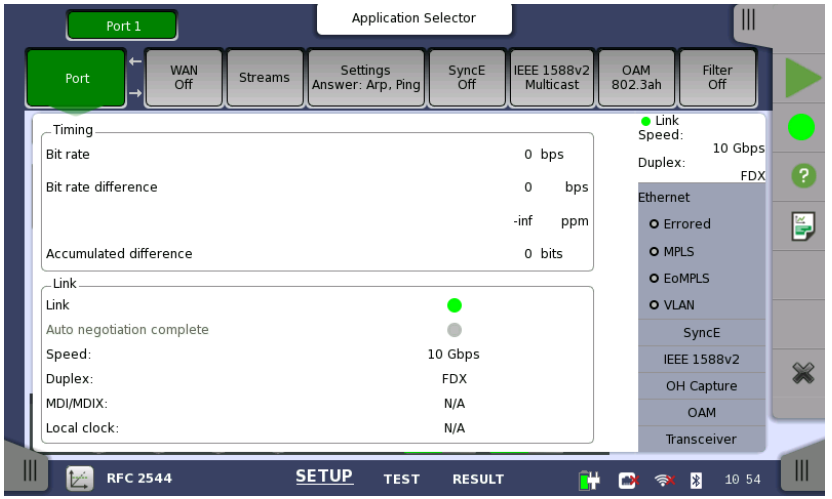
- Line alarms as LED indicators
- Displays current line status





MT1100A Cable Test for Electrical Ethernet

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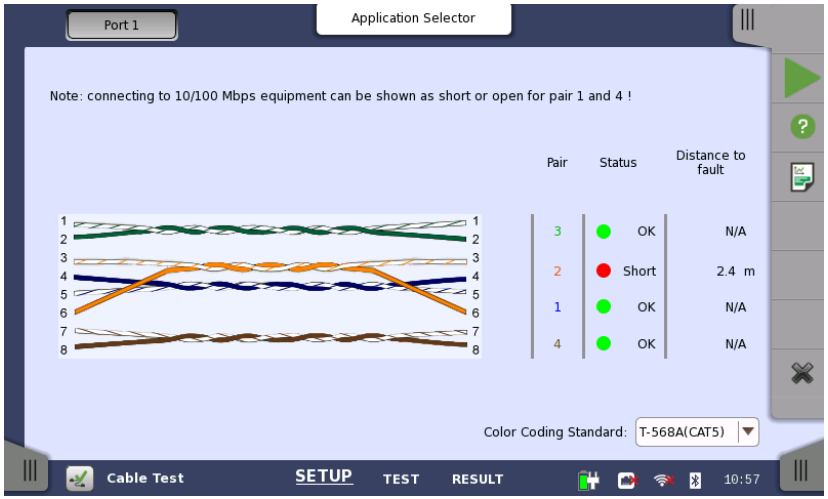
- Some problems on electrical Ethernet are basic:
  - Short in wire pair
  - Break in wire pair
- Cable test easily identifies such basic problems
- Cable test displays distance from instrument to fault



MT1100A Signal Level Display for Optical Ethernet

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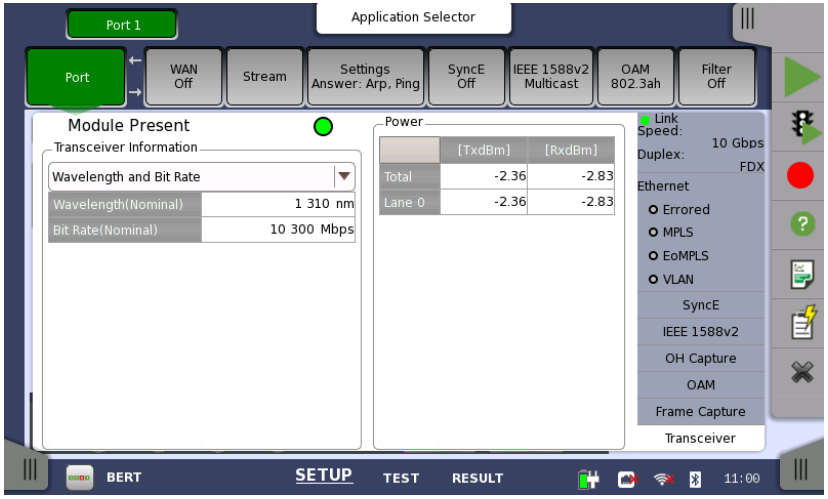
- Some problems on optical Ethernet connection are basic:
  - Bent cables
  - Breaks in cable
  - Dirty connectors
- Optical signal level display easily identifies such problems



MT1100A Service Activation Test

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- What is ITU-T Y.1564?
  - Anritsu actively involved in creating Y.1564 standard
  - Defines new method for testing multiple Ethernet services on network simultaneously
  - Designed to allow service providers to assess customer end-to-end network performance including:
    - End user traffic profiles with multiple frame sizes
    - Services with different traffic priorities on network
  - Verifies following for each surface:
    - Frame Loss, transfer time and jitter across network
    - Policing
    - Network ability to manage short-duration traffic bursts

MT1100A Service Activation Test

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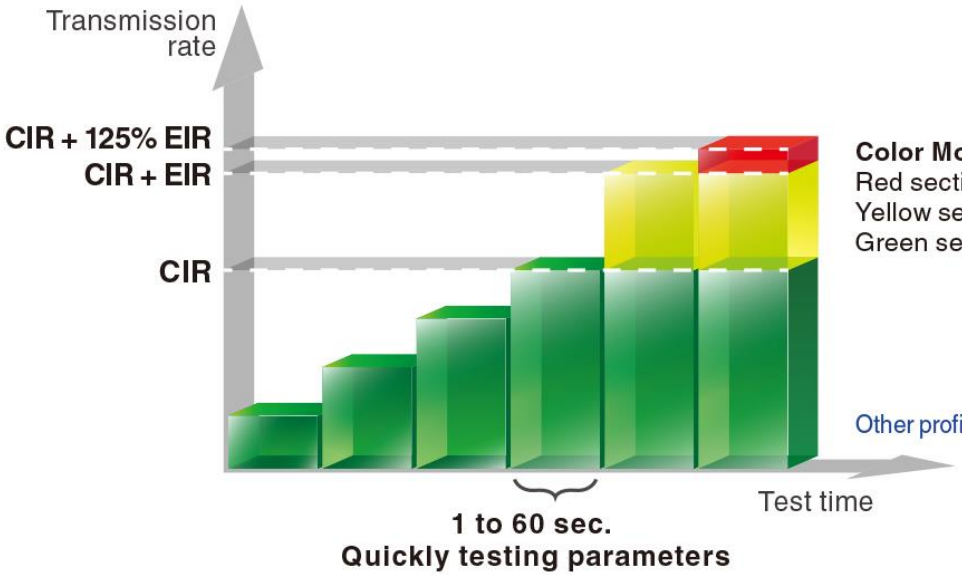
- What is ITU-T Y.1564?
  - ITU-T Y.1564 completes testing in two phases:
    - Phase 1: Service Configuration Test—confirms each service configured correctly throughout network at Committed Information Rate (CIR), and others rates as required
    - Tests one service at a time



Color Mode

Red section	: Confirm traffic dropped when policing is applied
Yellow section	: Non guaranteed traffic
Green section	: Guaranteed traffic; Service Acceptance Criteria (SAC) on Frame Loss Ratio (FLR), Frame Transfer Delay (FTD), Frame Delay Variation (FDV) and Availability (AVAIL) are verified.

Other profile parameters : Committed Burst Size (CBS) Excess Burst Size (EBS)

MT1100A Service Activation Test

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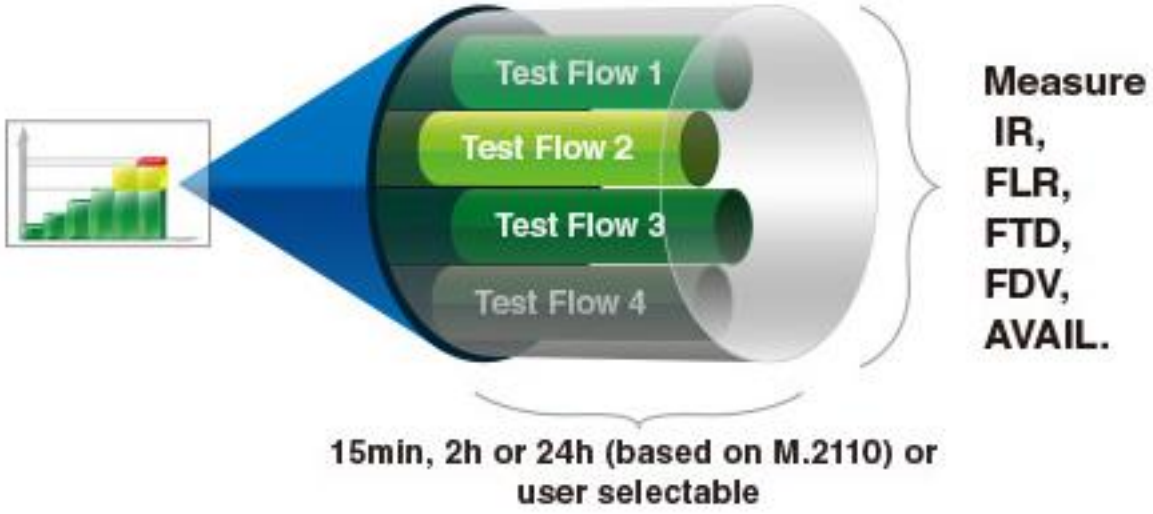
- What is ITU-T Y.1564?
  - ITU-T Y.1564 completes testing in two phases:
    - Phase 2: Service Performance Test—Transmits one or many services simultaneously at CIR confirming all traffic can transverse network under full service load
    - Default test time: 15 minutes, 2 hours, or 24 hours



MT1100A Service Activation Test

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- What is ITU-T Y.1564?
  - Test configurations:
    - One-way test, using two testers
      - Provides individual results for each direction
      - “Preferred configuration” in Y.1564
      - How to synchronize two instruments to test one-way FTD (Frame Transfer Delay) is an issue.

    - Round-trip test
      - FDV (Frame Delay Variation) may be irrelevant

MT1100A Service Activation Test

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- What is ITU-T Y.1564?
  - RFC 2544 often used for Service Activation Test
    - Not intended use for RFC 2544:
      - "Benchmarking Methodology for Network Interconnect Devices"
      - Defines number of tests used for describing performance characteristics of network devices
  - Y.1564 intended for Service Activation Test

Item	ITU-T Y.1564	RFC 2544
Designed for	Service activation	Device performance
Concurrent services	Multiple services simultaneously	One service at a time
Simulates	Realistic network	One service on network
Testing time	Short due to simultaneous testing of services	Long due to sequential test of parameters and services
Test result	Directly related to SLA requirements	Link performance limit

MT1100A Service Activation Test

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- Supports tests specified in Y.1564
- Features:
  - Two-step test based on:
    - Bandwidth profile parameters: CIR, EIR, CBS, EBS
    - Performance parameters: FTD, FDV, FLR, AVAIL
  - Includes support for CM (”Color Aware”) and EMIX
  - Local–Remote operation
    - One-way test results using two MT1100A units
    - GPS add-on option for one-way FTD measurements
  - Round-trip measurements

MT1100A Service Activation Test

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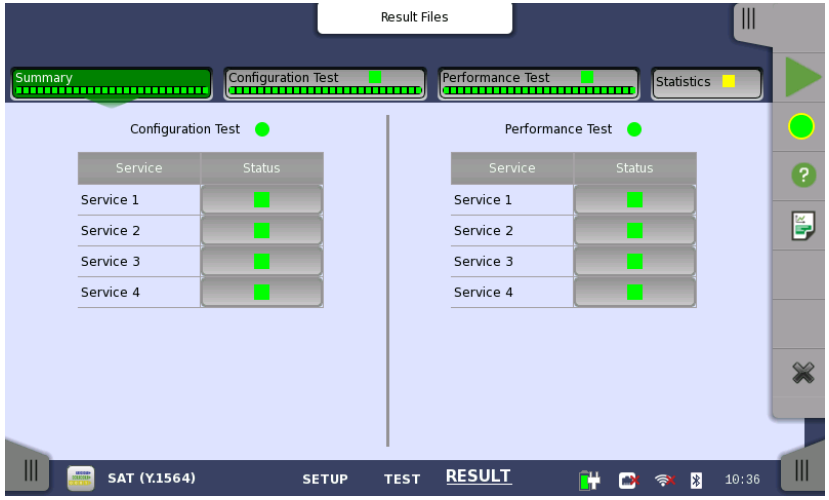
- Results
  - On instrument display
    - Easy-to-understand GO/NO GO display
    - Full result details also available
  - As pdf reports



Result Summary

Result Details

MT1100A Service Activation Test

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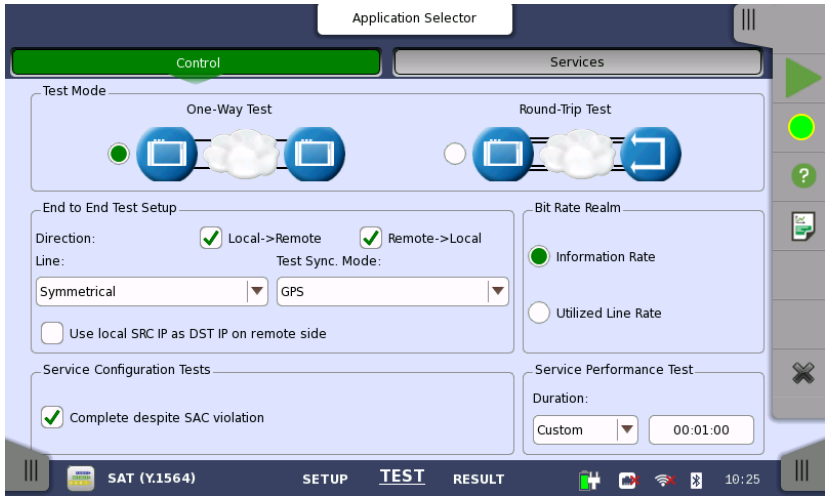
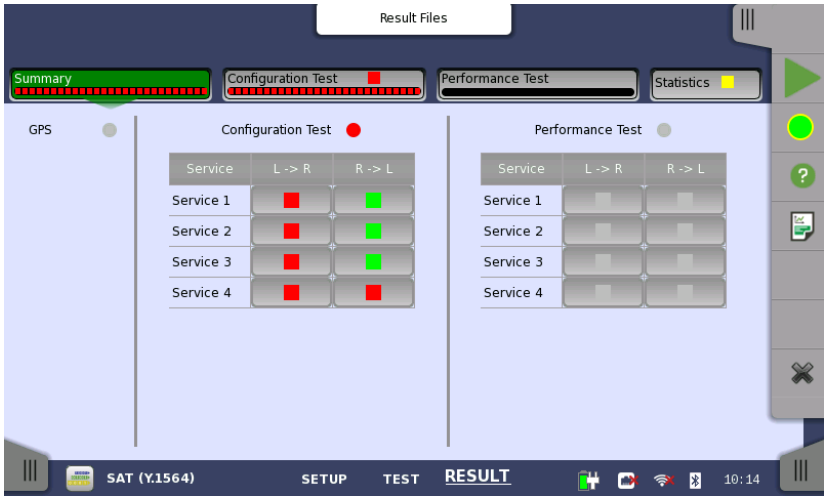
- Setup of overall test conditions
  - Display results from local and remote instruments on local instrument when one-way test (using two instruments) selected



Test Setup



Result Summary on Local Instrument after Test

MT1100A Service Activation Test

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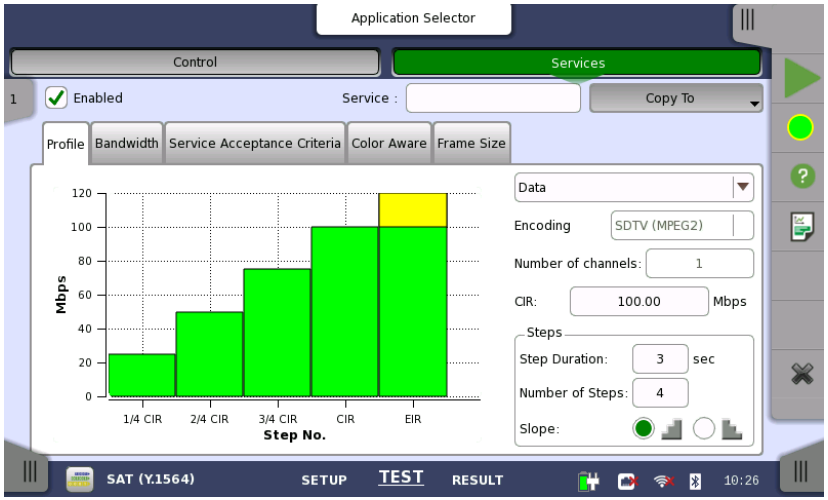
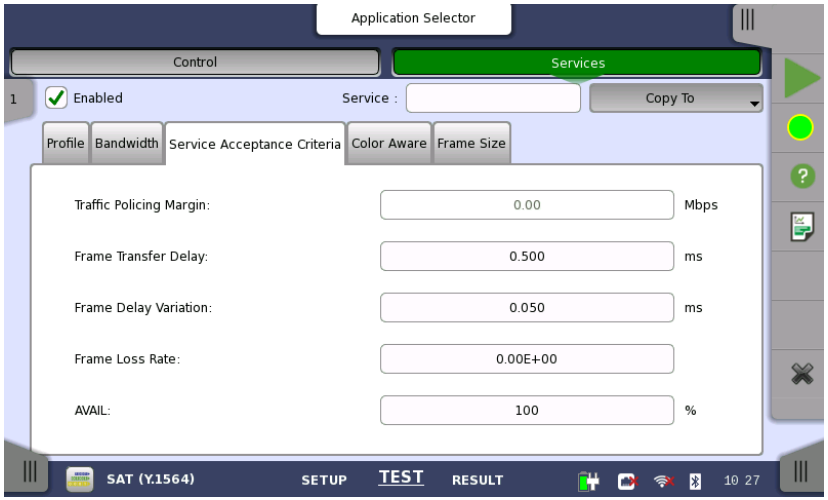
- Setup of each service
  - Graphical presentation of traffic profile for easy overview
  - Full flexibility in programming parameters





MT1100A Service Activation Test

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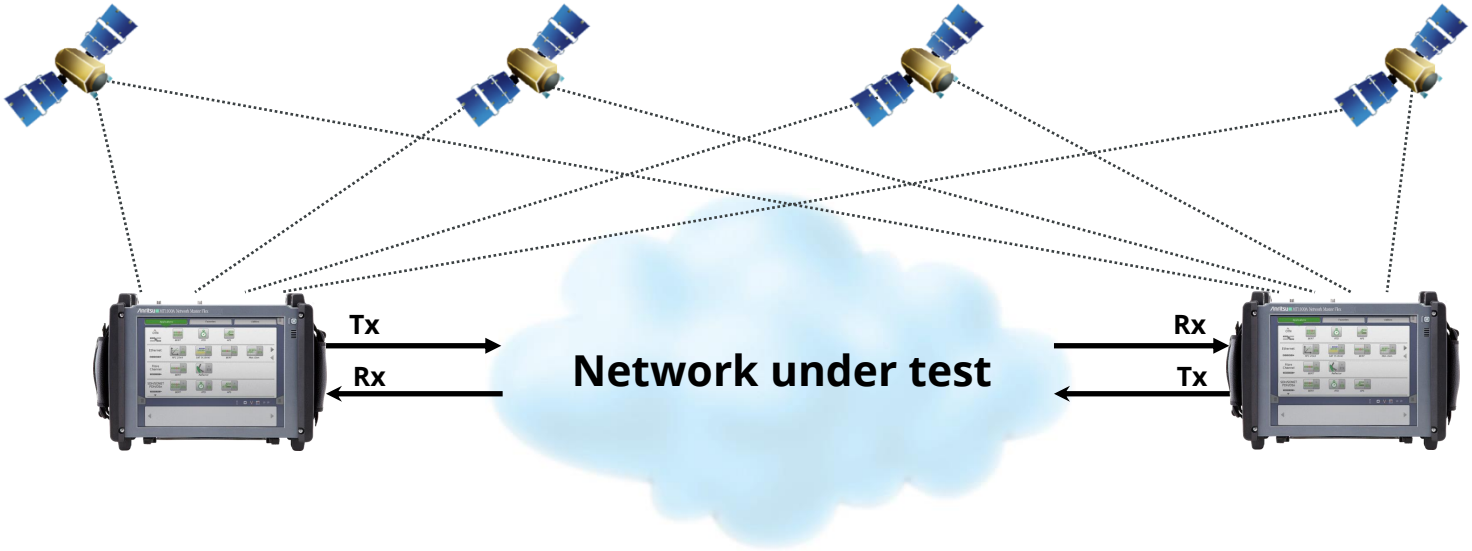
- GPS synchronization
  - Accurate information on one-way FTD with GPS synchronization option
    - Once synchronized, MT1100A holds synchronization for period of time
      - Relevant when difficult to get GPS signals at test site



MT1100A RFC 2544 Analysis

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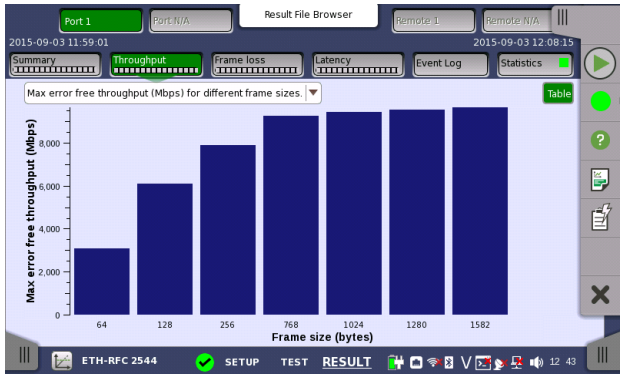
- ETF RFC 2544 “Benchmarking Methodology for Network Interconnect Devices”
  - Defines number of tests used to describe performance characteristics of network devices
  - Throughput — for selected layer
  - Frame Loss
  - Latency
  - Packet jitter
  - Burstability
- Easy-to-interpret graphs
- Full-detail tables



Graphs are bar graphs with legends (where applicable), giving users a better overview of results

RFC 2544 tables fit the screen width – no need for horizontal scrolling

MT1100A RFC 2544 Reporting

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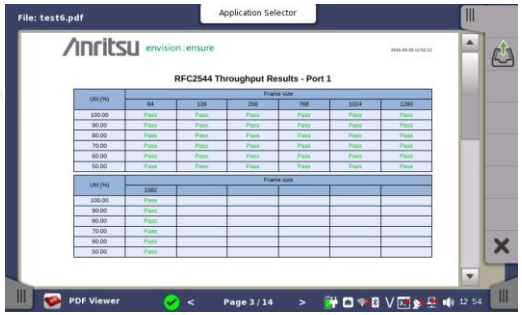
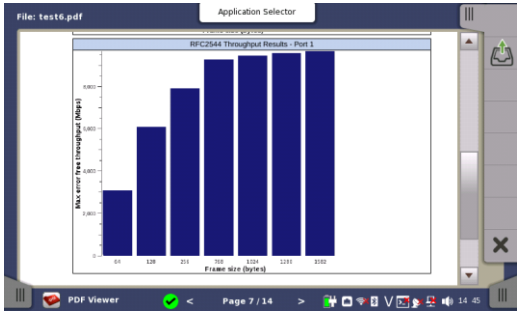
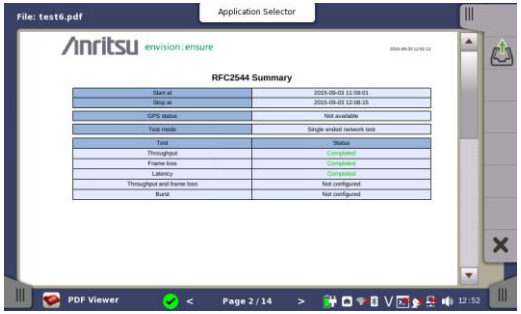
- Report tables are organized like the GUI with Tx row followed by Rx row, making it easy to find faulty test areas with Frame loss.
  - New tables display per-port test results before actual results tables.
    Users can quickly identify combinations of Frame sizes and utilizations with problems.





RFC 2544 graphs same as GUI



PDF reports are displayed with the built-in PDF viewer

RFC2544 Summary section with new table showing which tests completed

Benefit of RFC 2544 End-to-End Test

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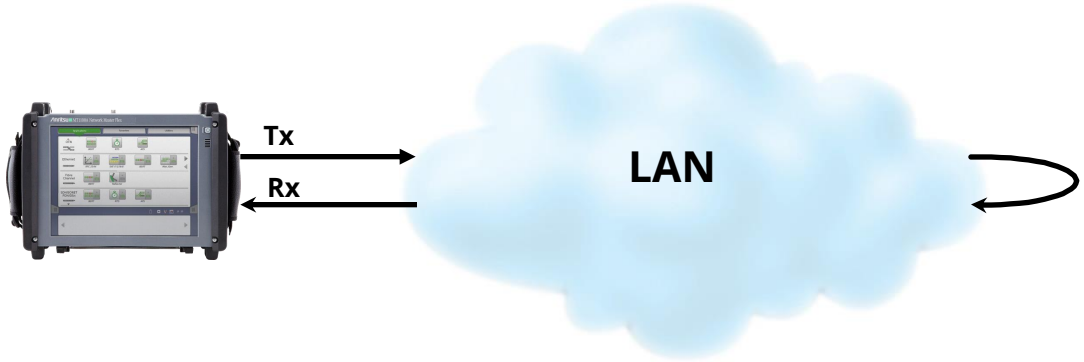
- Typical test set-up with one instrument and reflector or loop-back OK for symmetrical links:



- For Ethernet links carried over asymmetrical connections (xDSL, WIMAX) throughput tests only reflect performance of link direction with lowest capacity
- Symmetrical typical test set-up does not identify transmission performance differences between two link directions

MT1100A RFC 2544 End-to-End Test

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- RFC 2544 end-to-end test with Local–Remote relationship
  - Needed for test of Ethernet links over asymmetrical connections
  - Identifies transmission performance differences between two directions in link
  - User sets test at local master instrument which exchanges set-up and results with remote slave instrument
  - Tests Throughput, Frame Loss and Burstability
  - Tests two lines simultaneously

MT1100A Ethernet Ping Test

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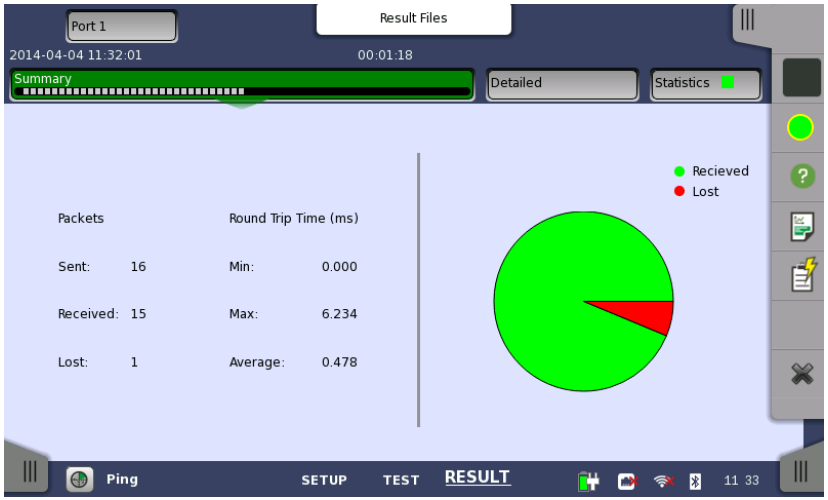
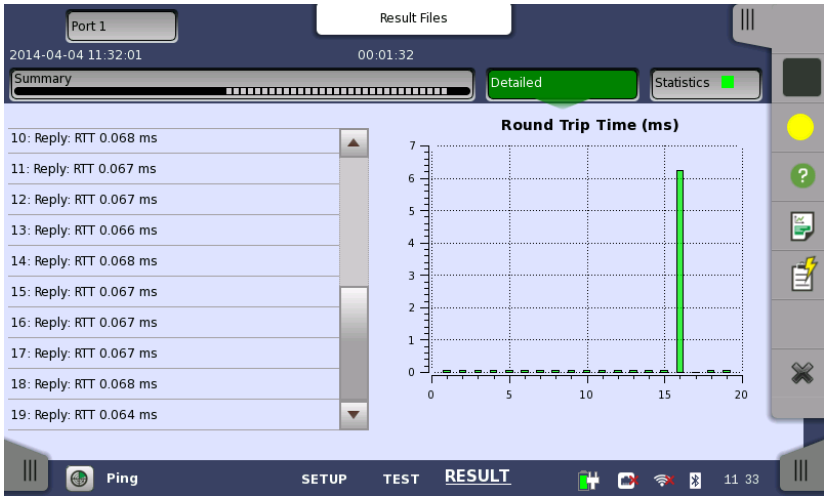
- Ping test applications:
  - Installation and commissioning
  - Troubleshooting and maintenance
- Popular tool for testing:
  - Continuity
  - Connectivity
  - Response time





MT1100A Ethernet Traceroute Test

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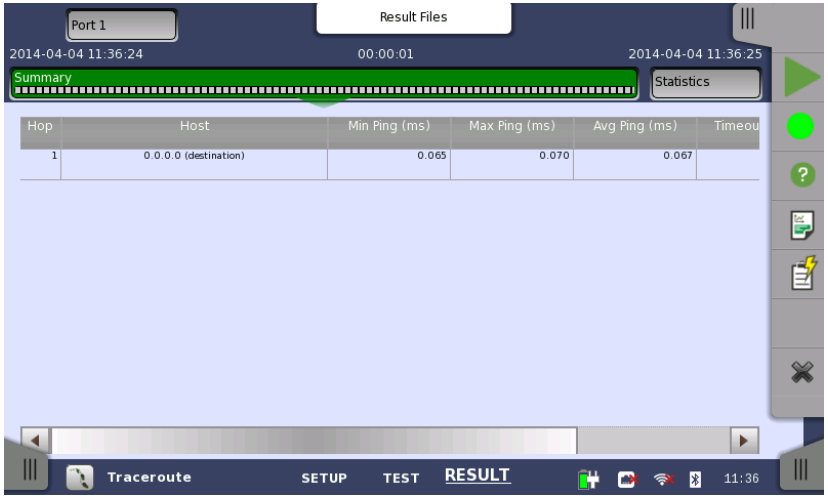
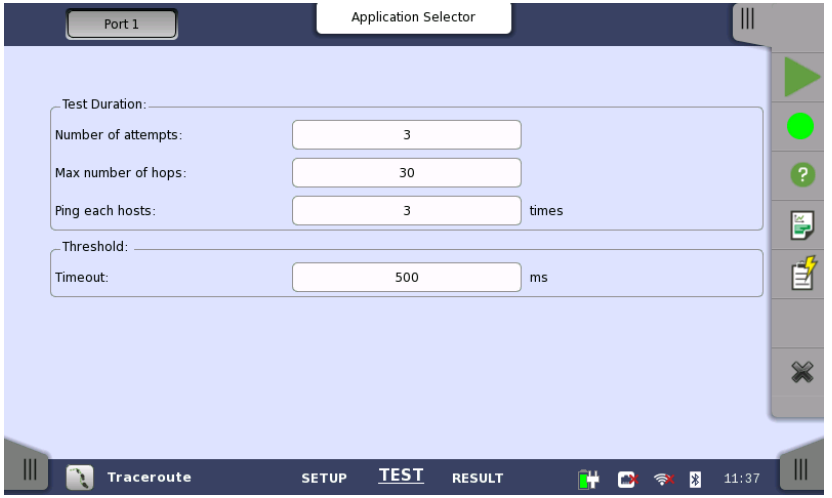
- Traces IP route over IP network
- Ping timing data per hop





MT1100A Ethernet BER Tests

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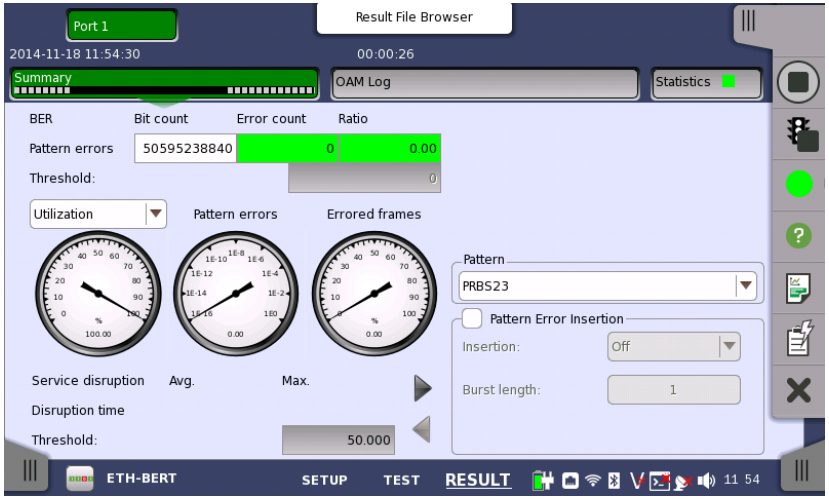
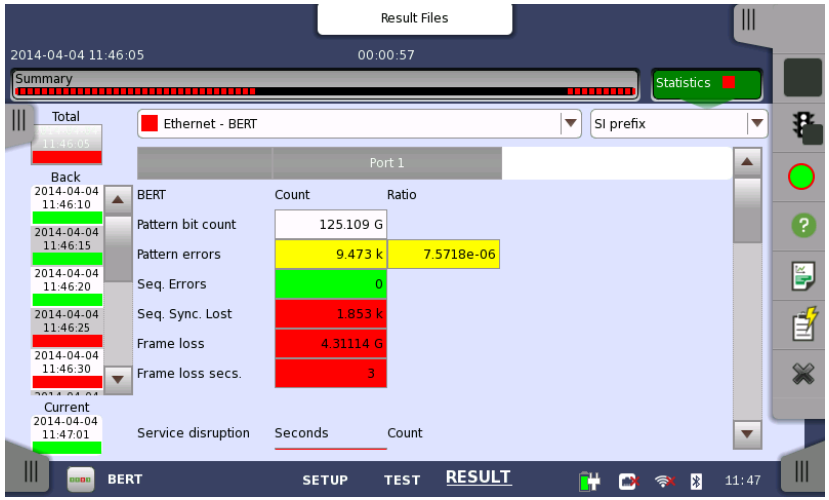
- Traditional test of physical connection
- Generates and detects test patterns
- Counts errors in received test pattern
- Color-coded errors and alarms for easy overview
- Pattern generation:
  - Unframed
  - Layer 2 (Mac address)
  - Layer 3 (with IP header)
  - Layer 4 (with UDP/TCP header)
- Detects sequence errors and loss of sequence synchronization
- Frame loss count and frame loss seconds





MT1100A BER Tests

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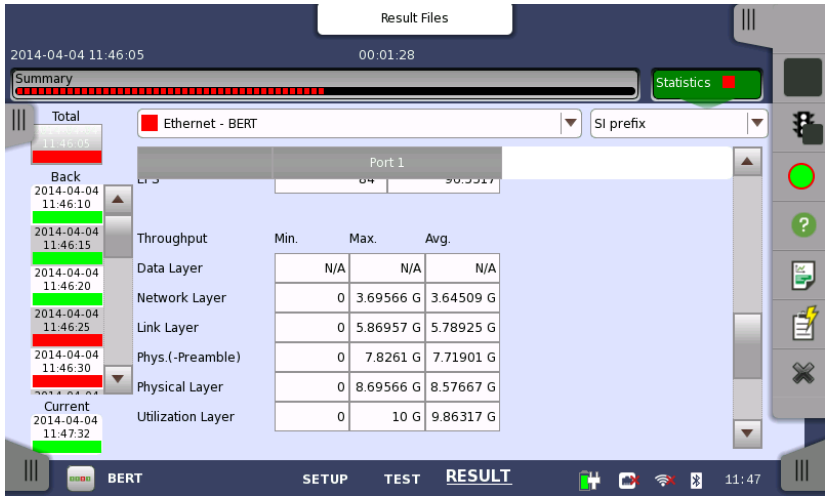
- Layered Throughput analysis

Frame representation	Throughput Calculation
IFG | Pre-amble | MAC header | MPLS (opt) | EoMPLS (opt) | VLAN (opt) | LLC (opt) | SNAP (opt) | IP head | UDP TCP | PAYLOAD | CRC	Data layer
IFG | Pre-amble | MAC header | MPLS (opt) | EoMPLS (opt) | VLAN (opt) | LLC (opt) | SNAP (opt) | IP head | UDP TCP | PAYLOAD | CRC	Network layer
IFG | Pre-amble | MAC header | MPLS (opt) | EoMPLS (opt) | VLAN (opt) | LLC (opt) | SNAP (opt) | IP head | UDP TCP | PAYLOAD | CRC	Link layer
IFG | Pre-amble | MAC header | MPLS (opt) | EoMPLS (opt) | VLAN (opt) | LLC (opt) | SNAP (opt) | IP head | UDP TCP | PAYLOAD | CRC	Physical layer no preamble
IFG | Pre-amble | MAC header | MPLS (opt) | EoMPLS (opt) | VLAN (opt) | LLC (opt) | SNAP (opt) | IP head | UDP TCP | PAYLOAD | CRC	Physical layer
min. IFG | Pre-amble | MAC header | MPLS (opt) | EoMPLS (opt) | VLAN (opt) | LLC (opt) | SNAP (opt) | IP head | UDP TCP | PAYLOAD | CRC	Utilization layer
CMA 3000 frame size (does not include Preamble) Area included in throughput calculation min. IFG | Area included in utilization calculation	Frame information



Why Service Disruption on Ethernet Links?

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- Many Ethernet links carried over OTN/SDH/SONET via backbone network
  - OTN/SDH/SONET networks sometimes have Automatic Protection Switching (APS)
  - If OTN/SDH/SONET network line fails, APS switches traffic to working line
  - Switch and service disruption should be completed in less than 50 ms

MT1100A Service Disruption Measurement

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- Service disruption can be measured as part of BER test
  - Using far-end loopback or two MT1100A testers
  - Max. acceptable service disruption time can be set
    - Color-coded results when max. time exceeded

MT1100A Ethernet Signal Analysis

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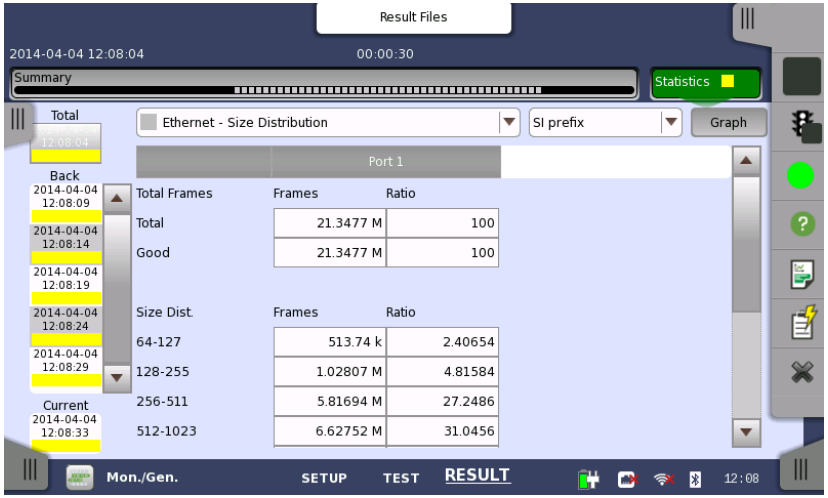
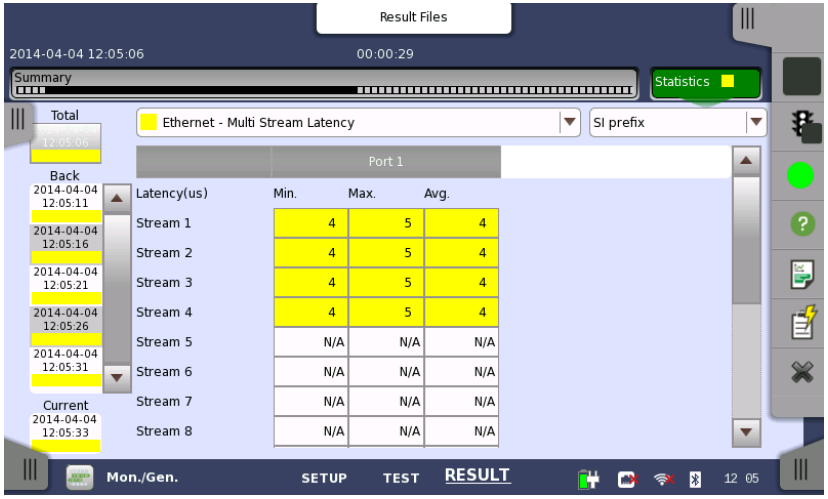
- Frame performance
- Frame type statistics
- Frame size distribution statistics
- Burst statistics
- Transmit statistics
- Full-detail tables
- User-defined thresholds to highlight problems

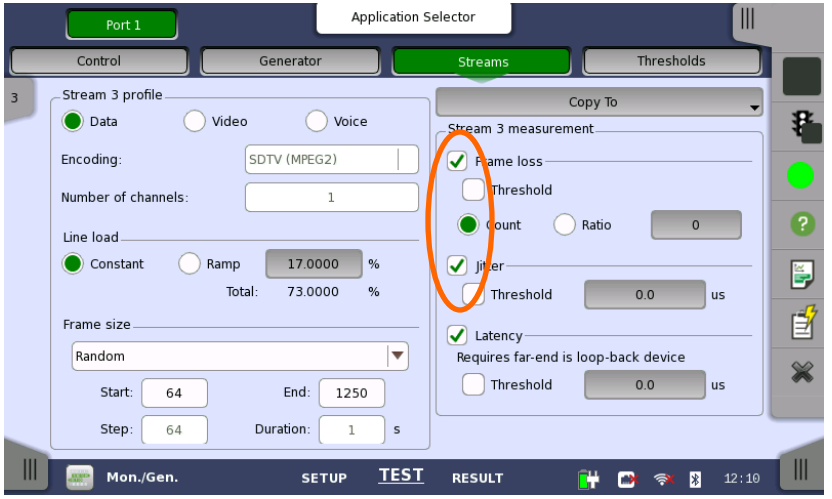


MT1100A Latency and Packet Jitter Measurements

Back to Index page

- Latency and packet jitter can cause problems for real-time services like VoIP
  - Part of statistical measurements
  - User selects included information





Benefit of Ethernet Multistream Test

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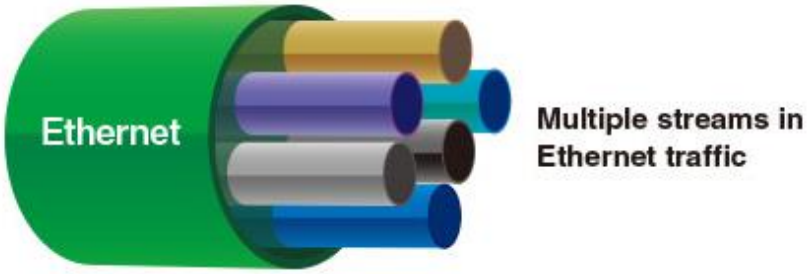
- By sending several traffic streams with different priority settings, the user can verify that high-priority traffic is transported better (i.e. has lower frame loss) through a congested network than low-priority traffic.



- VoIP traffic is often given high priority to ensure service quality
  - Sometimes DSCP/TOS byte used to give high priority
  - Other times high priority given to selected TCP/UDP ports
- Some operators allocate certain traffic capacity to each traffic type on link with limited capacity
- User can verify that each traffic types gets allocated capacity by sending several traffic streams with different type indications
  - Traffic type indicated by VLAN tags

MT1100A Ethernet Multistream Test

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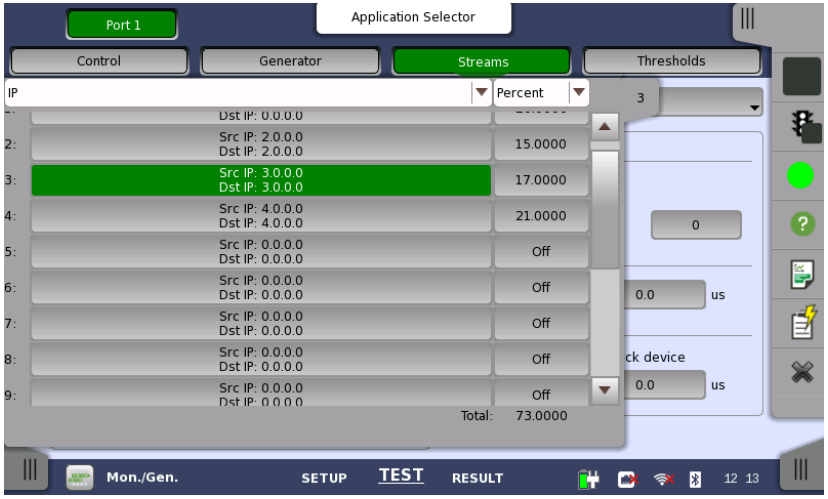
- Using MT1100A, user can generate up to 16 streams per port on Ethernet link
  - Individual settings for traffic load and header information for streams, including DSCP/TOS byte and TCP/UDP port numbers for each stream



Stream Selector and Overview

MT1100A Ethernet Multistream Test

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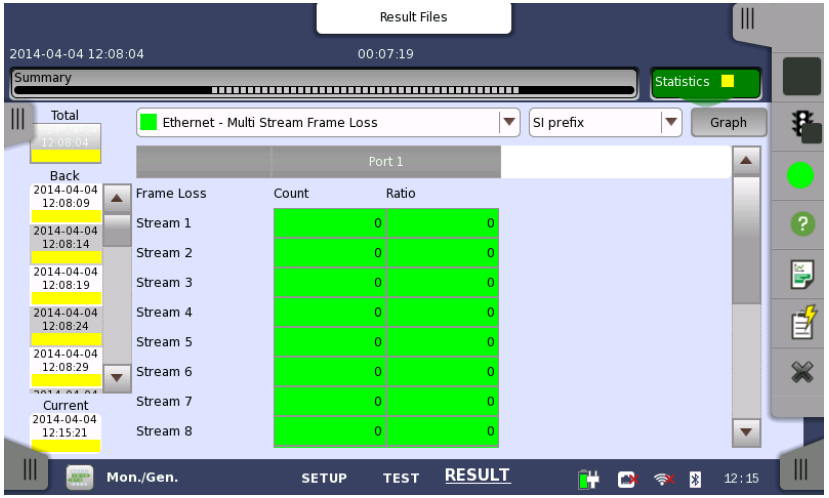
- Multistream function displays frame loss for up to 16 streams per port, making it easy to spot whether high-priority traffic has lower frame loss than low-priority traffic



Simple Stream Address Creation

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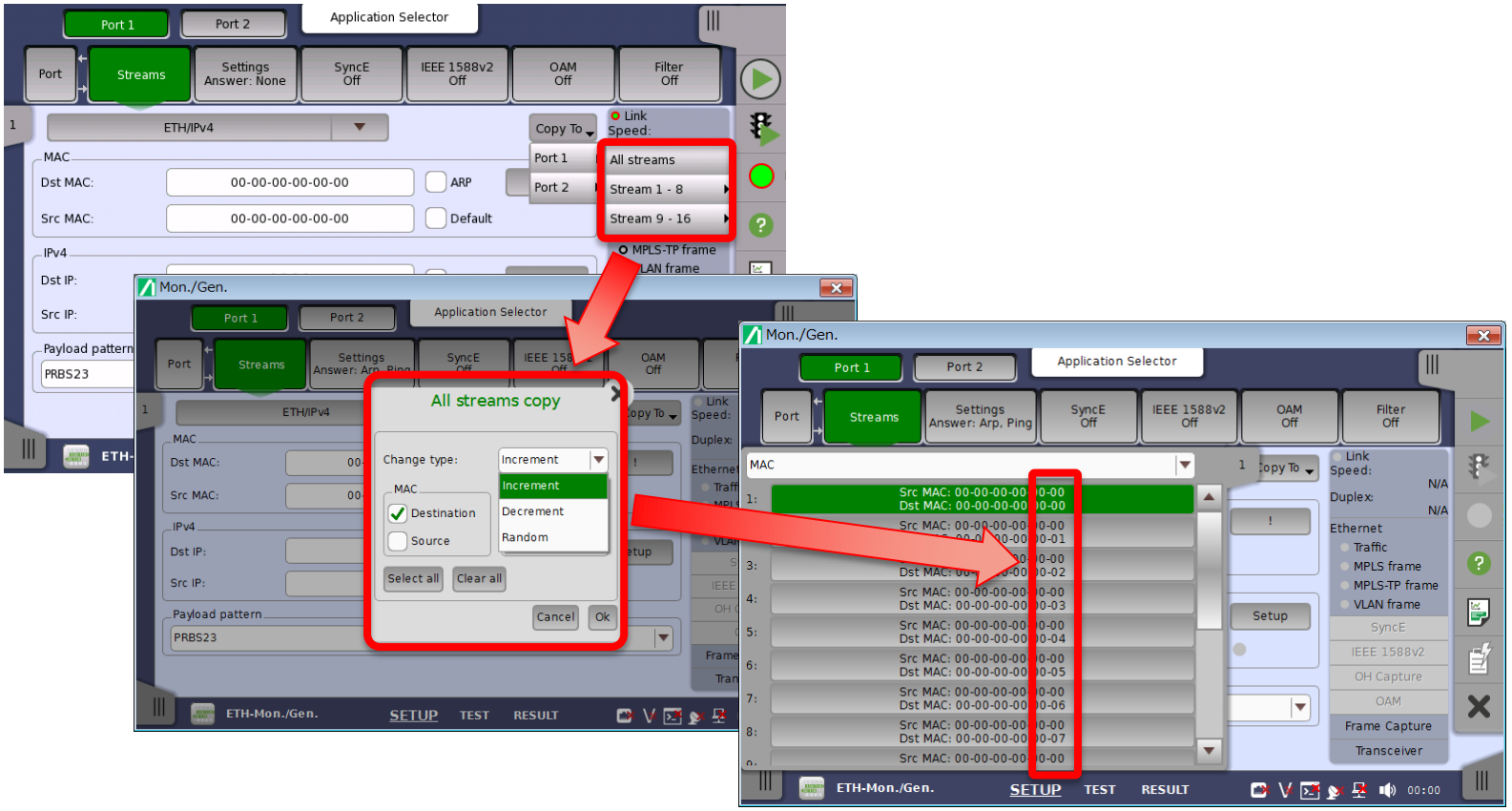
- When generating Ethernet and IPv4/v6 test Frames, a function supports creation of [Increment], [Decrement], and [Random] streams for the address specified location, resulting in shorter test setting times.



VLAN Background

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- Virtual Local Area Networks (VLANs) - IEEE 802.1Q
  - Segment LAN on organizational basis, by functions, project teams or applications
    - Each VLAN has ID and priority
      - 802.1p priority bits (3) segment traffic into eight Classes of Service (CoS), enabling traffic differentiation
      - 12-bit ID supports 4096 VLANs
- Stacked VLAN (“Q-in-Q”) IEEE 802.1ad
  - VLAN carried on VLAN
    - Method to provide more VLAN IDs
    - Allows service provider to carry customer VLAN traffic transparently service provider VLAN
    - Sometimes service provider and/or customer use more than one VLAN tag

MT1100A Ethernet Stacked VLAN Function

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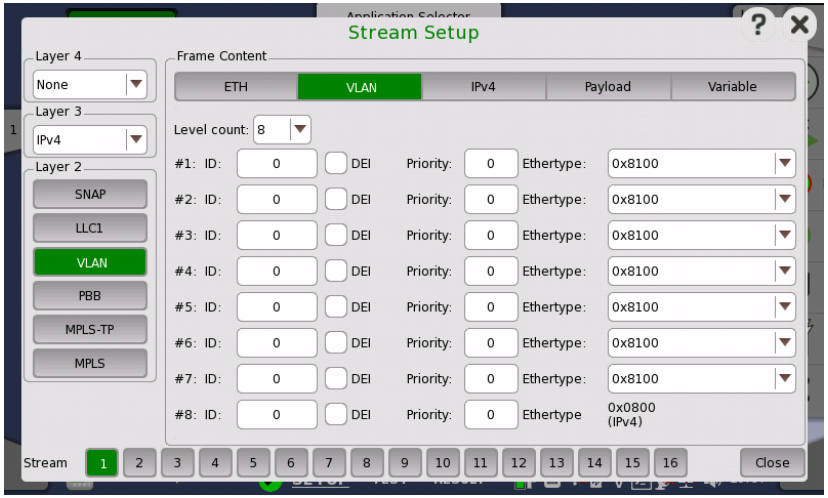
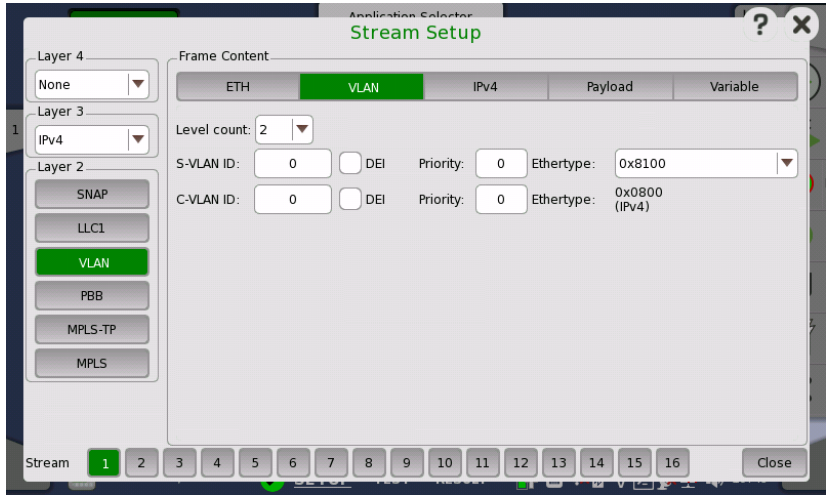
- Insert up to eight layers of VLAN tags into Ethernet frame
  - Can be combined with Multistream function
  - Special layer naming when two layers selected
    - S-VLAN – Service provider VLAN
    - C-VLAN – Customer VLAN





CFI bit renamed to DEI (Drop Eligible Indicator)

MT1100A Ethernet Stacked VLAN Function

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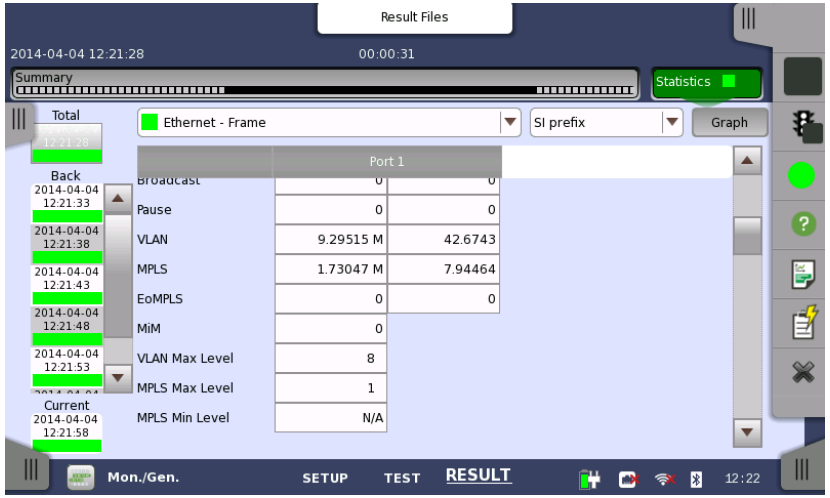
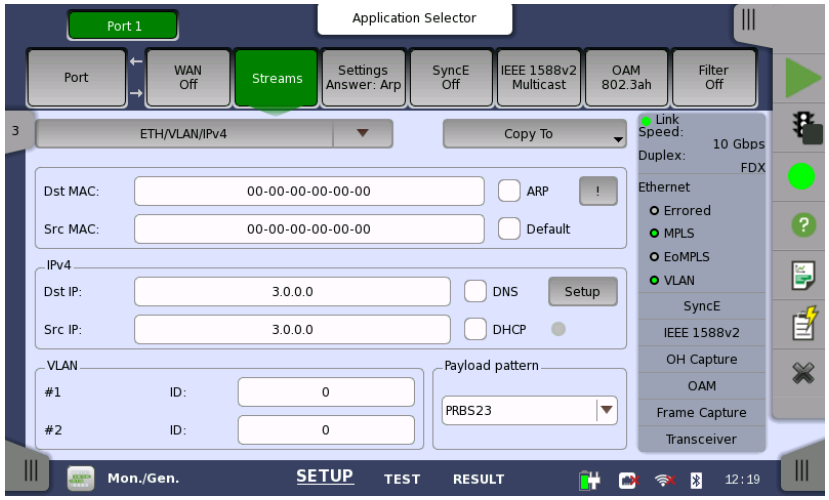
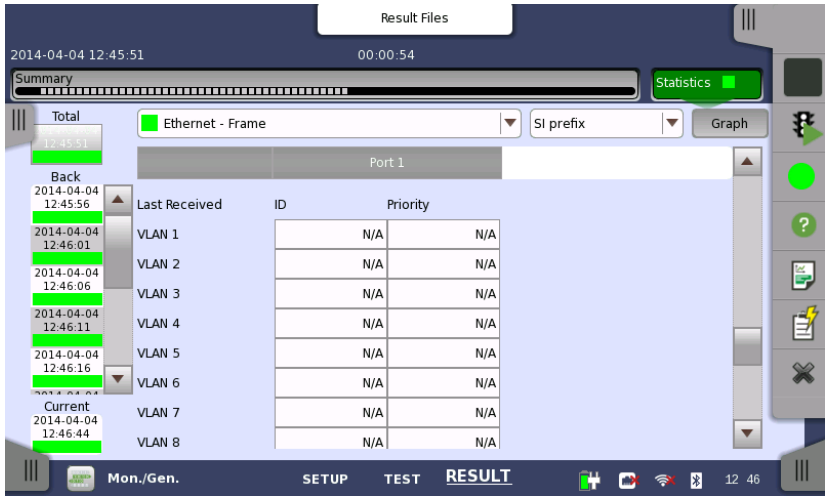
- VLAN information:
  - Indicates detected VLAN tagged frames in Status pane
  - Counts detected VLAN tagged frames and max. VLAN tag level in statistical measurements
  - Displays information on last received VLAN frame







MPLS Background

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- Multi-Protocol Label Switching (MPLS)
  - Carries data; considered to be between Layer 2 (Data Link Layer) and Layer 3 (Network Layer); often called "Layer 2.5“.
  - Simplifies point-to-point routing
    - MPLS header has one or more 'labels’ (label stack) and each label has four fields:
      - 20-bit label value
      - 3-bit field for QoS priority
      - 1-bit bottom of stack flag
      - 8-bit TTL (time to live) field
- EoMPLS (Ethernet over MPLS) or PWE3 (Pseudo Wire Emulation Edge-to-Edge)
  - Defines method to transport Layer 2 protocol across MPLS network

MT1100A MPLS/MPLS-TP Function

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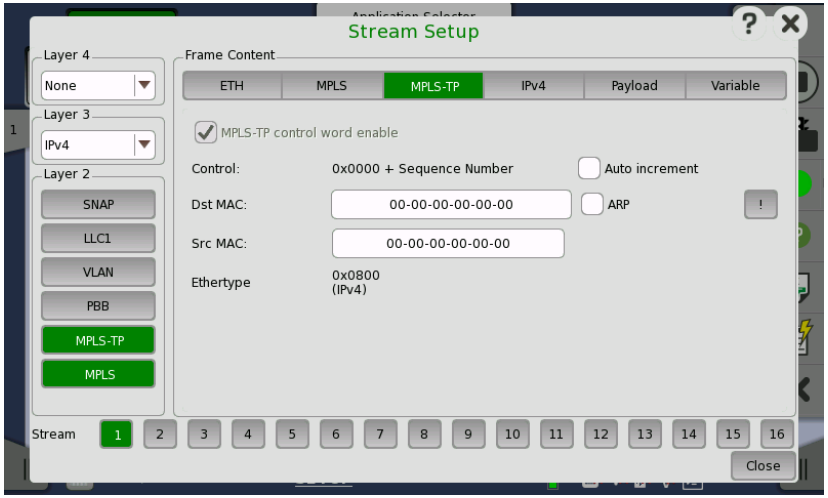
- Stacked MPLS generation
  - Inserts up to 8 layers of MPLS labels into Ethernet frame
  - Can be combined with Multistream facility
  - EoMPLS Control word can be added with MPLS-TP



MT1100A MPLS/MPLS-TP Function

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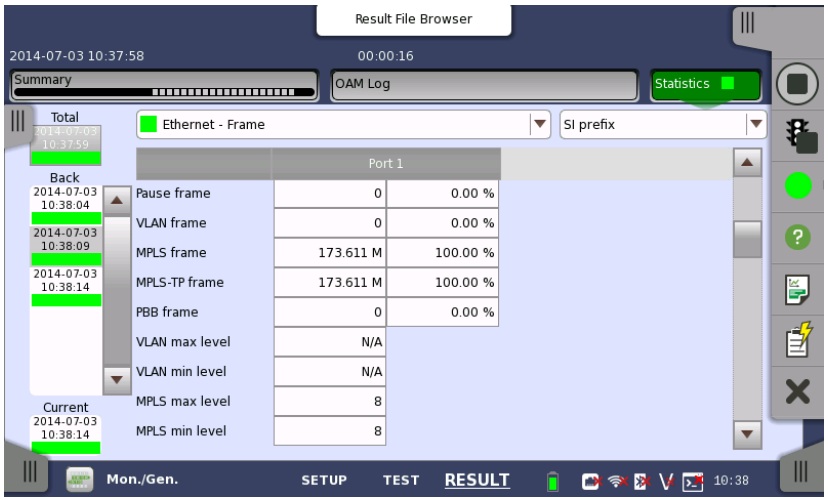
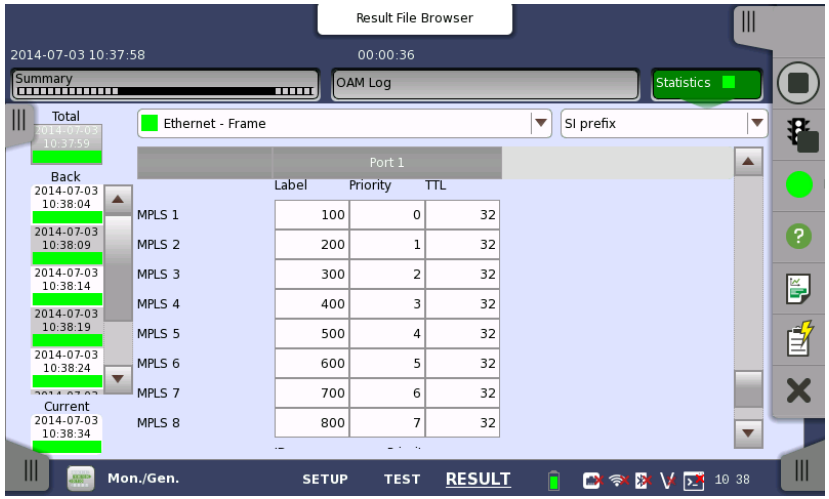
- MPLS information:
  - Indicates detection of MPLS and EoMPLS frames in Status pane
  - Counts detected MPLS and MPLS-TP (EoMPLS) frames and max. MPLS layer
  - Displays information on latest received MPLS frames





MT1100A MPLS-TP Function

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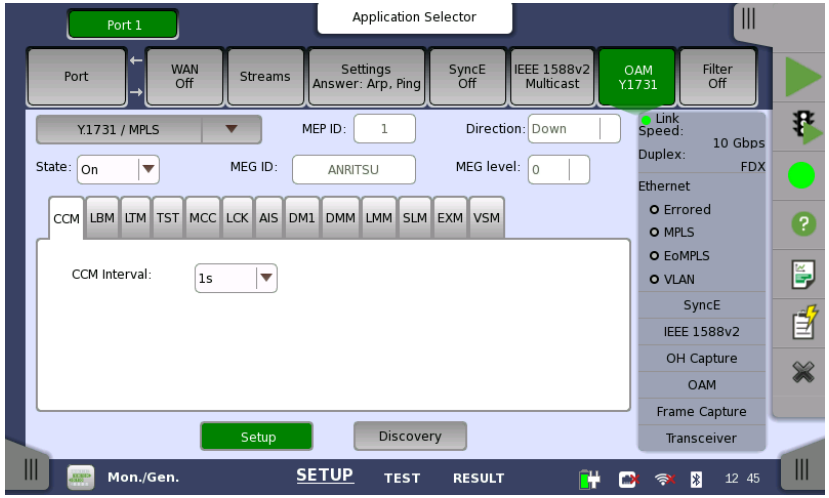
- MPLS-TP information:
  - Activation of MLPS-TP OAM function



MT1100A PBB Function

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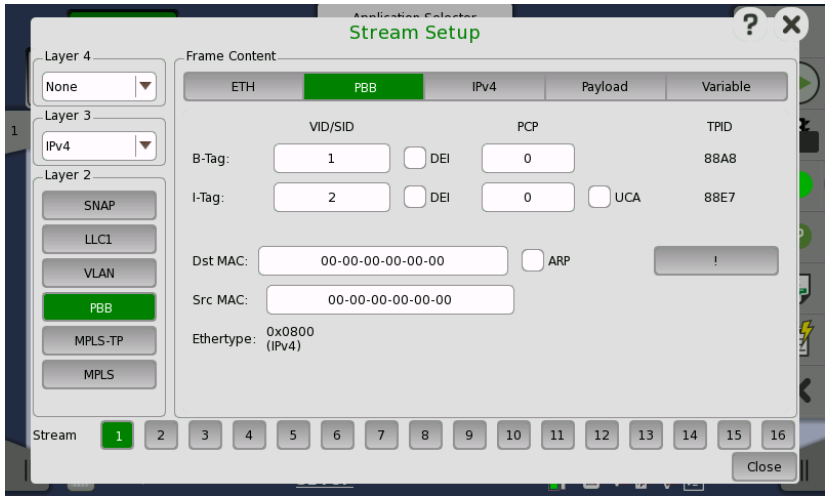
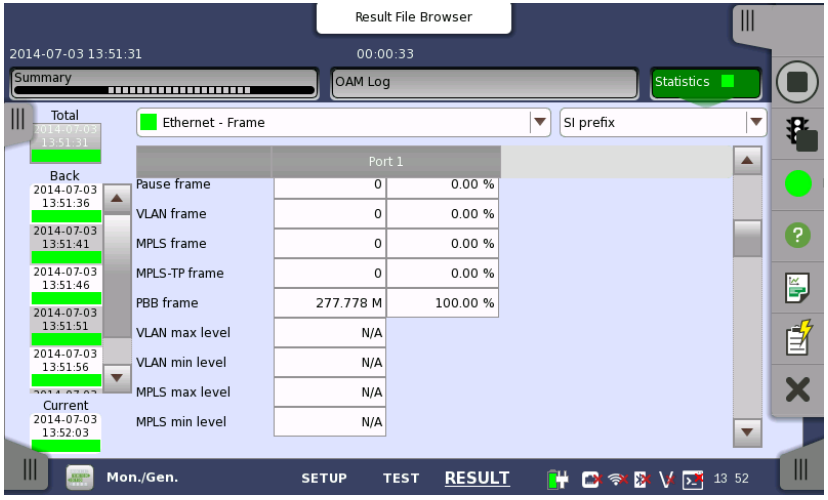
- PBB(Mac-in-Mac) information:
  - Counts PBB frames at result page
  - Can be combined with Multistream facility





MT1100A TCP Function

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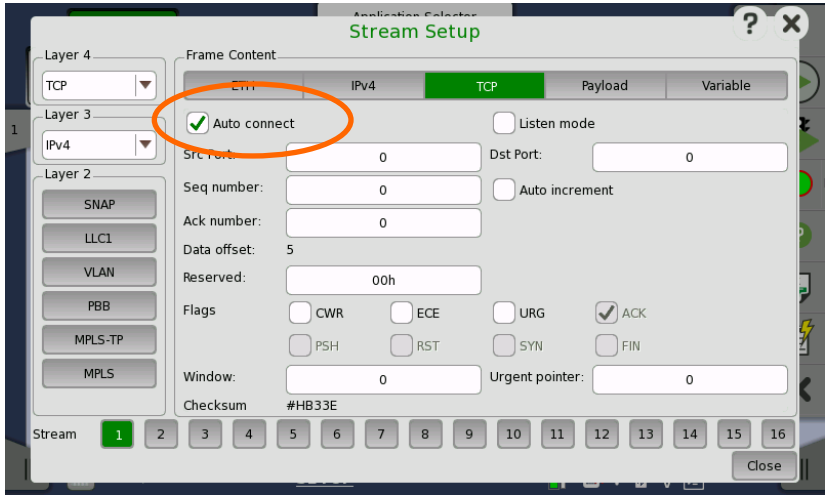
- Set TCP connections before sending traffic with TCP headers
  - Allows traffic to pass firewalls using “state-full inspection”
  - Limited implementation:
    For example:

    No retransmissions
    No flow control



MT1100A Ethernet Traffic Generator

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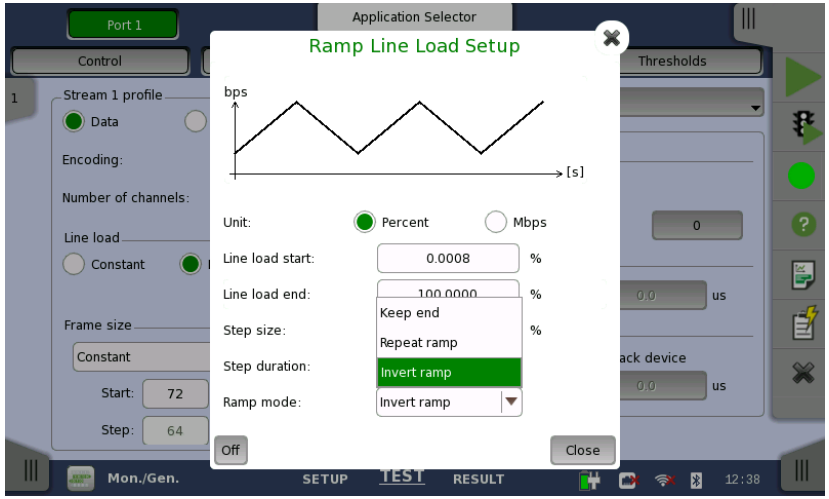
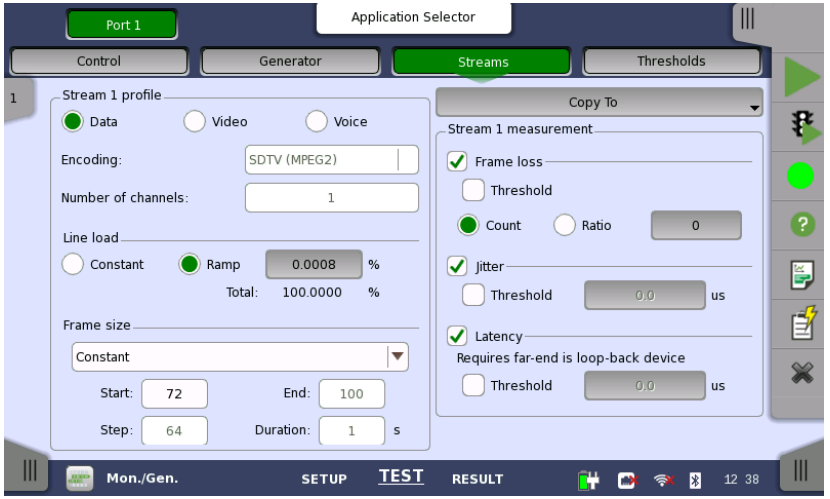
- Ramp Traffic: Increases traffic automatically until maximum capacity exceeded
  - Program control for each stream
- Burst Traffic: Continuous sending at specified conditions
- Generate Tx rates above 100%
- Data type profiles (data, video, audio)





Custom Editing of Ethernet Header

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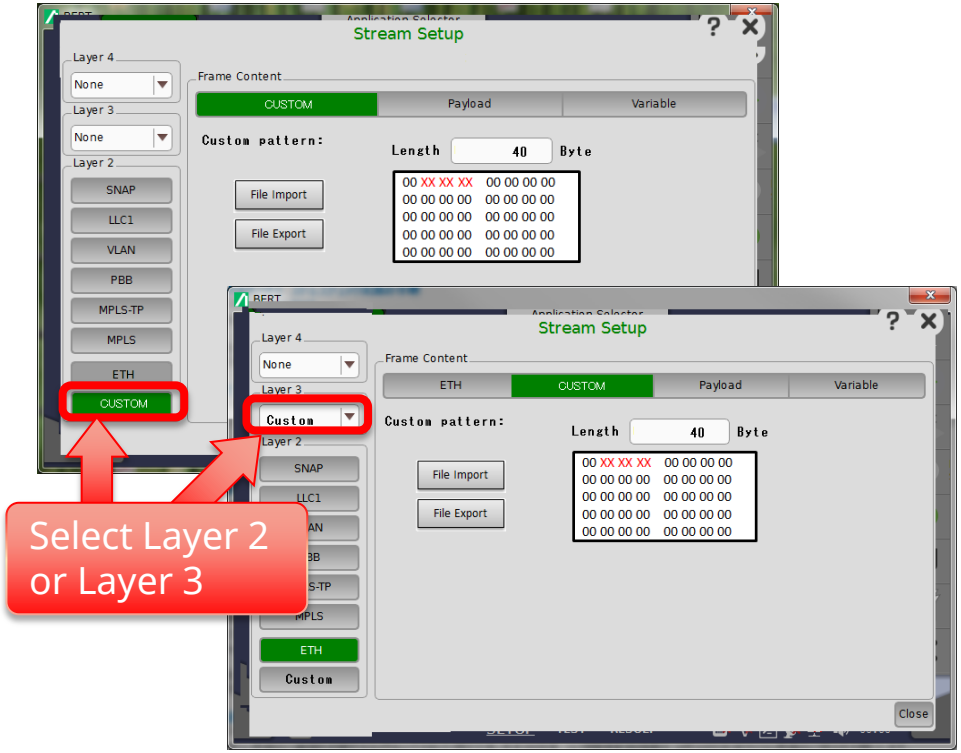
- Free editing of the Ethernet Header in the Frame stream settings to support special protocols for R&D.
  - This function can be used with the following applications:
    - Ethernet BERT Application



- ✓ Edit Custom header with text editor for Save and Load
- ✓ Supports Header lengths up to 256 bytes

- ◆ The following restrictions apply:
  - "Ethernet over OTN" not supported
  - Rx filters other than Layer 2 not supported when using Layer 3 Custom headers
  - No Rx filters supported when using Layer 2 Custom headers
  - Arp/Ping functions not supported when using Layer 2/3 Custom headers

MT1100A Ethernet Frame Capture Function

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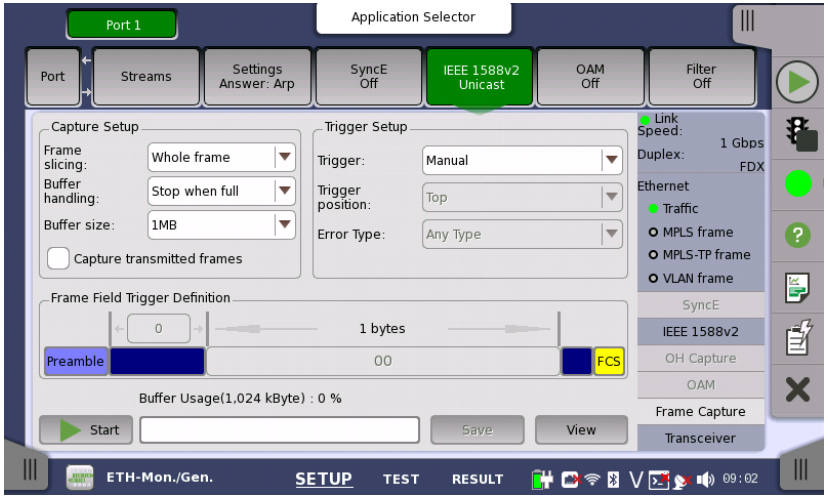
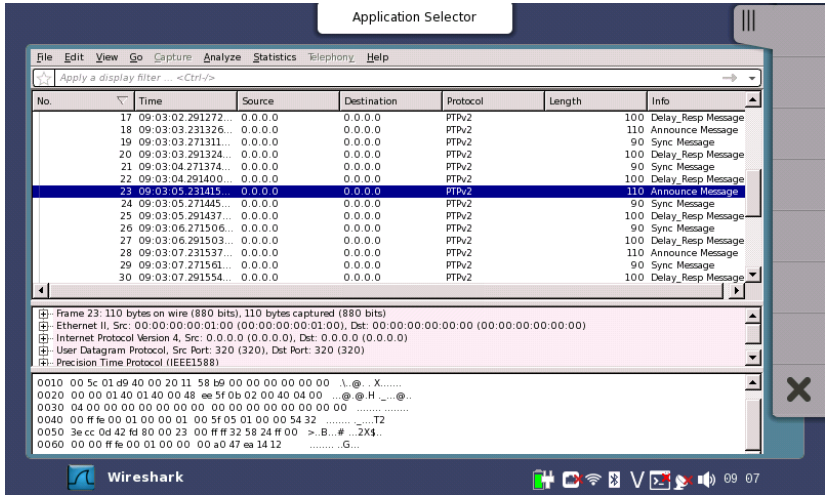
- Protocol analysis
  - For advanced Ethernet troubleshooting
  - Captures frames in live traffic of monitored line
  - Analyzes captured frames using Wireshark® protocol analysis software





Network Discovery and In-band Control

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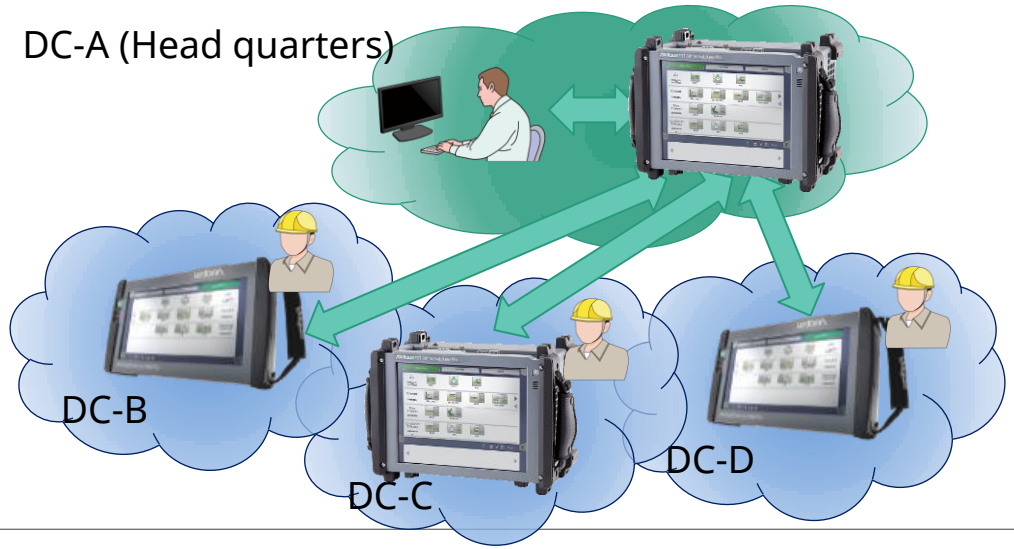
- No Need for Two Engineers for End-to-end Test
  - One engineer controls both local and remote testers without dedicated LAN for remote access
  - Testing from one end cuts OPEX
- Process
  - Discover other “Network Master(s)” on network
  - Remote-control far-end tests, such as RFC2544, Y.1564, Reflector (L2/L3/L4 loopback) etc.
  - Generate report at local controller with results summarized at both local and remote testers



Validating PCS

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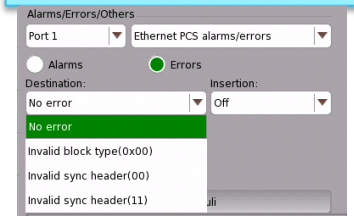
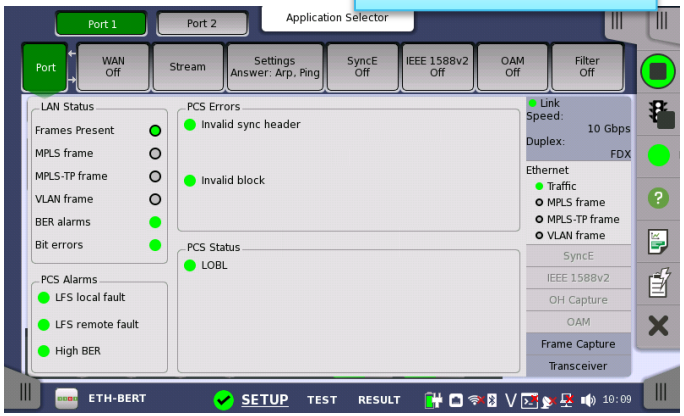
- Validating PCS operation at the 10 GbE interface to support fast troubleshooting in the PCS layer:
  - Error/Alarm Insertion
  - Error/Alarm Display/Count
  - 10G/40G/1000G LAN PHY is supported

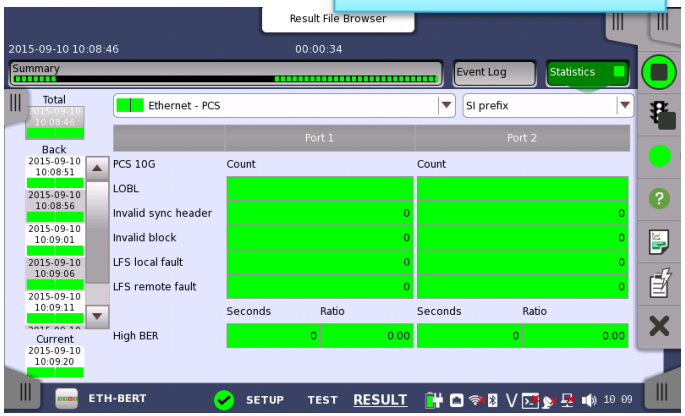
Error/Alarm Insertion Screen



PCS Error/Alarm Status



PCS Error/Alarm Statistics



- Does not support Stimuli function Invalid alignment marker/BIP error

10G WAN PHY Background

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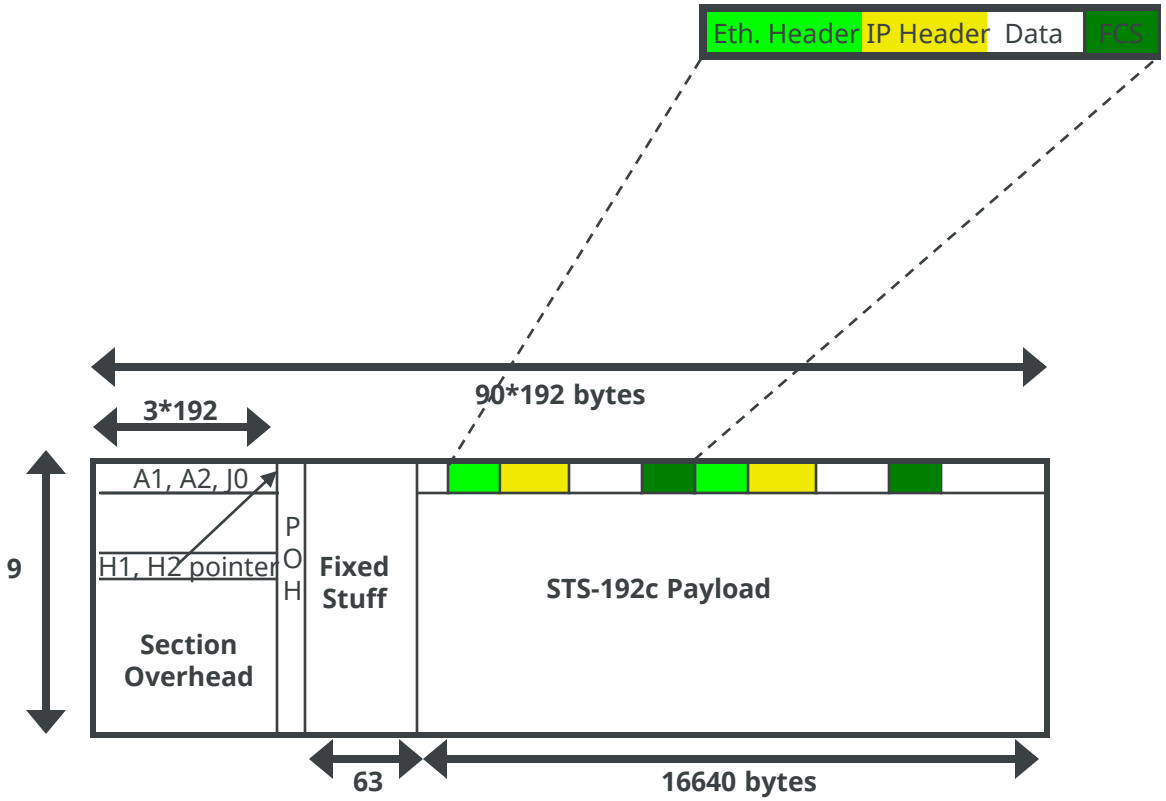
- 10G WAN PHY
  - Mapping Ethernet frames to SONET/SDH



Fixed pointer in transmitted WAN signal; may have changed value when reaches destination

MT1100A 10G WAN PHY Function

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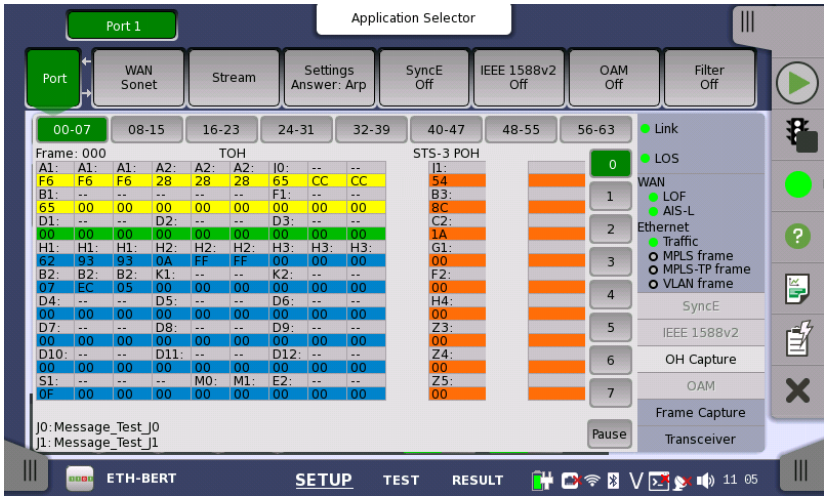
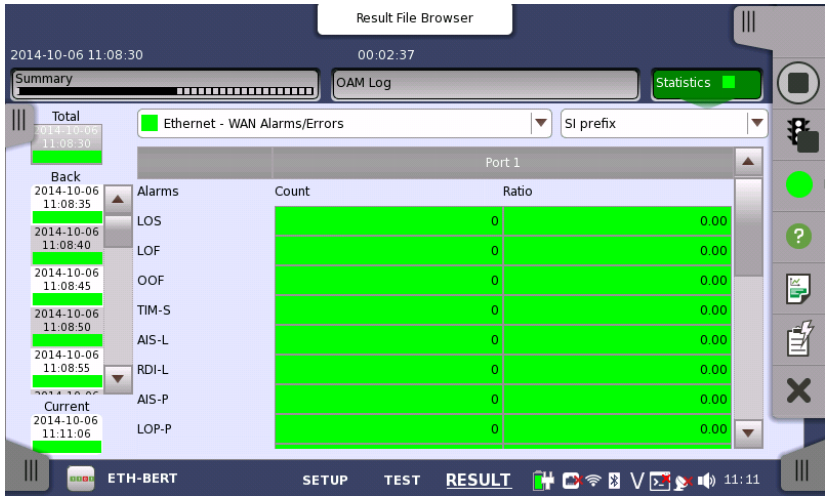
- WAN results
  - Bi-directional overhead byte capture (requires dual-port version)
  - Error and alarm statistics on WAN part of signal with Ethernet BERT application





MT1100A 10G WAN PHY Function

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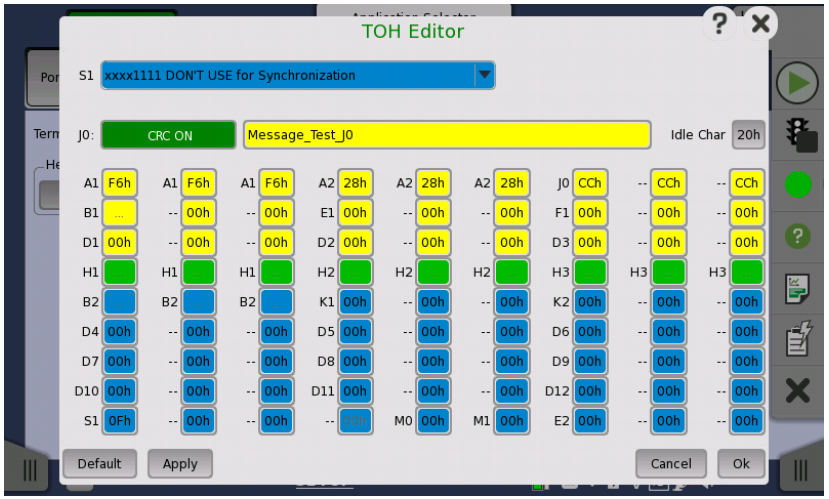
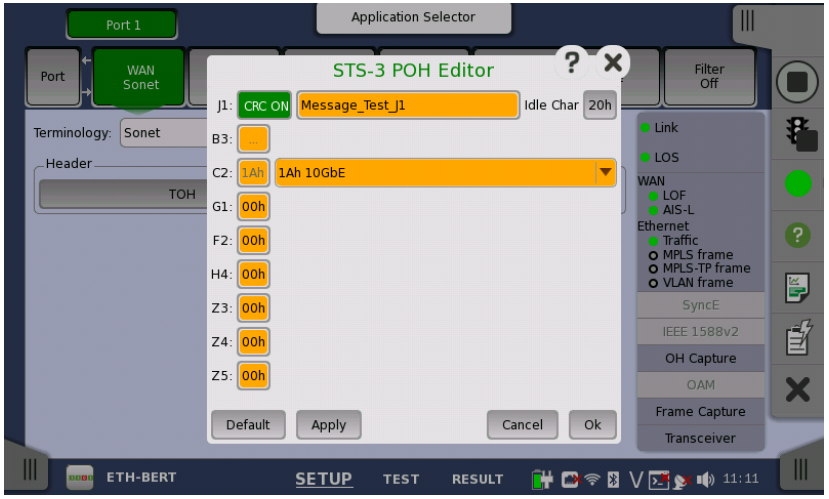
- WAN overhead byte generation
  - User programming of transmitted OH bytes
  - SDH or SONET terminology





Network Master Flex MT1100A

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- TCP Throughput Option (RFC 6349)

RFC 6349 Testing – TCP Throughput Option (up to 10 Gbps)

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- Optimized performance essential in modern communication networks
- IP network operators can test networks based on IETF RFC 2544 and ITU-T Y.1564
  - Even when network seems fine at these tests, customers may complain that achieved throughput below agreement with operator
  - Can be caused by non-optimal configuration of Transmission Control Protocol (TCP) providing higher-layer connections through network, or badly configured network element burst size settings
- TCP adds reliability to communication over IP network because data receiver acknowledges packets received correctly
  - To support this, network elements have buffering
    - Data throughput reduced if buffering dimensions incorrect
- Operators use RFC 6349 test methodology to optimize TCP throughput

Benefit of TCP Throughput Test (up to 10 Gbps)

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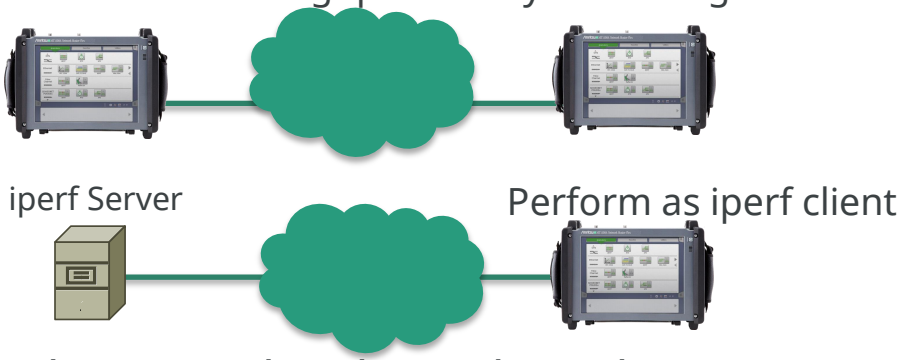
- Eliminate end-user factors from test by emulating TCP host

Bi-directional TCP throughput test by emulating end user hosts



- MT1100A TCP throughput test hardware based
  - Always validate maximum TCP throughput potential possible on customer's network.
  - Repeatable tests with consistent results
- MT1100A can perform bi-directional TCP throughput testing
  - More realistic test result can be got.
- MT1100A can test up to four ports simultaneously
  - Can shorten multiple network commissioning test time.

RFC 6349 Testing – TCP Throughput Option (up to 10 Gbps)

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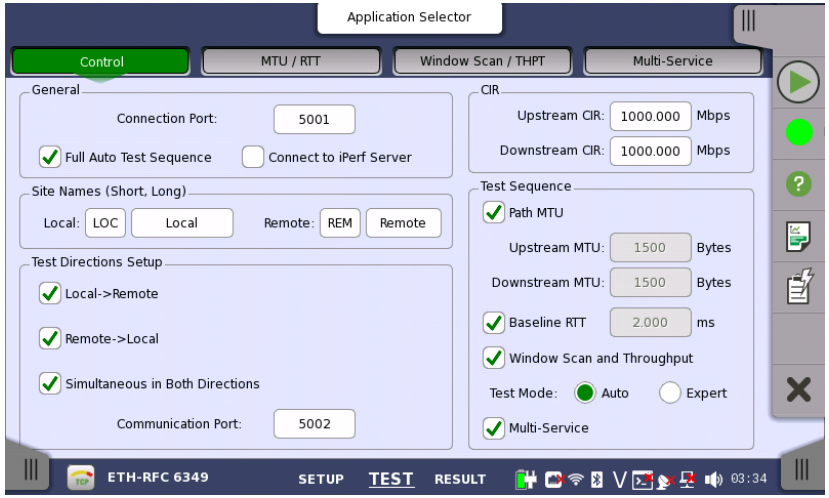
- TCP performance verification using RFC 6349 test methodology
- Client and server modes
- Connect to iperf server as client
- Automated or manual testing
  - New installation mode
  - Troubleshooting mode
- Simultaneous bi-directional testing with independent settings
- Configuration of TCP Throughput (RFC 6349) test



RFC 6349 Testing – TCP Throughput Option (up to 10 Gbps)

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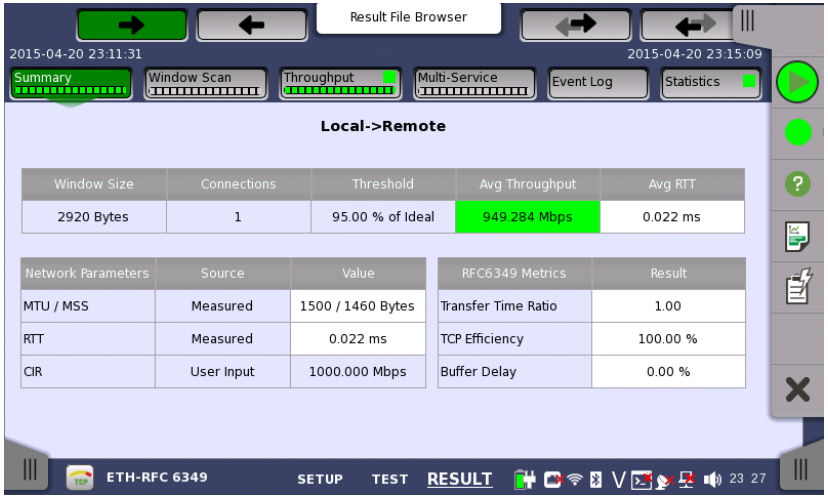
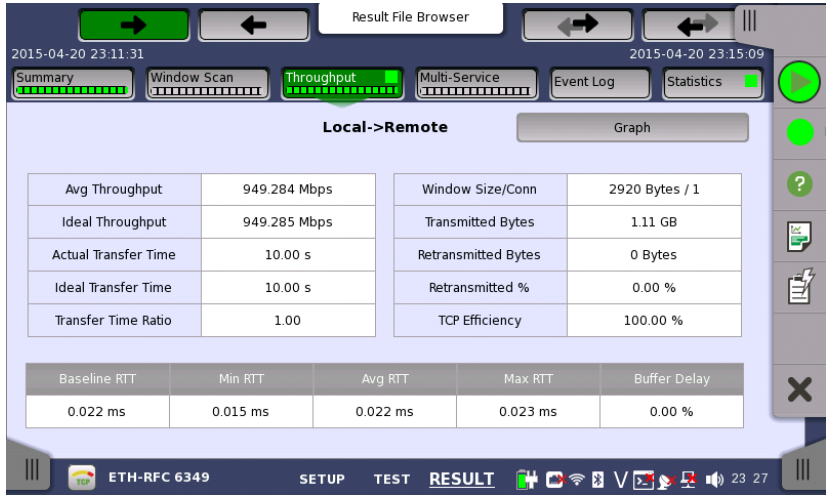
- Measurements include:
  - MTU (Maximum Transmission Unit) based on RFC 4821
  - RTT (Round-Trip Time)
  - Window scan
  - Throughput
  - Multi-service (if selected)
- Measurement results include:
  - Transmitted and Retransmitted Bytes
  - TCP Transfer Time Ratio
  - TCP Efficiency
  - Retransmitted Percentage
  - Buffer Delay Percentage





RFC 6349 Testing – TCP Throughput Option (up to 10 Gbps)

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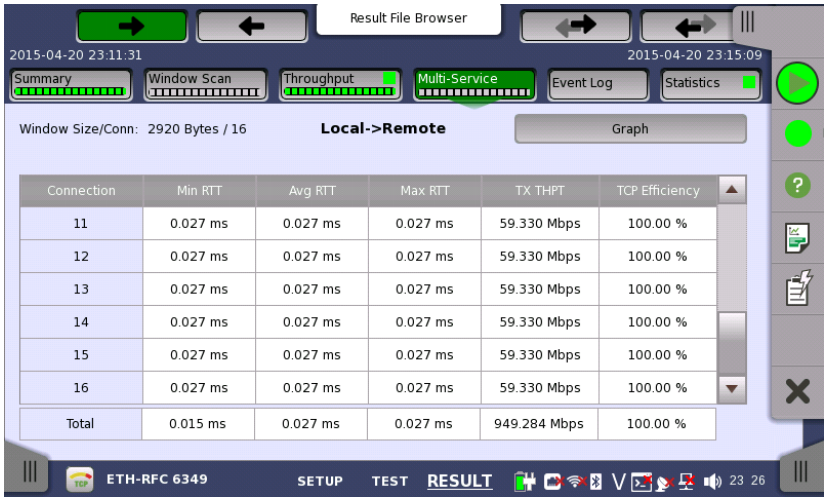
- Multi-service results (when selected)
  - Test up to 16 connections



Window Scan Result

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- MT1100A runs “Window Scan” test measuring TCP Throughput at each window size

Optimum window size

TCP Throughput Metrics

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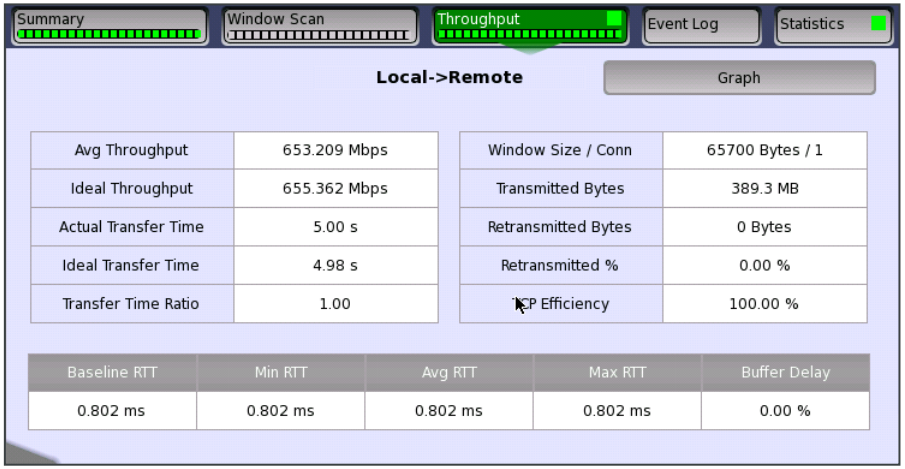
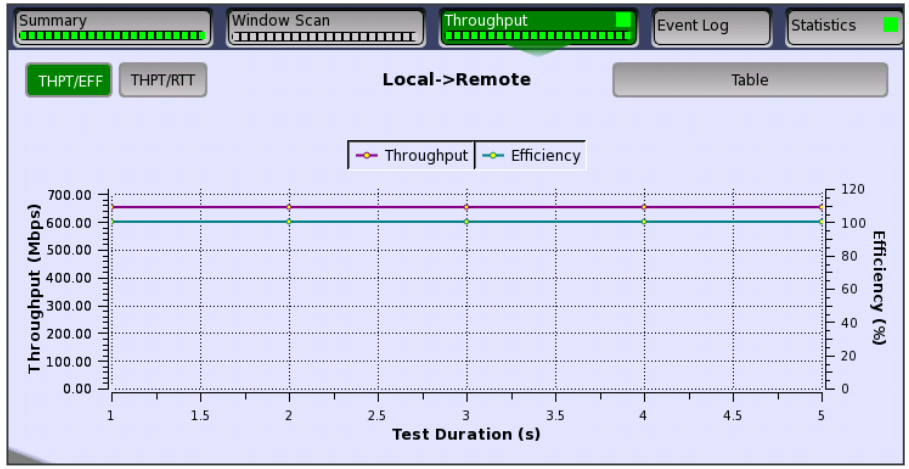
$$\text{TCP Transfer Time Ratio} = \frac{\text{Actual TCP Transfer Time}}{\text{Ideal TCP Transfer Time}}$$

$$\text{TCP Efficiency \%} = \frac{\text{Transmitted Bytes} - \text{Retransmitted Bytes}}{\text{Transmitted Bytes}} \text{ X } 100$$

$$\text{Buffer Delay \%} = \frac{\text{Average RTT during transfer} - \text{Baseline RTT}}{\text{Baseline RTT}} \text{ X } 100$$





Network Master Flex MT1100A

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- Ethernet OAM Functionality

Ethernet OAM Background

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- Ethernet moved from LAN technology to Carrier Class technology
- Ethernet Operations, Administration and Maintenance (OAM) developed to:
  - Ease operations, administration, and maintenance of complex Ethernet networks
  - Reduce operational expenses
- Ethernet OAM covers:
  - Link fault management
  - Connectivity fault management
  - Performance monitoring

Ethernet OAM Layers

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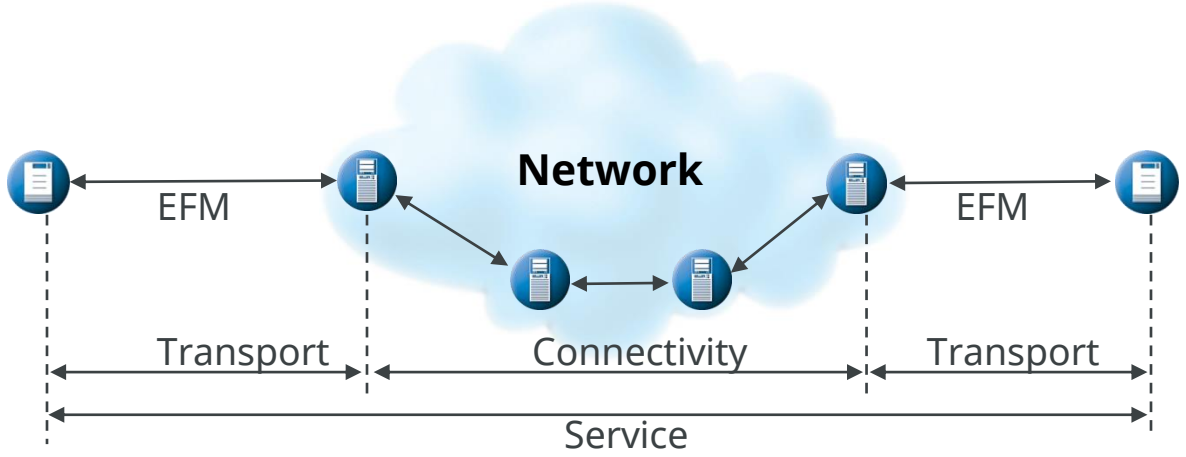
OAM layers	Functions	Standards
Transport layer	Ensures bi-directional communication between two directly connected devices Focuses on Ethernet First Mile (EFM) Link fault management	IEEE 802.3 (now includes IEEE 802.3ah)
Connectivity layer	Monitors path between two devices not directly connected Connectivity fault management incl. Link trace, continuity check and loopback protocols	IEEE 802.1ag ITU-T Y.1731
Service layer	Monitors status of services as seen by customer Performance monitoring including Frame Loss, Frame Delay and Throughput measurements	ITU-T Y.1731



Ethernet OAM Y.1731 and IEEE 802.1ag

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- Y.1731 and IEEE 802.1ag similar
  - Supported by both Y.1731 and IEEE 802.1ag:
    - Connectivity fault management
  - Supported by Y.1731 only:
    - Performance monitoring
  - Same frame format for OAM PDUs (Protocol Data Units)

Ethernet OAM IEEE 802.3ah

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- Ethernet OAM IEEE 802.3ah functions:
  - Remote failure indication during fault
  - Remote loopback mode (“Real” loopback)
  - Fault isolation
  - Link performance and status monitoring
  - OAM discovery mechanism
    - Determines whether remote device has OAM enabled and configured parameters and supported functions compatible with requesting device
  - Optional activation of OAM
    - OAM can be enabled on ports subset or all ports
  - Extension mechanism
    - Available for higher-level management applications

Ethernet OAM

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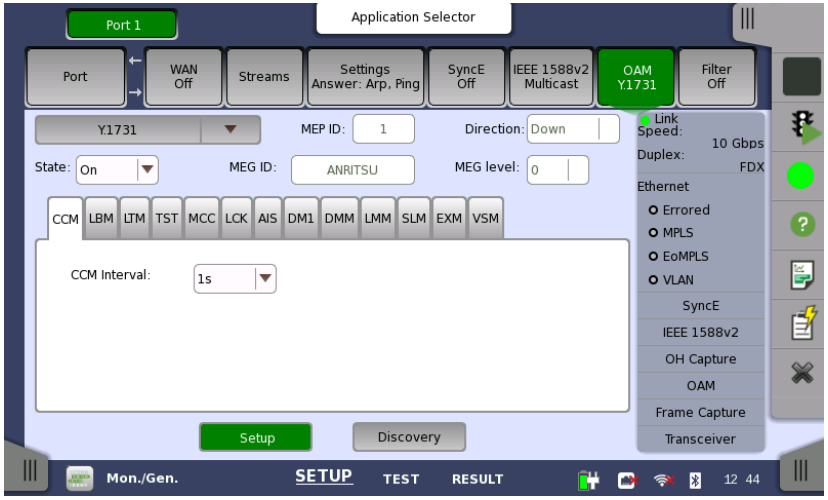
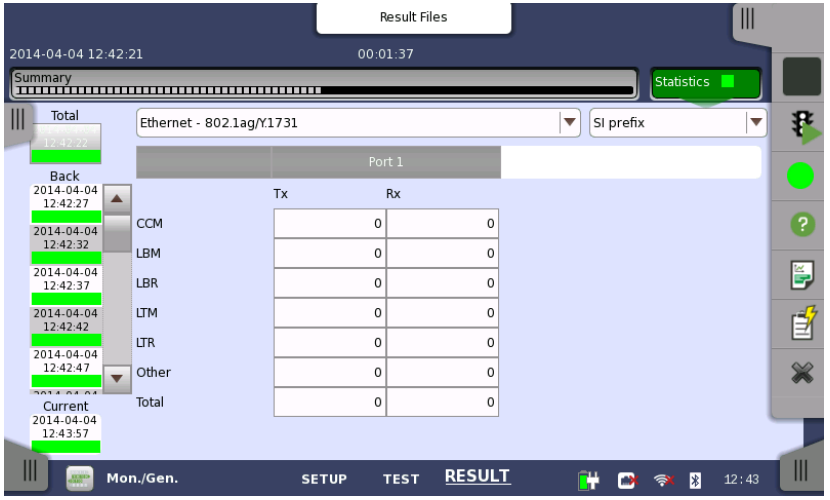
- Ethernet OAM Y.1731 set-up and results:





Network Master Flex MT1100A

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- Mobile Backhaul Test
  - Synchronous Ethernet Test

Synchronous Ethernet Test (up to 10 Gbps)

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- Recently Ethernet become dominant technology for data transmission, due to simplicity and low cost
  - Started as LAN (Local Area Network) technology but now used for end-to- end communications
- Synchronous networks (PDH, SDH/SONET) migrating to Ethernet-based packet-switched network (PSN)
- Asynchronous nature of Ethernet causes transmission challenges:
  - Many existing networks have strong requirement for frequency synchronization across entire network
  - PDH, SDH/SONET technologies have “built-in” physical layer ability to carry reference Clock

Synchronous Ethernet Test (up to 10 Gbps)

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- Synchronization can be applied to Ethernet-based packet networks using Synchronous Ethernet
- Techniques under consideration for Ethernet synchronization are:
  - Physical synchronization signal forwarding as defined in ITU-T recommendations G.8261, G.8262 and G.8264 (in many cases now called SyncE)
  - Packet-based synchronization as defined in IEEE1588 v2 Precision Time Protocol (PTP)
    - ITU-T G.8265.1 telecom profile for frequency synchronization
    - ITU-T G.8275.1 telecom profile for phase/time synchronization

MT1100A Synchronous Ethernet Test (up to 10 Gbps)

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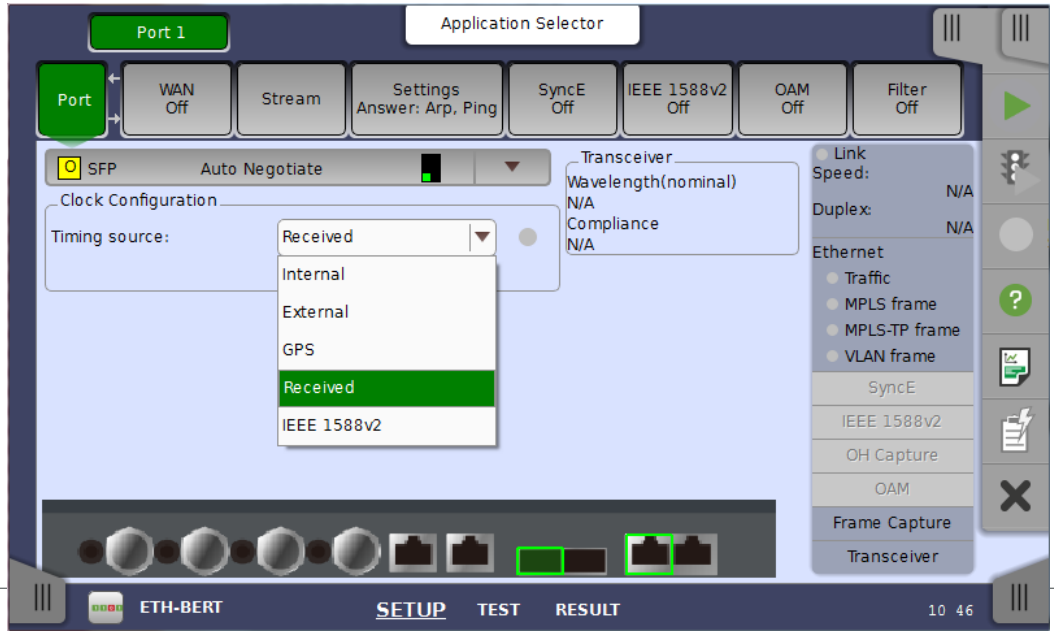
- SyncE (ITU-T G.826x) functions:
  - Detect ESMC messages and real time display of received SSM/QL byte
  - Record ESMC message log
  - Generate alarm when SSM/QL not received within 5 seconds
    - Clear alarm on SSM/QL reception
  - Transmit ESMC/SSM messages with user-defined QL
    - Four user-selectable QL interpretations
  - SyncE recovered frequency monitor and synchronized packet generation.



MT1100A Synchronous Ethernet Test (up to 10 Gbps)

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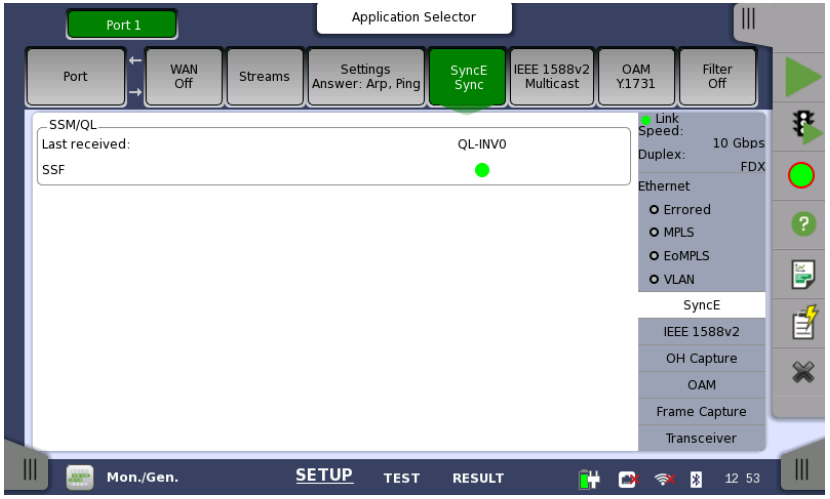
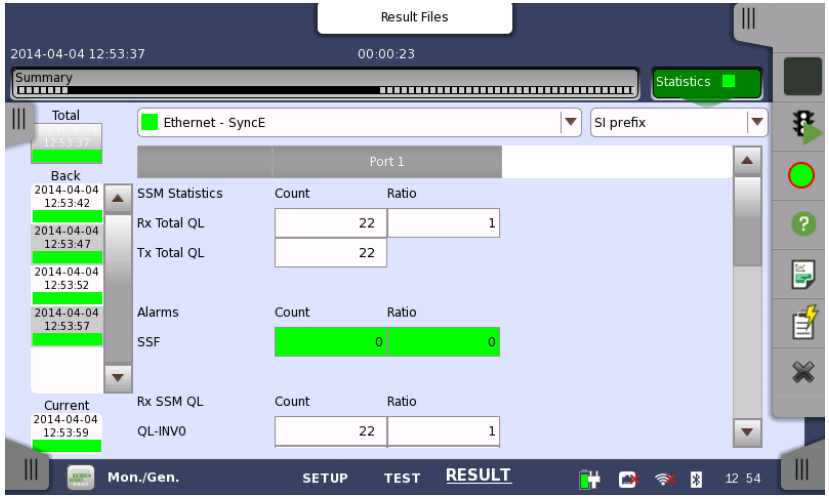
- SyncE (ITU-T G.826x) results (per port):
  - Status information:
    - Rx SSM QL (current value)
  - Statistics on SSM QL messages and values





MT1100A Synchronous Ethernet Test (up to 10 Gbps)

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- IEEE 1588 v2 (PTP) functions:
  - Support G.8265.1, G.8275.1 profile and 'User defined' one.
  - Emulating a master clock.
    - Selectable UTC source from internal instrument clock or GPS.
    - Configurable parameters of Announce message, etc.
  - Emulating slave clock
    - Configurable parameters of message interval, etc.
    - Best master clock algorithm (BMC)
  - Supported encapsulations: PTP-UDP-IP(IPv4 and IPv6) and PTP-MAC
  - Support stacked VLAN and MPLS
  - Real time PTP signaling sequence in ladder chart, off-line analysis by PCAP file capture, message statistics, message rate measurement.

For quick analysis and troubleshooting of IEEE 1588 v2 (PTP) signaling

MT1100A Synchronous Ethernet Test (up to 10 Gbps)

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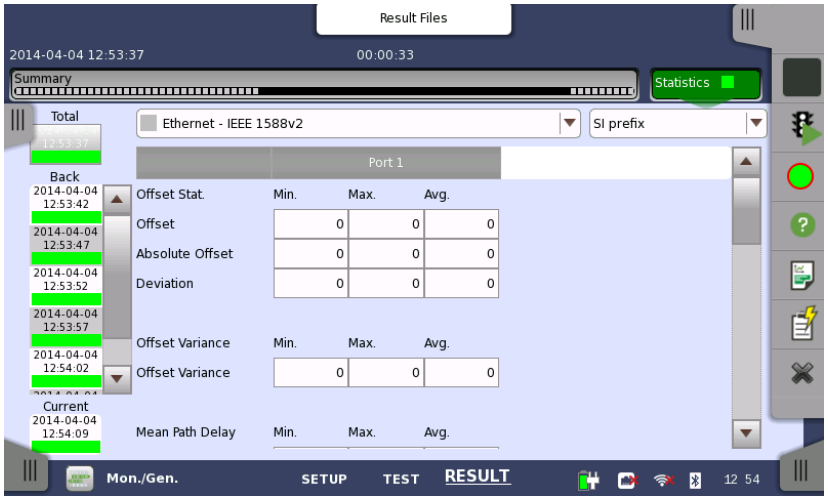
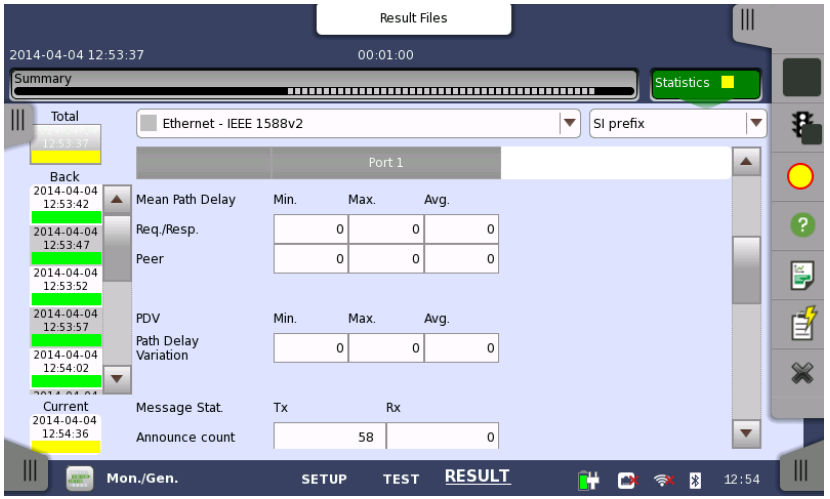
- IEEE 1588 v2 (PTP) results – statistics on:
  - Offset and offset variance
  - Path Delay Variation (PDV)
  - Messages
  - Clock state transitions





MT1100A Synchronous Ethernet Test (up to 10 Gbps)

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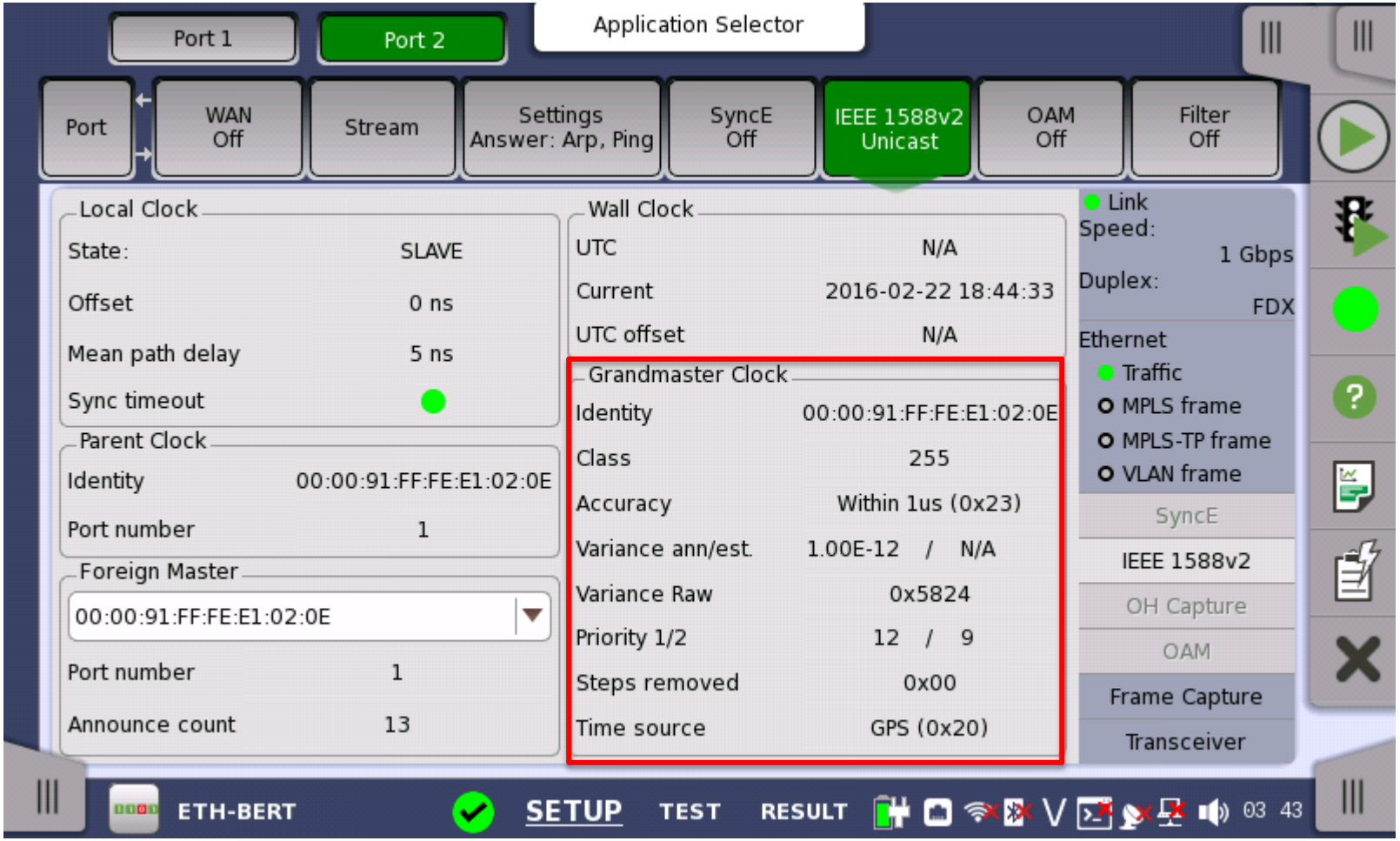
- IEEE 1588 v2 (PTP) clock status real time information



Network Master Flex MT1100A

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- Mobile Fronthaul Installation and Verification
  - CPRI/OBSAI Test

CPRI Background

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- Operators supporting explosive spread of smartphones and tablets by increasing bandwidth of mobile communications networks
- Driving complete change in mobile communications systems
  - Adoption of Centralized-Radio Access Network (C-RAN).
    - Using C-RAN, the mobile fronthaul is configured from centralized Base Band Units (BBU) and multiple Remote Radio Head (RRH) units connected via general-purpose interfaces, such as the Common Public Radio Interface (CPRI) or Open Base Station Architecture Initiative (OBSAI).

CPRI Bit Rates

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- CPRI bit rates are referred to as “option #”
- There are now eight options (CPRI Specification V6.0)
- MT1100A supports Option 8, 10.1376 Gbps, reflecting marketing requirement of supporting exploring mobile network bandwidth.
- MT1100A can perform simultaneous testing up to 4 ports to reduce commissioning testing time.

Option	Bit Rate (Gbps)	Line Code
1	0.6144	8B/10B
2	1.2288	8B/10B
3	2.4576	8B/10B
4	3.0720	8B/10B
5	4.9152	8B/10B
6	6.1440	8B/10B
7	9.8304	8B/10B
8	10.1376	64B/66B

OBSAI Bit Rates

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- Four OBSAI bit rates are defined.
- MT1100A supports 6.144 Gbps, reflecting marketing requirement of supporting exploring mobile network bandwidth.
- MT1100A can perform simultaneous testing up to 4 ports to reduce commissioning testing time.

Bit Rate (Gbps)	Line Code
0.768	8B/10B
1.536	8B/10B
3.072	8B/10B
6.144	8B/10B

C-RAN Market

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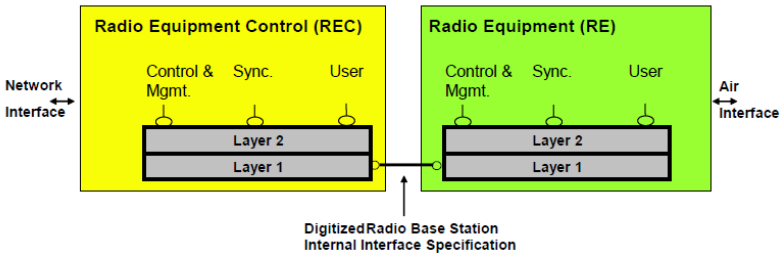
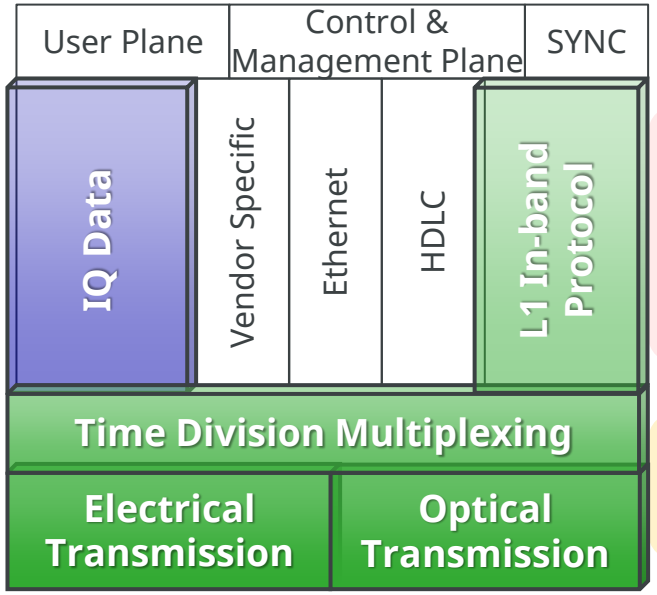
- Market requirements
  - Minimizing number of BBU's per antenna cuts operator costs (rent, power, HW, etc.)
    Locating BBU 15 km or more from multiple RRH requires reliable connection i.e. C-RAN
  - CPRI runs over C-RAN with two main layers:
    - Layer 1: Physical transport
    - Layer 2: Several areas

    C-RAN main interest is L1 in-band protocol; understanding this area allows operator to troubleshoot alarms and errors



In CPRI, BBU is called REC, and RRH is called RE (Fig. 1 from CPRI Specification V6.0)



CPRI/OBSAI – Test cases

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- Test case 1
  - Test the line between REC(s) and RE(s)
    - System testing
    - Installation testing
  - The line can be
    - Optical
    - Carried over radio link or microwave link
    - CPRI over OTN
    - Instrument is connected via optical interface to the link
  - Terminate both sides of the transmission line
    - BER test (Framed or unframed)
      - One side could be loop back
    - Delay measurement
      - With one side in loop back

Test case 1

CPRI/OBSAI – Test cases

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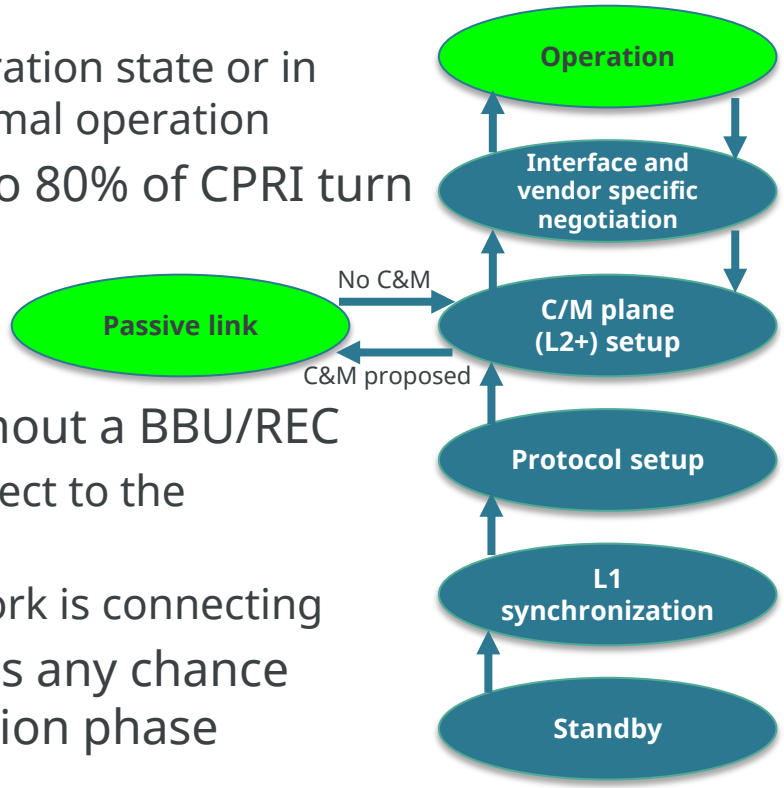
- Test case 2
  - CPRI Specification V6.0 defines
    - When both the devices are in the Operation state or in the Passive link state, the link is in normal operation
  - Operators have experienced that up to 80% of CPRI turn up issues happen in the lowest layers
  - Essential during installation to confirm the RRH/RE is able to communicate to the ground even without a BBU/REC
    - Confirming the RRH/RE is able to connect to the Passive Link state
    - Confirming HDLC layer (Layer 2) network is connecting
  - With the above completed it minimizes any chance of issues during the BBU/REC installation phase



Extract from Figure 30 in CPRI Specification V6.0: Start-up states and transitions

CPRI/OBSAI – Test cases

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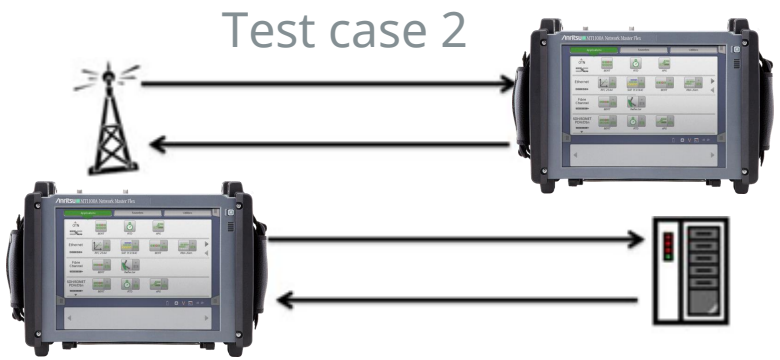
- Test case 2
  - Connect to the actual equipment (REC or RE) to verify that it is alive
    - Signal level and frequency measurement
      - Optical cable ends may be checked with Video Inspection Probe (VIP)
    - Monitor control word K30.7 – indicates error in the 8B/10B line code (CPRI option 1-7 only) – and 8B/10B code violations
    - Check equipment behaviour
      - Check that the equipment can reach the “Passive Link” state
      - Confirming HDLC layer (Layer 2) network is connecting
      - Check the equipment’s behaviour when alarms are generated



CPRI/OBSAI – Test cases

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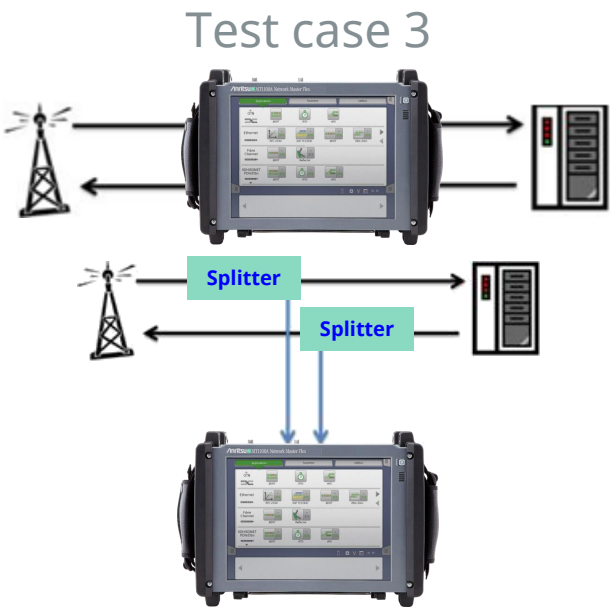
- Test case 3
  - Monitoring of the actual line between REC (Radio Equipment Control) - (master) and RE (Radio Equipment) - (slave)
    - Utilizing dual port in through mode or monitor
      - Monitor interactive behaviour of equipment
    - For maintenance or in-service troubleshooting



MT1100A CPRI Wire Line Testing

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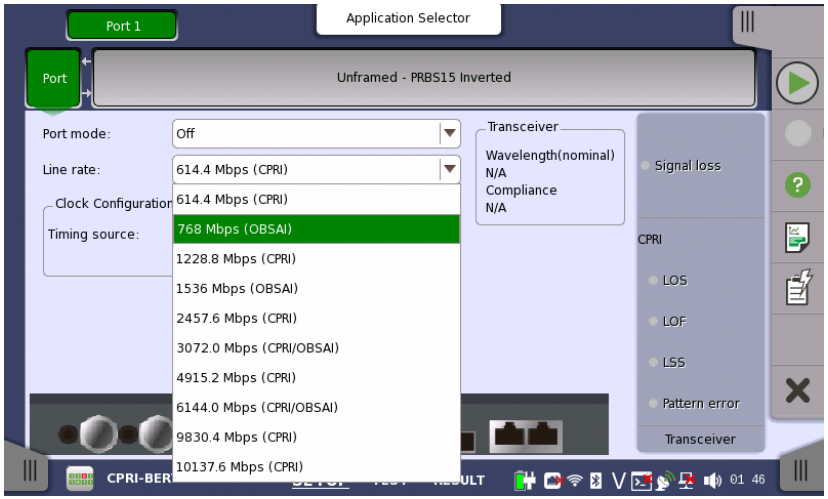
- Supports CPRI interface rate option 1 (614.4 Mbit/s) to option 8 (10.1376 Gbit/s)
  - Ensures testing of current and future CPRI interfaces



MT1100A CPRI Wire Line Testing

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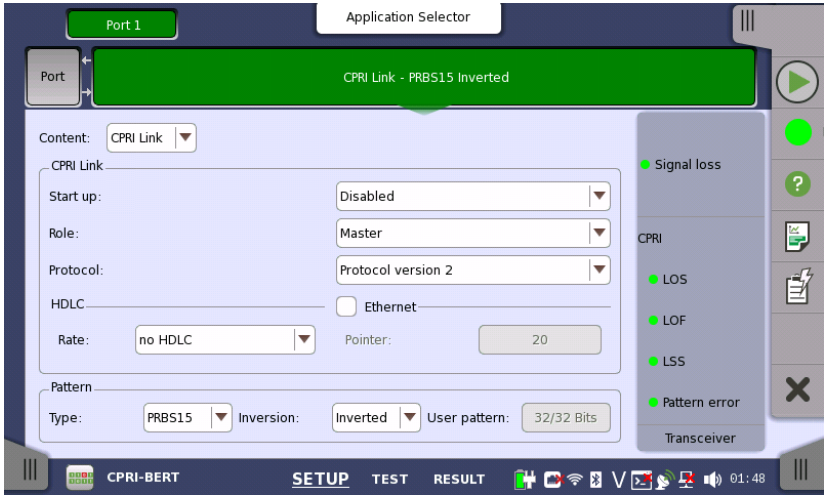
- Testing at any rate
- Ability to exercise BBU or RRH up to Passive link status (as per latest CPRI standard)
- Support of pass-through mode
  - Complete solution for detailed I&M testing



MT1100A CPRI Wire Line Testing

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- Displayed signal level and bit rate gives first verification of received- signal condition

- Using Video Inspection Probe (VIP) to check fiber end face confirms quality practices and removes key cause of turn-up failure.

MT1100A CPRI Wire Line Testing

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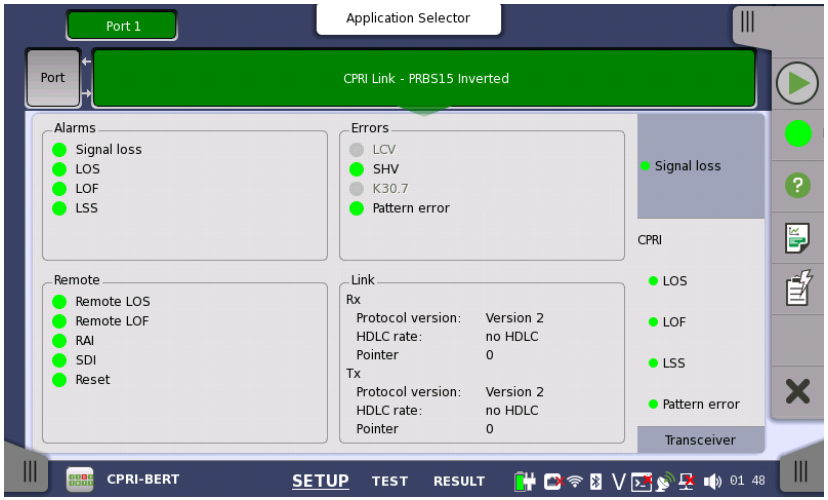
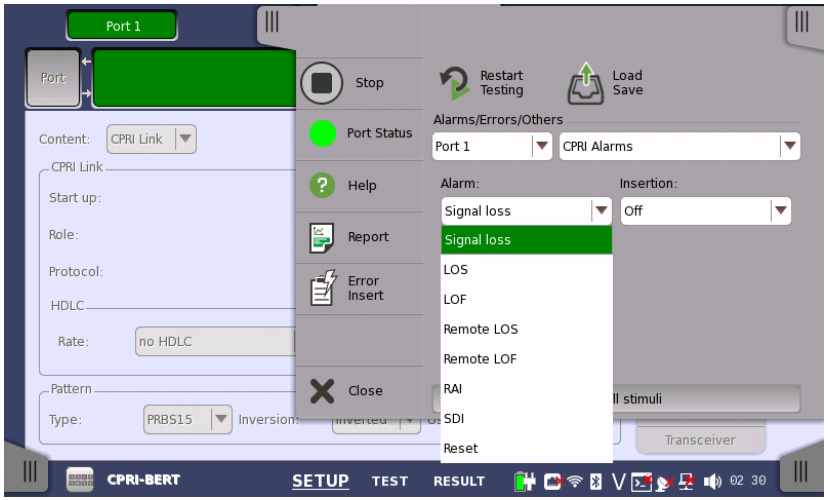
- Checking for and inserting Layer-2 alarms and errors from BBU to RRH
  - Ensures engineer can complete advanced fault finding and evaluate issue root cause





MT1100A CPRI Wire Line Testing

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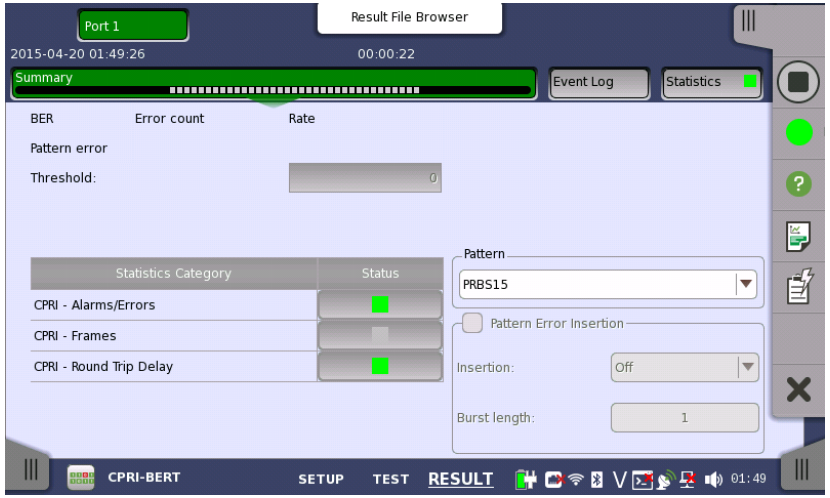
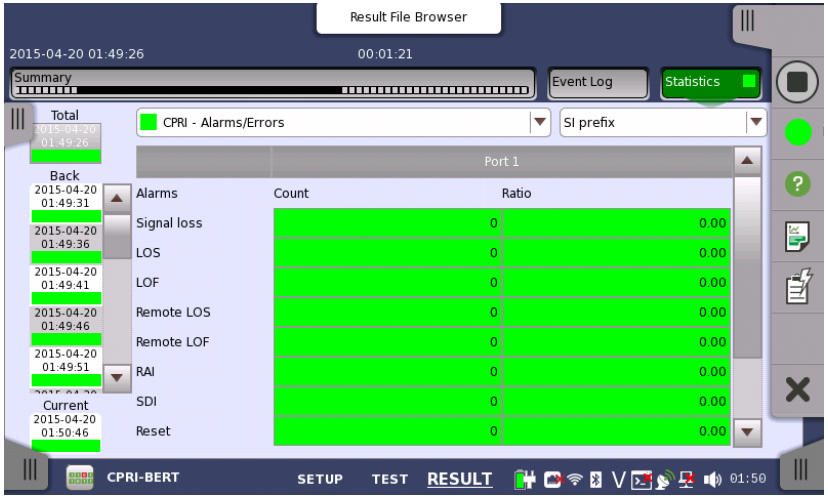
- Test results:
  - Summary screen with pattern error information and survey of result pages
  - Alarms/Errors screen with details of detected CPRI alarms and errors
  - Color coding highlights detected alarms and errors





MT1100A CPRI Wire Line Testing

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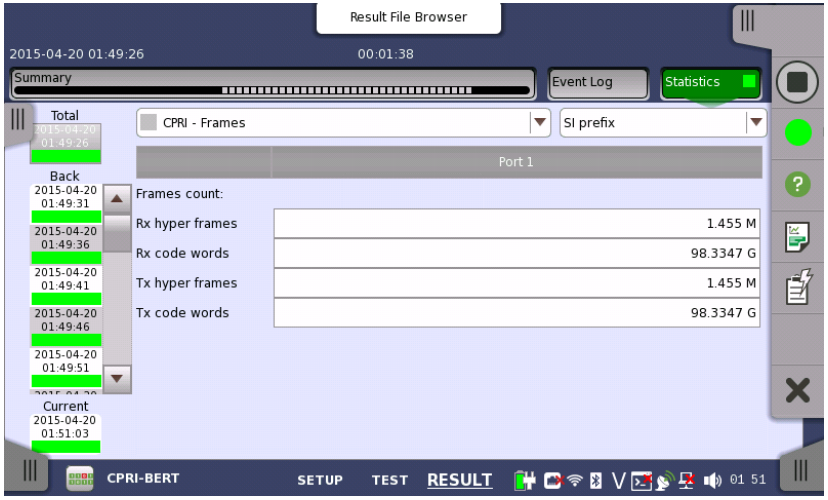
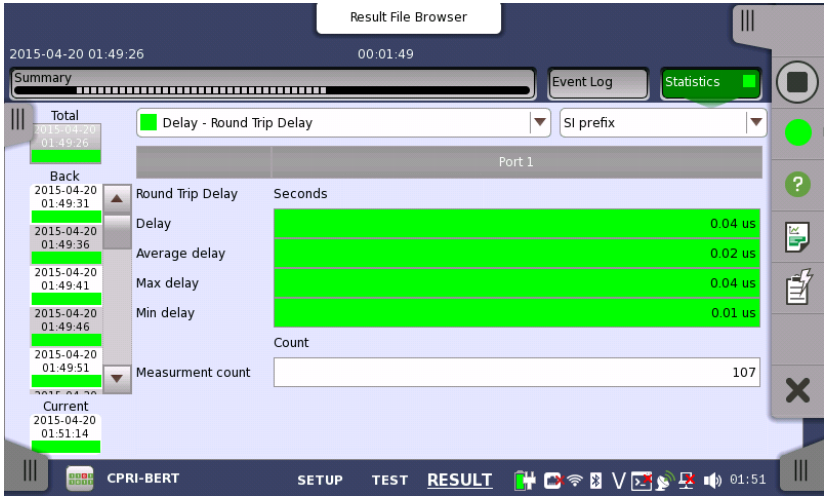
- Test results:
  - CPRI Frames screen with counts of received and sent frames and code words
  - Delay screen showing measured Round Trip Delay





MT1100A CPRI Wire Line Testing

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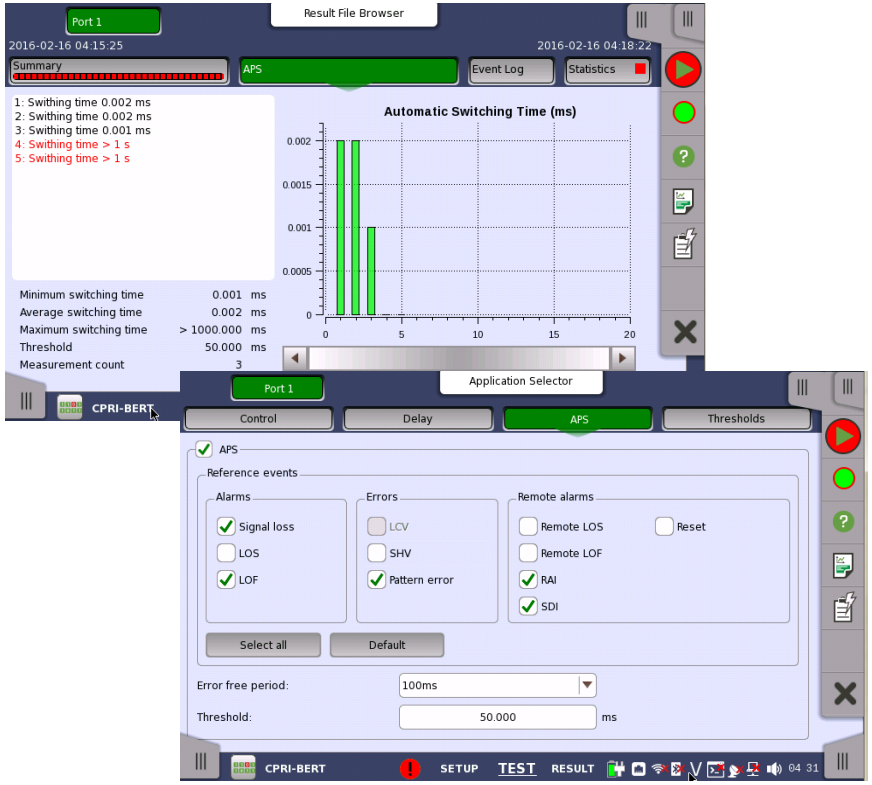
- Added APS measurement function to CPRI BERT application
  - Sets any APS measurement start/stop trigger using checkbox, with APS measurement started/stopped at selected trigger OR condition
  - Choice of triggers for network configuration and hypothetical faults for analyzing how equipment and network perform at APS operation



Graph and Event log screens for easy viewing and analysis

CPRI over OTN

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- Market requirements
  - Several vendors working on CPRI over OTN solutions
  - CPRI over OTN:
    - Transport raw radio (CPRI) data from RE over optical fiber to central location for baseband processing
      - Single location serving multiple REs
      - Consolidation has huge power and cost savings over distributed approach without impacting network scalability
  - OTN supports transport of several protocols over same fiber
    - Same management system across network

MT1100A CPRI Wire Line Testing

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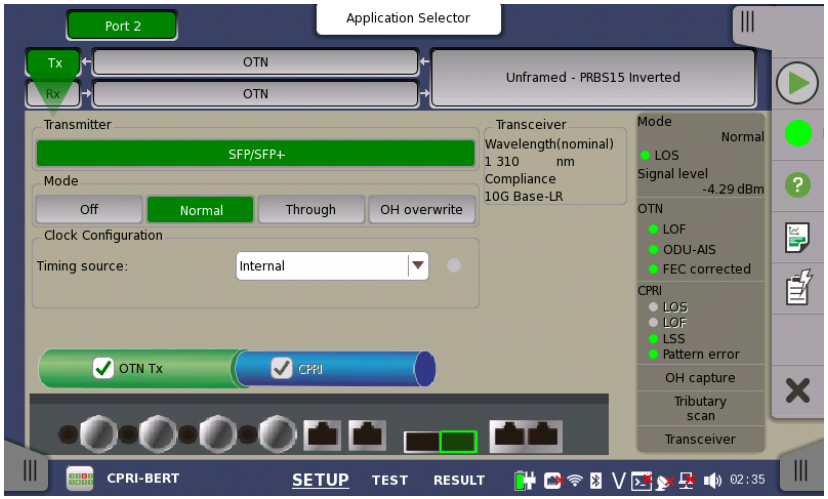
- Support for CPRI over OTN enables tests of latest CPRI implementations



Network Master Flex MT1100A

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- Powerful Storage Area Networking (SAN) Testing
  - Fibre Channel Functionality

MT1100A Product Highlights

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- Powerful tests of Fibre Channel links
  - Test of 1 GFC, 2 GFC, 4 GFC, 8 GFC and 10 GFC
    - Optional mapping to OTN
  - Latency measurement
  - BER testing including service disruption measurement
  - Line alarm and error monitoring
  - Normal or Reflector mode

MT1100A Product Highlights

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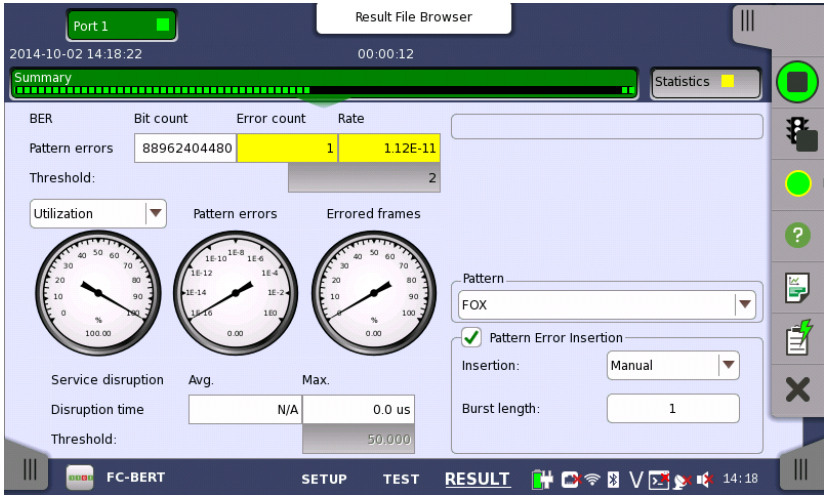
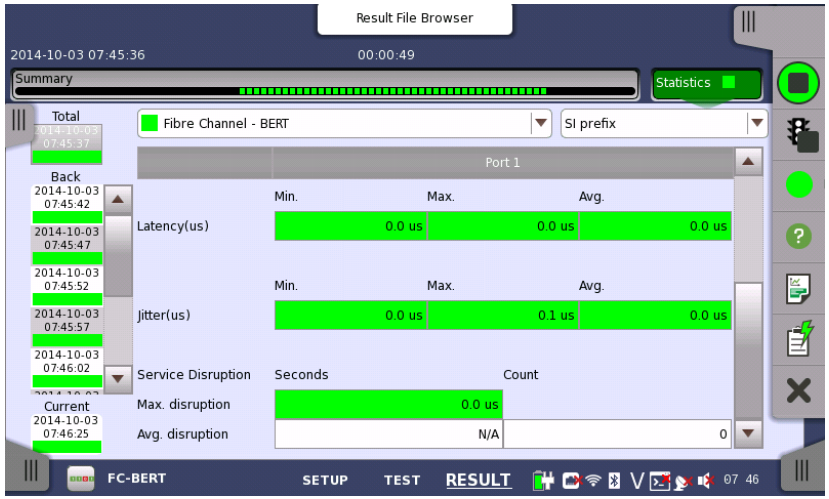
- Color-coded displays give easy overview of GO/NO-GO results on Fibre Channel links
- Powerful Fibre Channel statistics include Latency, Packet Jitter and service disruption information
  - Optional threshold settings for easy understanding of results





MT1100A Product Highlights

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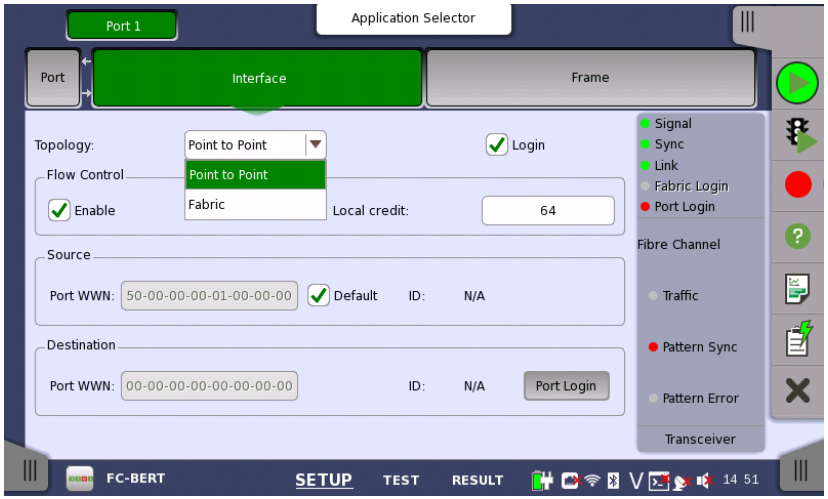
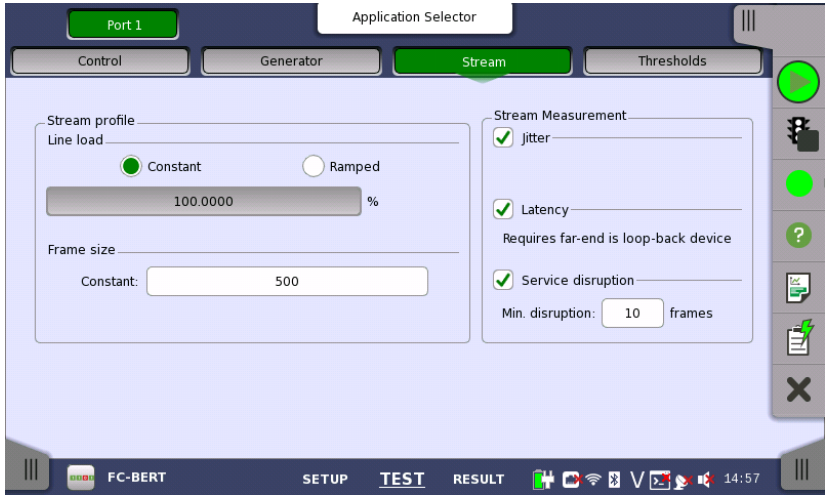
- Point-to-point and Fabric topology
- Latency, Packet Jitter and service disruption measurements





MT1000A Product Highlights

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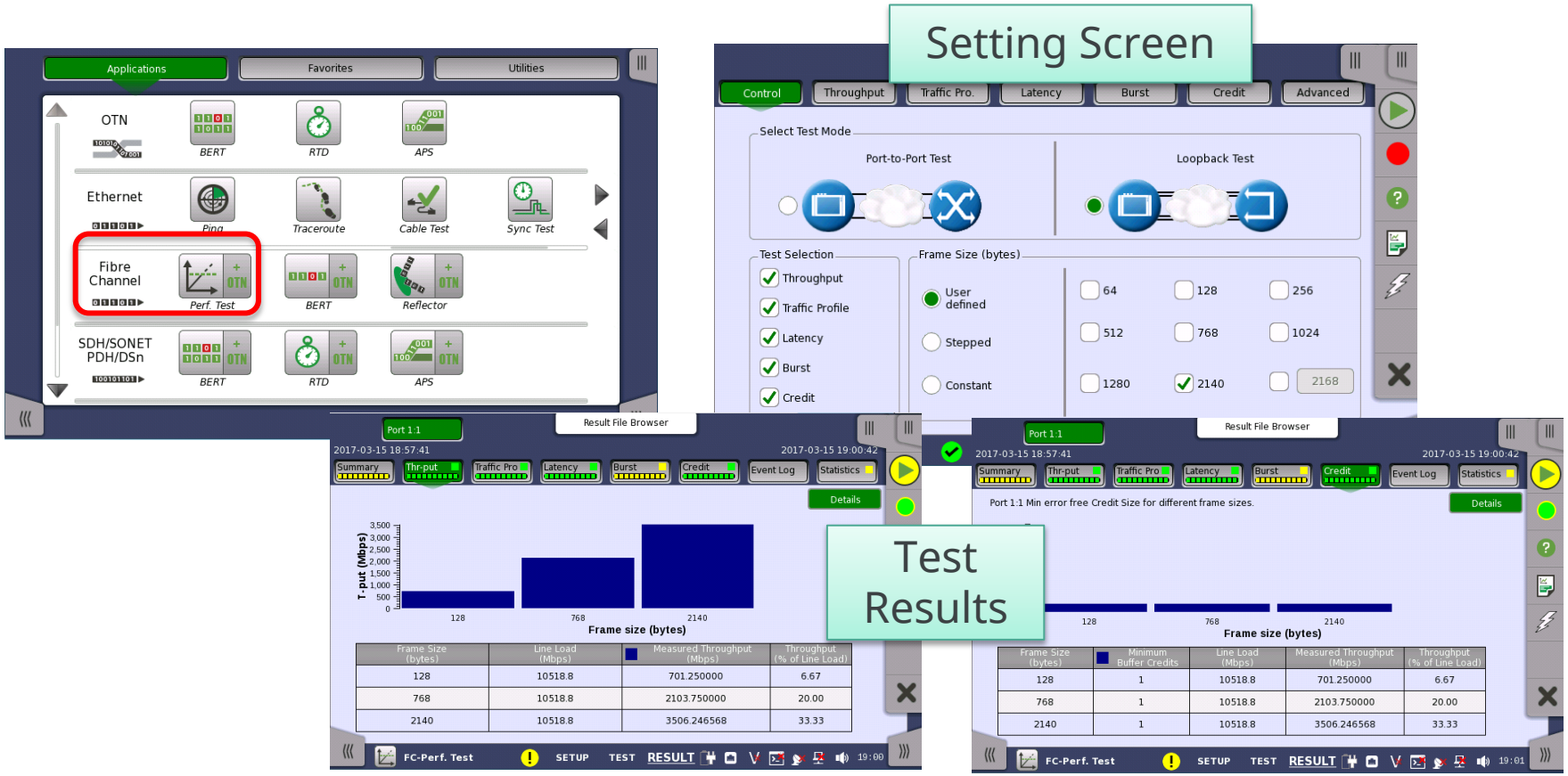
- Performance test application to Fibre channel interface
  - Supports throughput, latency, and buffer credit performance verification for Fibre channel networks and Fibre channel equipment



Network Master Flex MT1100A

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- Quick and Easy Tests of SDH/SONET/PDH/DSn Networks

MT1100A Product Highlights

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- Quick and easy tests of SDH/SONET/PDH/DSn
  - Testing SDH/SONET systems at STM-256/STM-64/STM-16/STM-4/STM-1/OC-768/OC-192/OC-48/OC-12/OC-3/STS-3 and embedded PDH (E1/E3/E4) and DSn (DS1/DS3) systems
  - Powerful PDH (E1/E3/E4) and DSn (DS1/DS3) testing
  - Simultaneous bi-directional monitoring of SDH/SONET/PDH/DSn lines
  - SDH/SONET mapping and de-mapping
  - Comprehensive error and alarm statistics
    - G.826/G.828/G.829/M.2100 error-performance measurements on SDH/SONET traffic
    - G.826/M.2100 error-performance measurements on PDH/DSn traffic
  - SDH/SONET OH byte testing and monitoring
  - SDH/SONET trouble scan
  - SDH/SONET pointer event generation and monitoring
  - SDH/SONET/PDH/DSn delay measurements

MT1100A Product Highlights

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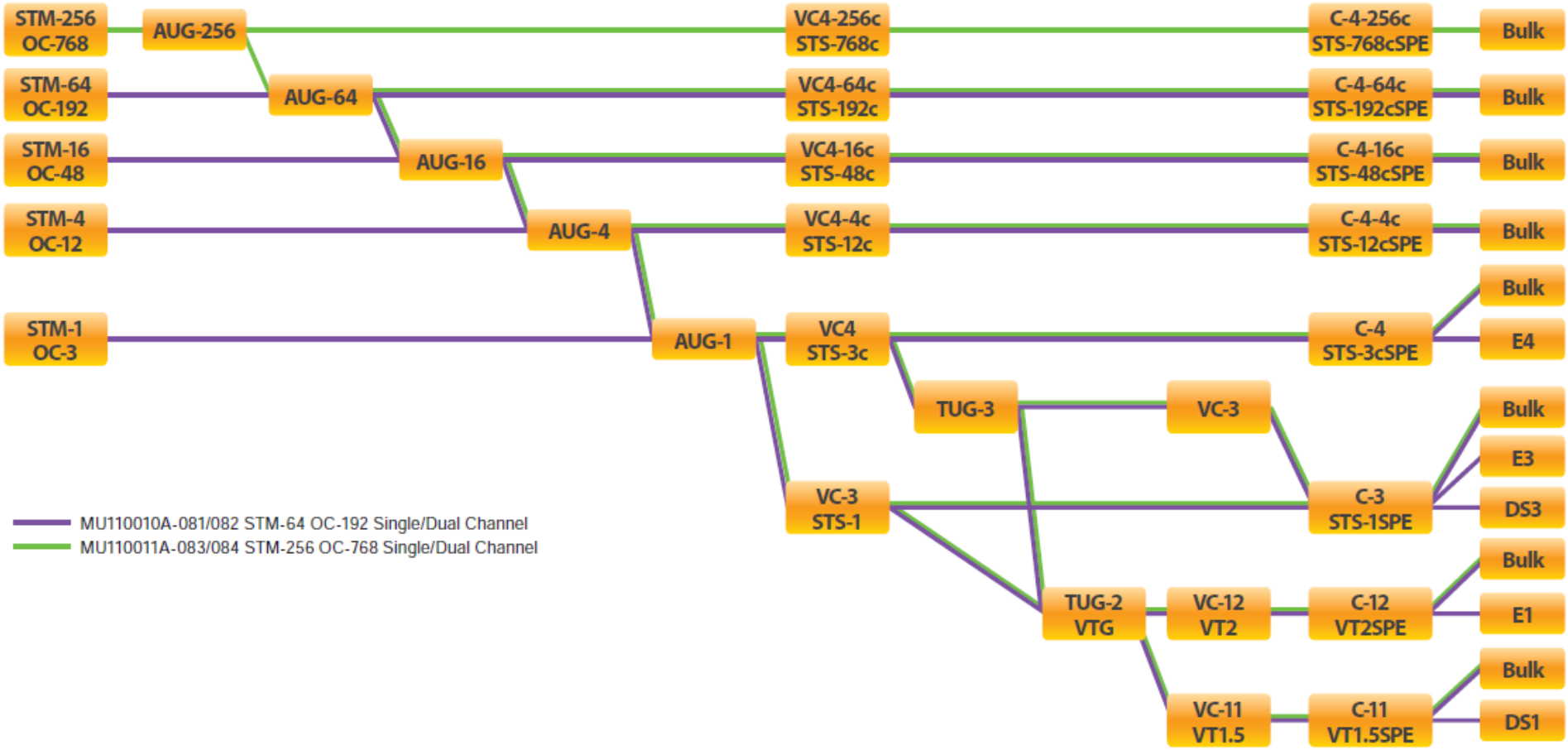
- SDH/SONET mappings



MT1100A SDH/SONET In-Service Measurements

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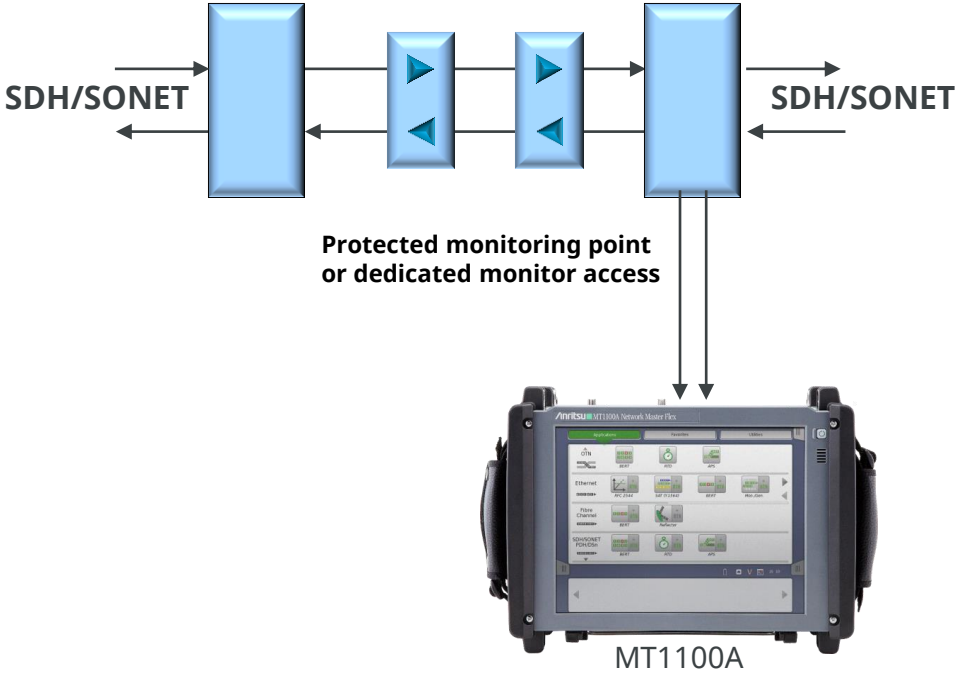
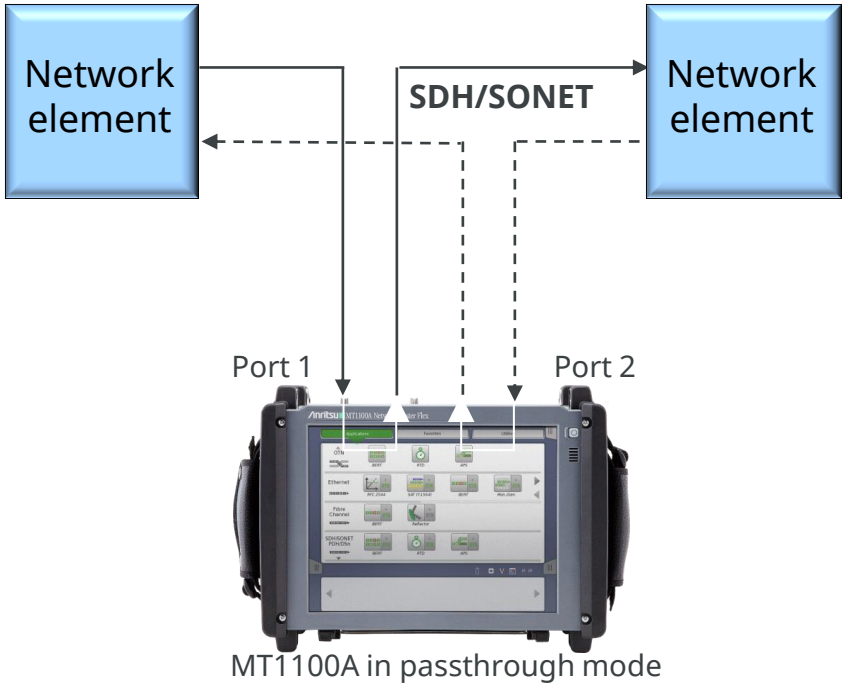
- Alarm and error monitoring for both sides of SDH/SONET line
- Frequency-deviation measurements
- G.826/G.828/G.829/M.2100 error-performance measurements on live traffic





MT1100A SDH/SONET Out-of-Service Testing

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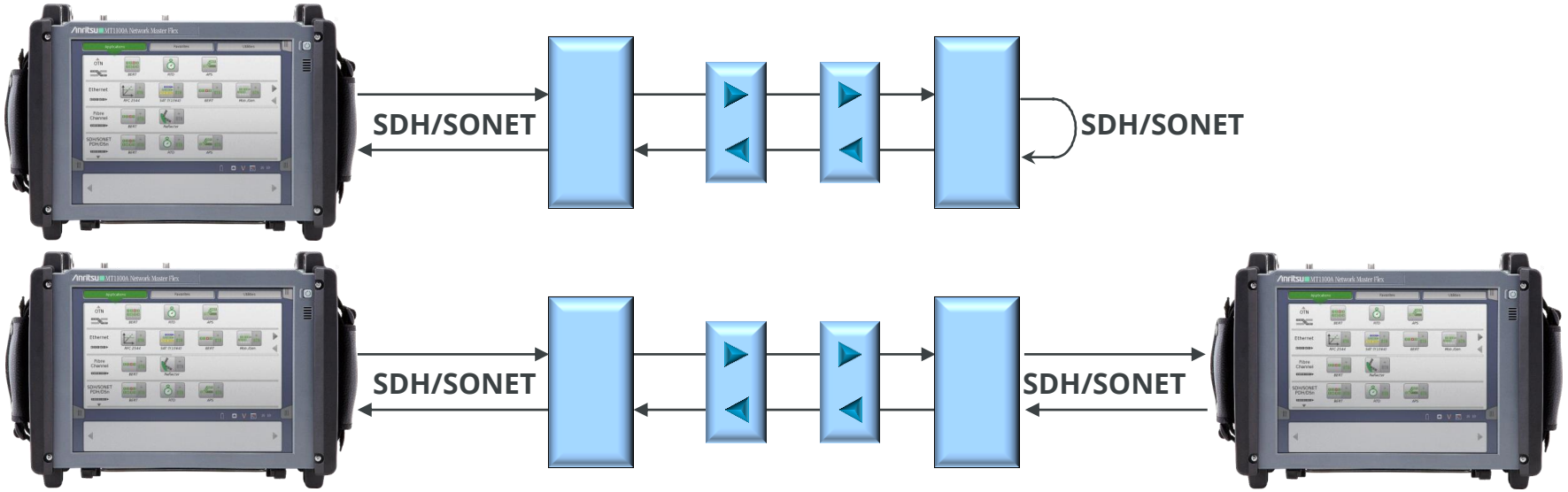
- Installing, commissioning and troubleshooting SDH/SONET lines
- Stressing system by generating alarms, errors, pointer operations, slip and frequency offset
- Testing synchronization circuits
- Generating embedded PDH/DSn signals
- G.826/G.828/G.829/M.2100 error performance
- Propagation time
- Alarm, error, slip and frequency-deviation measurements



MT1100A SDH /SONET Out-of-Service Testing

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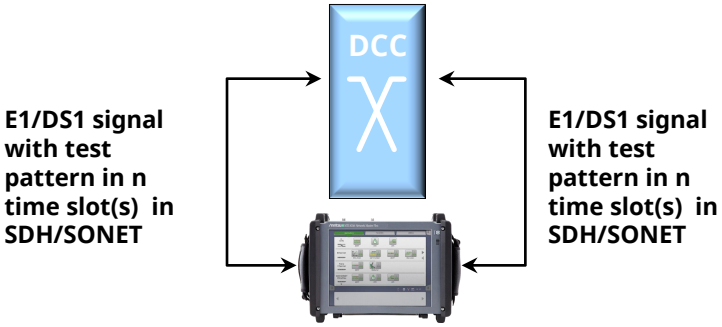
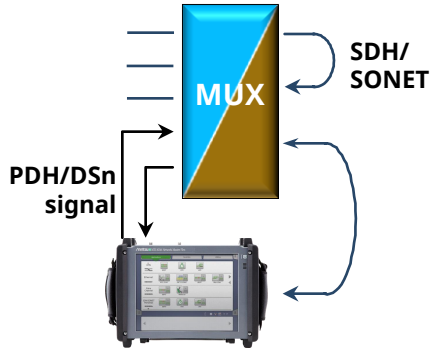
- Installing/commissioning
- G.826/G.828/G.829/M.2100 error-performance measurements
- System stressing by generating alarms, errors, slip and frequency offset
- Testing synchronization circuits
- Alarm, error, drift and frequency-deviation measurements
- Propagation time measurements





MT1100A SDH/SONET Line Status

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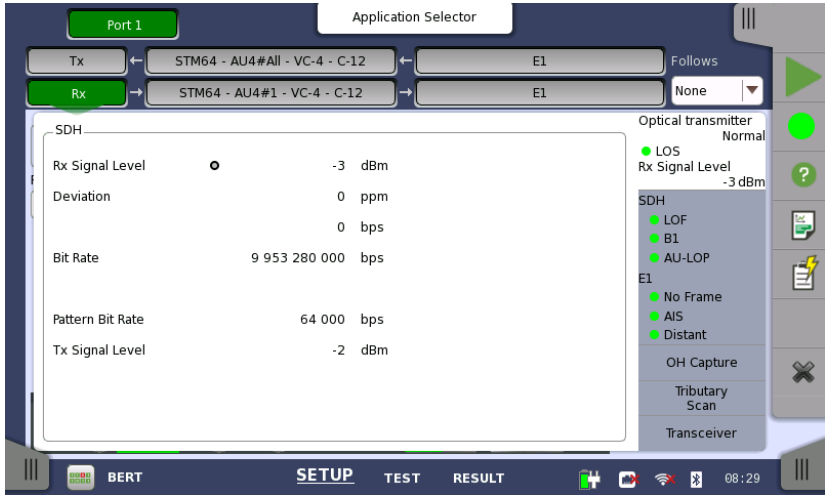
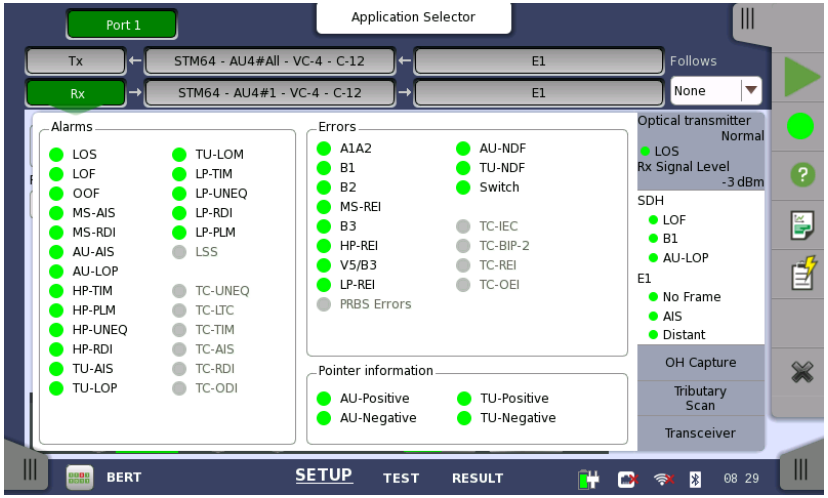
- Physical line information
- Current alarms and errors





MT1100A SDH/SONET Tributary Scan

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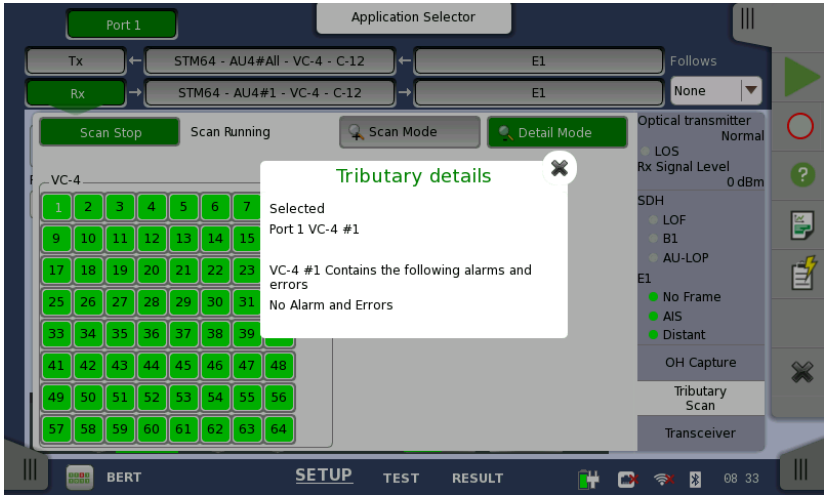
- Quick overview of problems in monitored SDH/SONET signals
- Detailed problem description when required
  - Click tributary for more details



MT1100A SDH/SONET Performance Measurements

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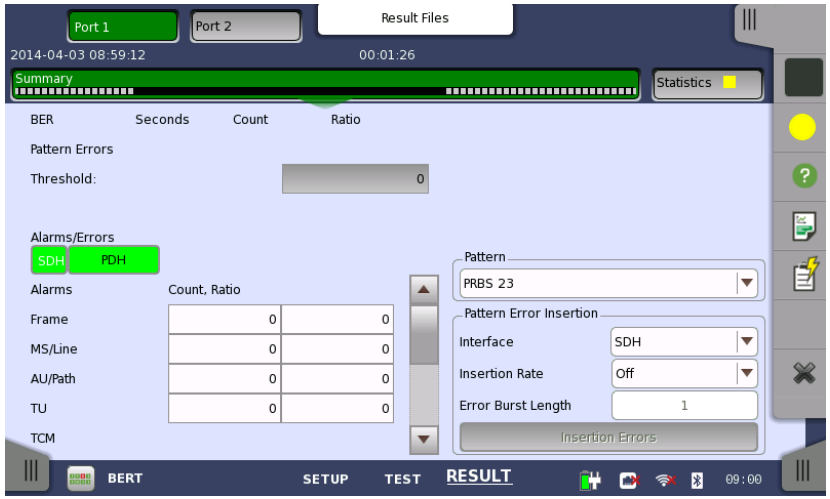
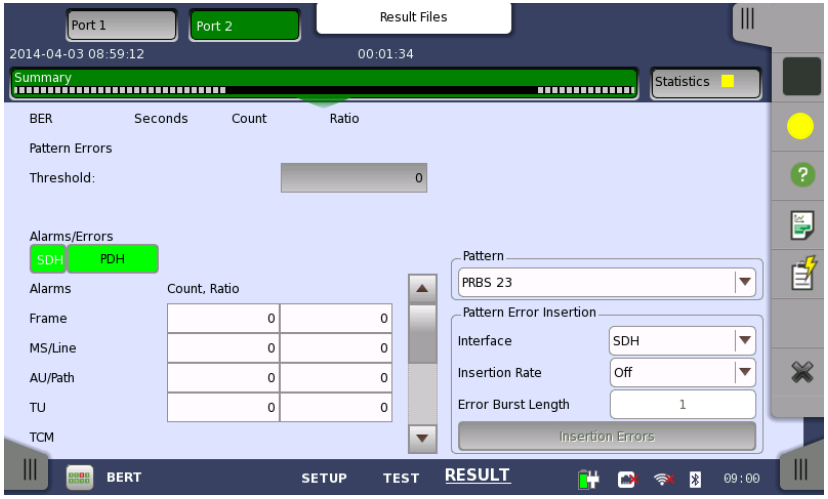
- Bi-directional performance measurement
  - Easy information switching between two ports
- BER measurements of embedded PDH/DSn signal





MT1100A SDH/SONET Overhead Byte Analysis

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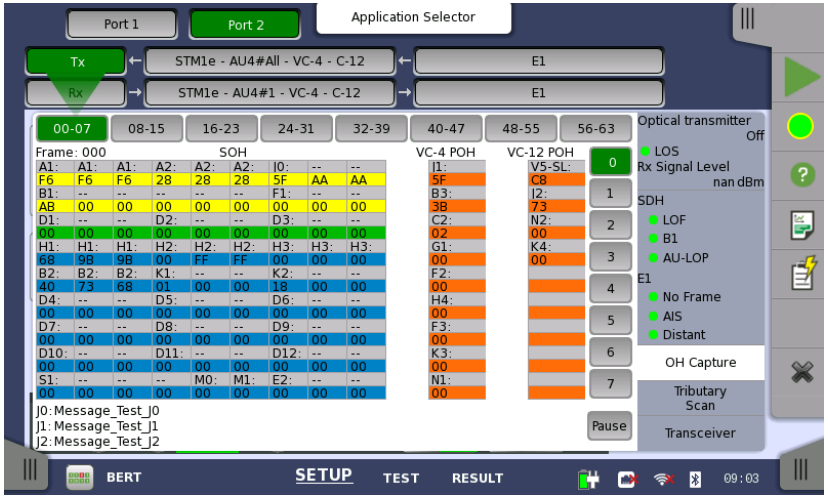
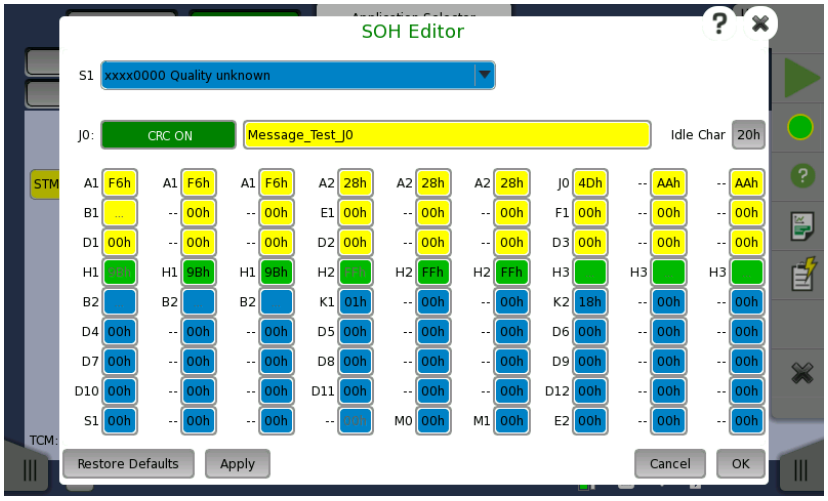
- Bi-directional OH byte capture
- User-programmable transmitted OH bytes

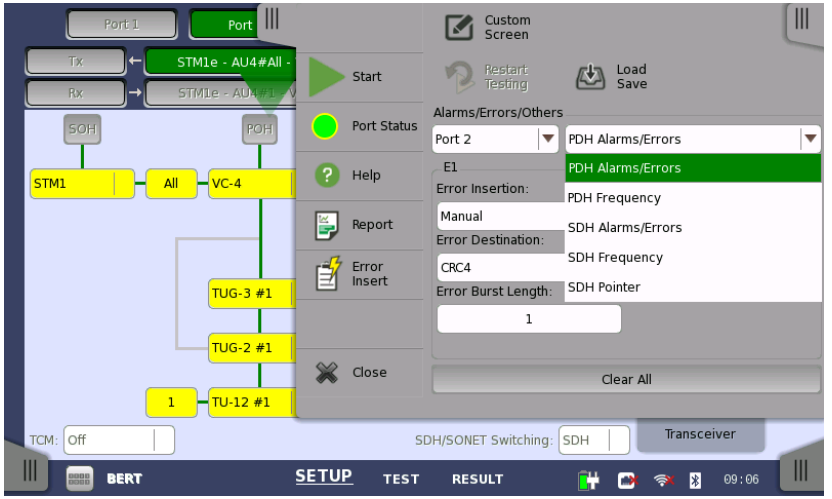




MT1100A SDH/SONET Event Insertion

Back to Index page

- Stress-test network elements by inserting events in test signal
- Inserted Events:
  - Alarms
  - Errors
  - Frequency deviations
  - Pointer operations



MT1100A SDH/SONET APS Test Application

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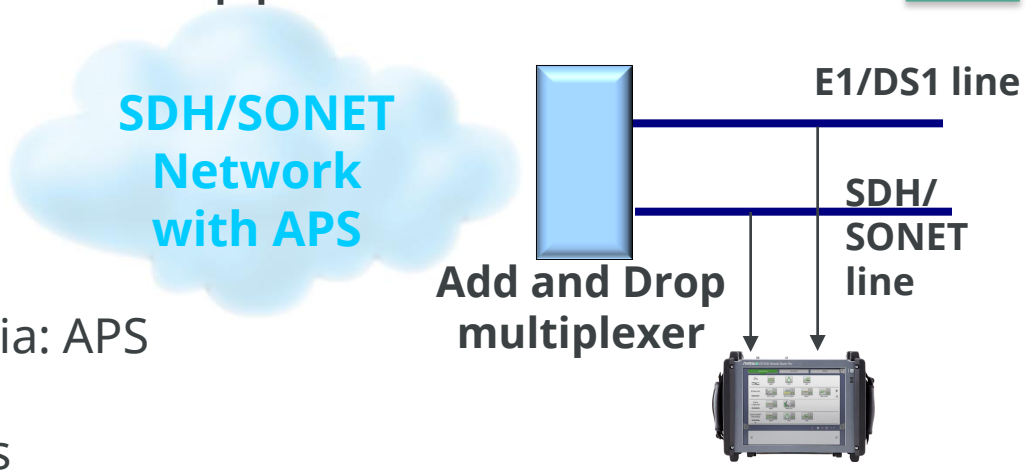
- Max switchover time measurement
  - User-defined max. time
  - User-defined switching criteria: APS measurement triggered by SDH/SONET or E1/DS1 events
  - Average time display
- APS protocol events can be generated and detected
  - No. of switchovers based on APS protocol events count
- Measurement at two receivers for simultaneous APS protocol event monitoring and switch time measurement



MT1100A SDH/SONET Pointer Movement Graph

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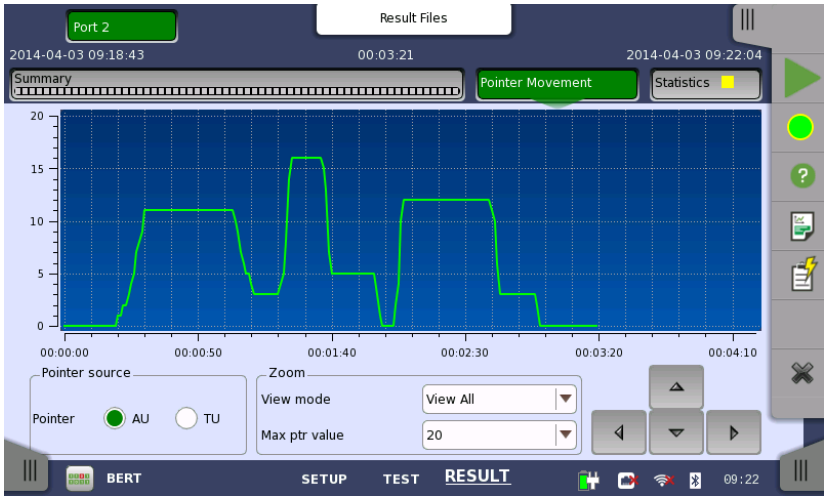
- Graph of pointer movements
  - Good overview of pointer operations
- Information on AU and TU pointer
- Magnify graph points of interest
- Results stored in MT1100A memory



MT1100A SDH/SONET TCM Functions

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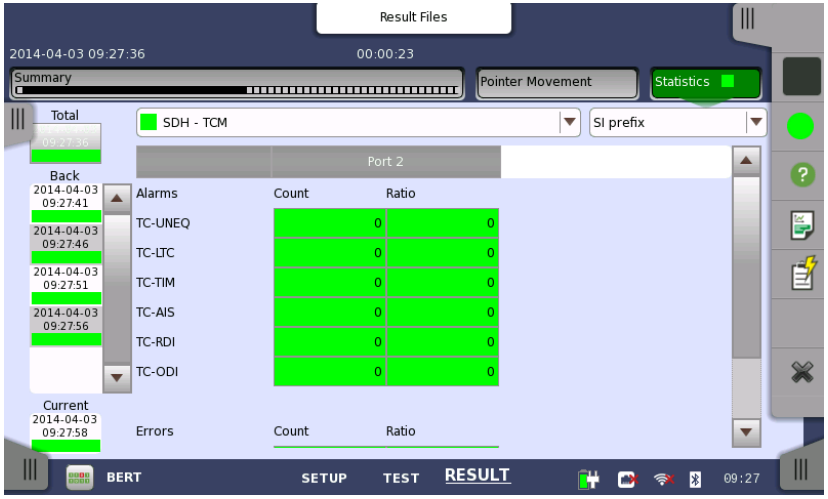
- Analyze TCM (Tandem Connection Monitoring) function in SDH/SONET systems
  - Simultaneous bi-directional monitoring of TCM information on SDH/SONET lines
  - Comprehensive TCM error and alarm statistics
  - Inject TCM events to stress-test network elements



MT1100A PDH/DSn Out-of-Service Testing

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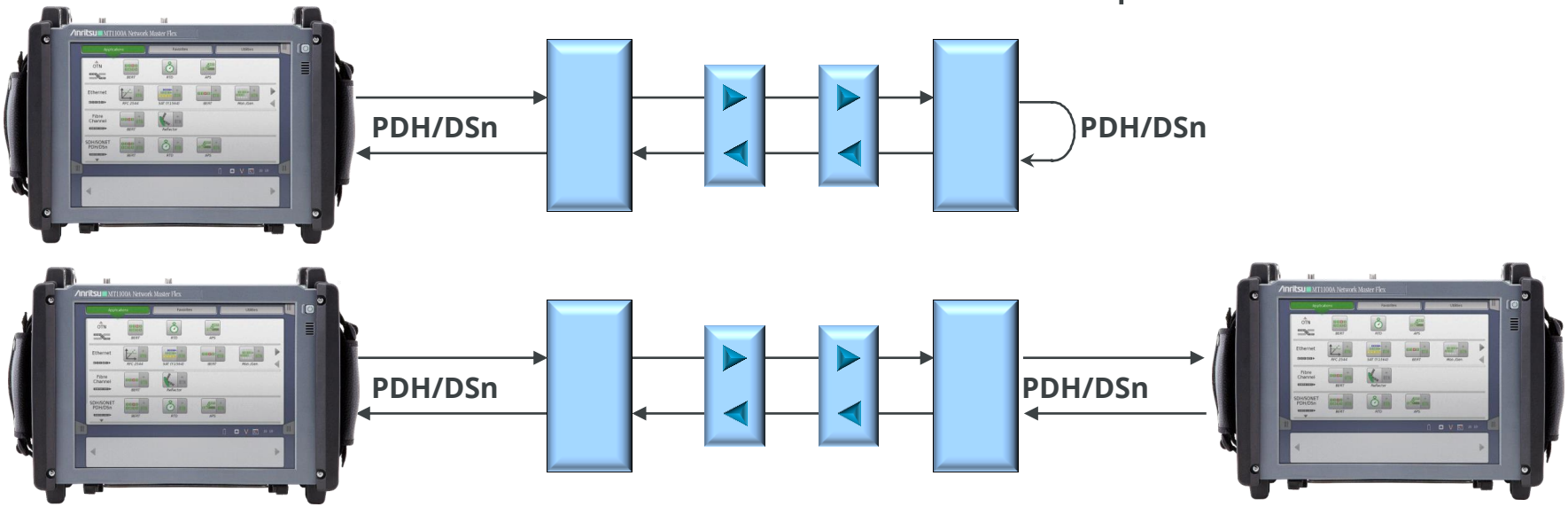
- Installing, commissioning and troubleshooting PDH/DSn lines
- Stress system by generating alarms, errors, slip and frequency offset
- Testing synchronization circuits
- G.821(E1/DS1)/G.826/M.2100 error performance
- Alarm, error, slip and frequency-deviation measurements
- Propagation time with far-end loopback



MT1100A PDH/DSn In-Service Measurements

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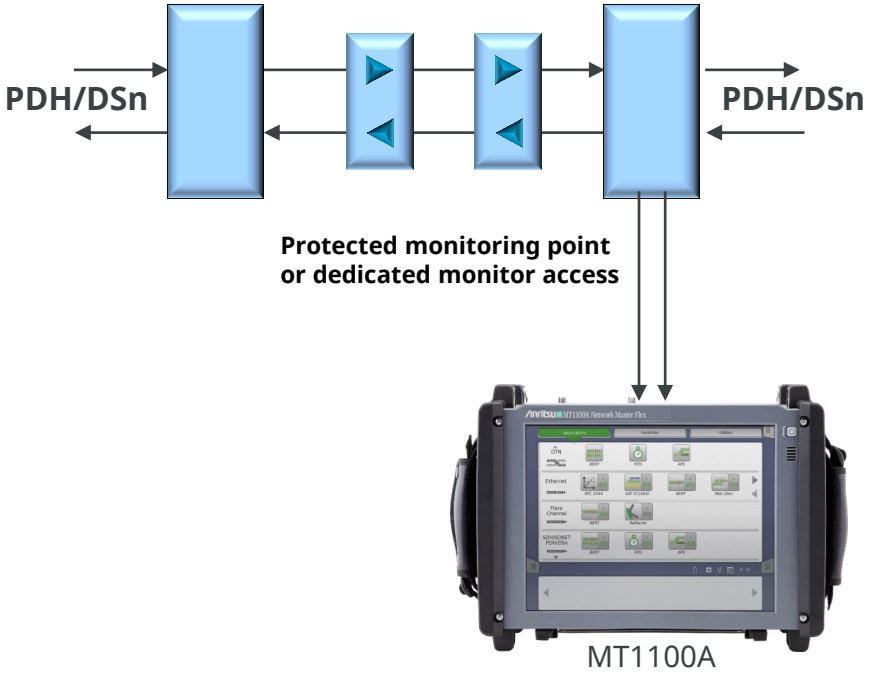
- Alarm and error monitoring at both sides of PDH/DSn line
- Frequency-deviation measurements
- G.821(E1/DS1)/G.826/M.2100 error-performance measurements on live traffic



MT1100A E1/DS1 Network-Element Testing

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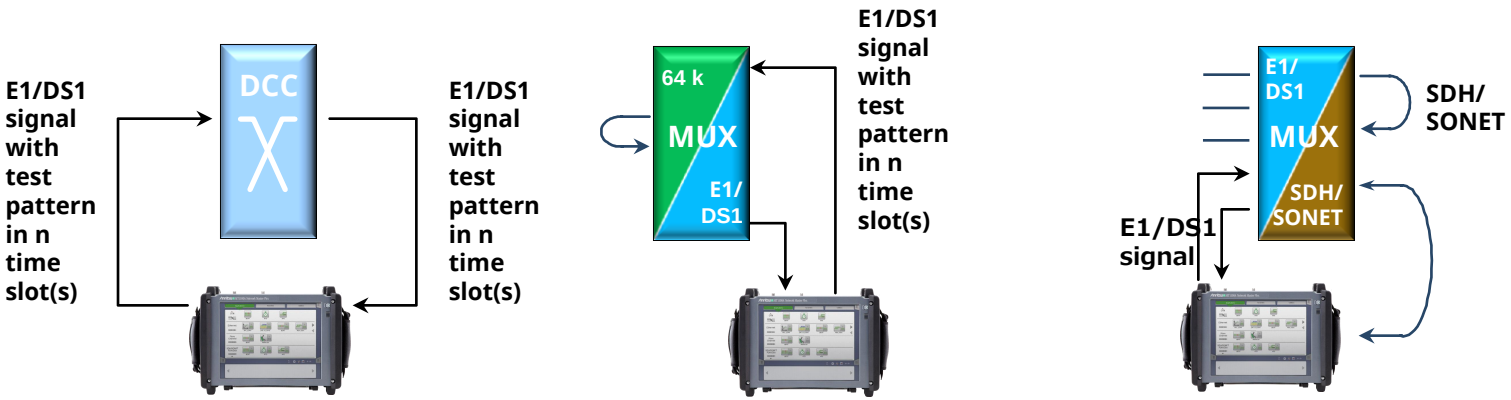
- Installing/commissioning
- G.821, G.826 or M.2100 error-performance measurements
- System stressing by generating alarms, errors, slip and frequency offset
- Testing synchronization circuits
- Alarm, error, slip and frequency-deviation measurements
- Propagation time measurements



MT1100A E1/DS1 Drop-and-Insert Testing

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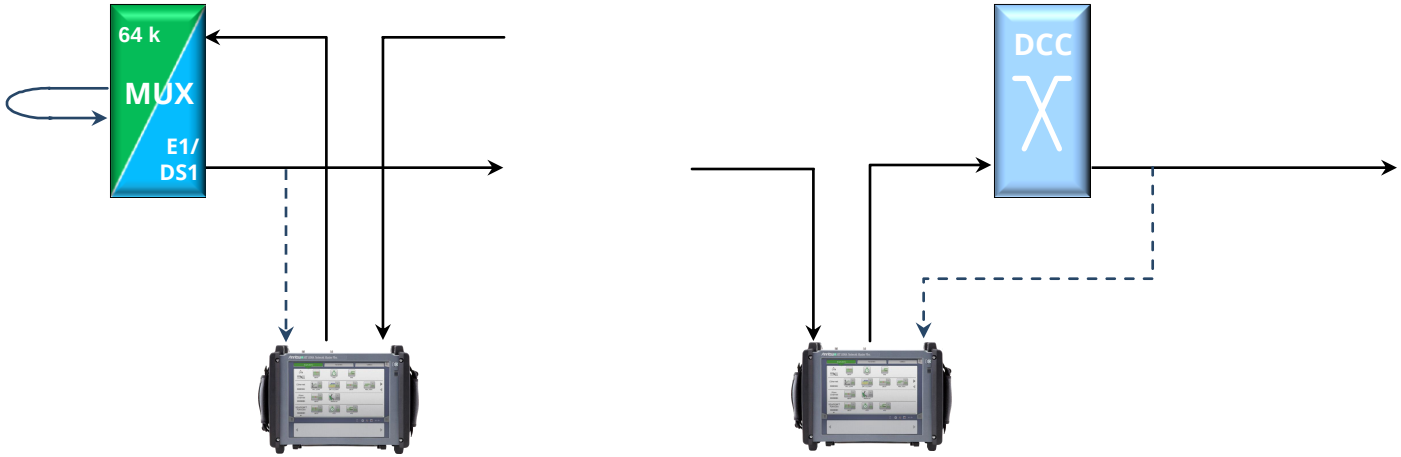
- Pseudo in-service testing on live PCM systems
- Add and drop N*64 kbps signals
- Alarm, error and slip generation and measurement
- Inject errors in live traffic channel
- G.821, G.826 or M.2100 error-performance
- Frequency deviation



MT1100A PDH/DSn Line Status

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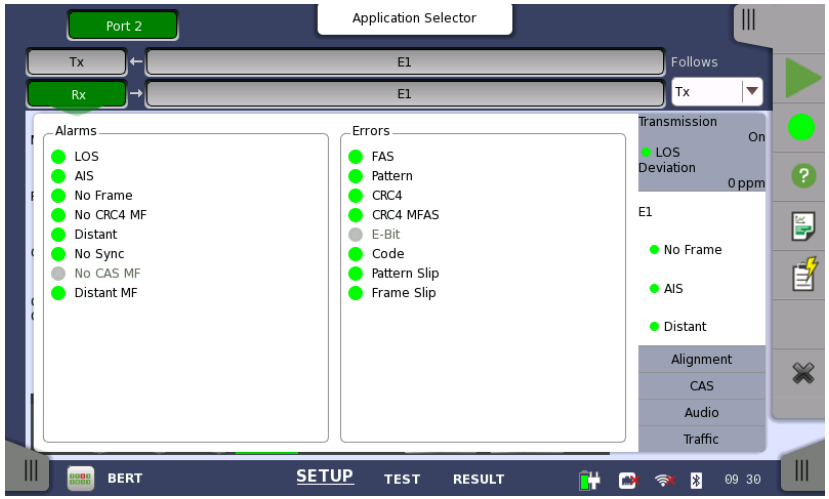
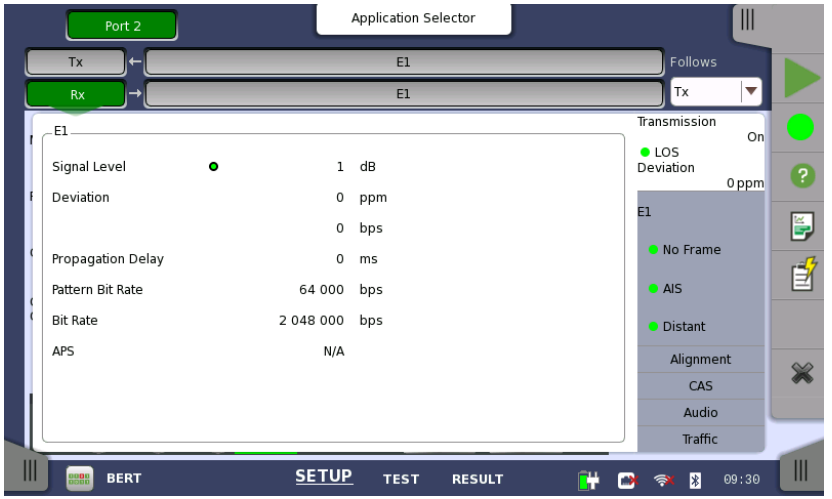
- Physical line information – display of current:
  - Input frequency and deviation
  - Input-level indication
  - Pattern bit rate
- Current alarms and errors





MT1100A PDH/DSn Alarm and Error Statistics

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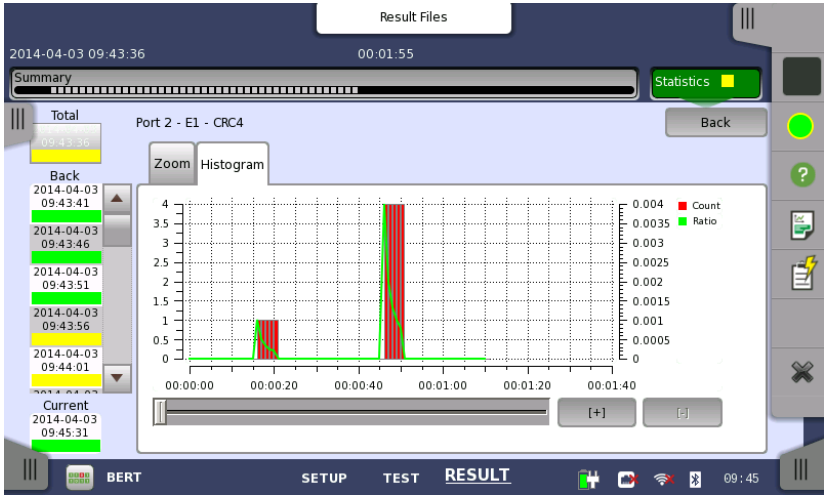
- Alarm-second counts and ratios
- Error counts and ratios
- M.2100, G.826 or G.821 parameters

- Histograms show measurement overview
  - Click parameter to activate histogram



MT1100A E1 Alignment and CAS Displays

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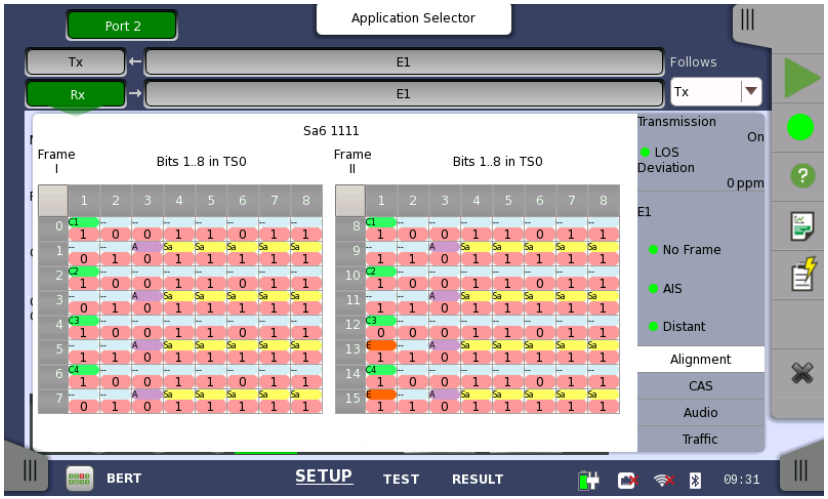
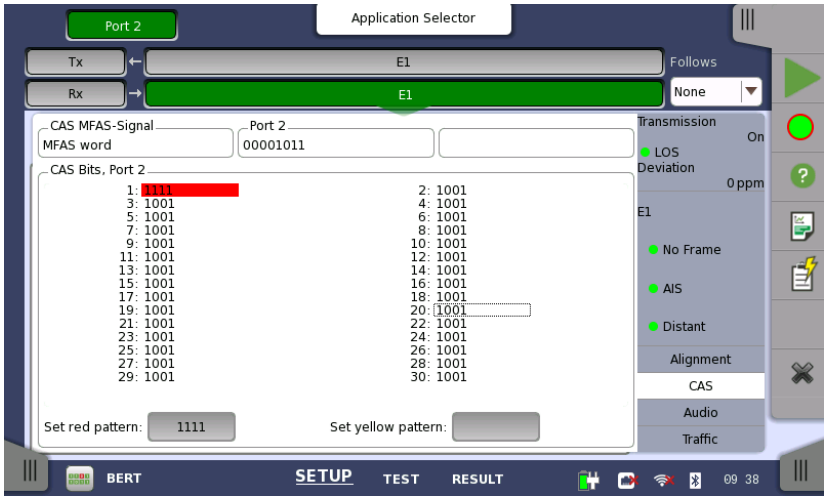
- Information on FAS words and Sa bits
- Information on CAS bits
  - User-selectable bit pattern for red and yellow colors

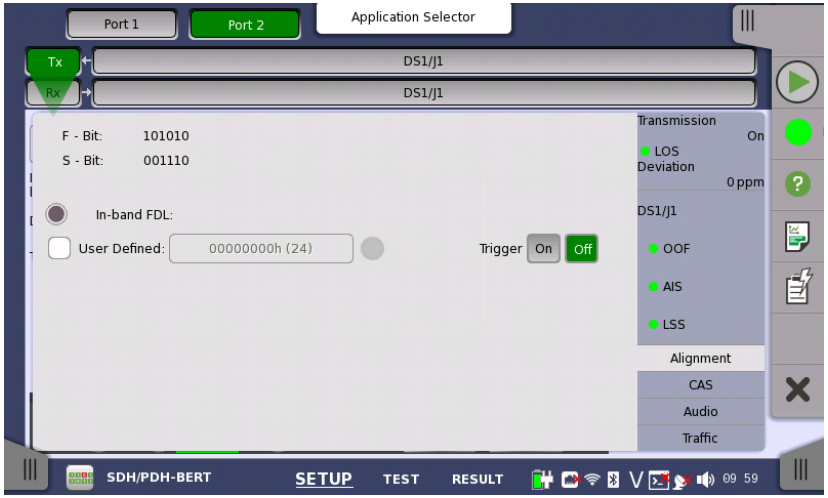


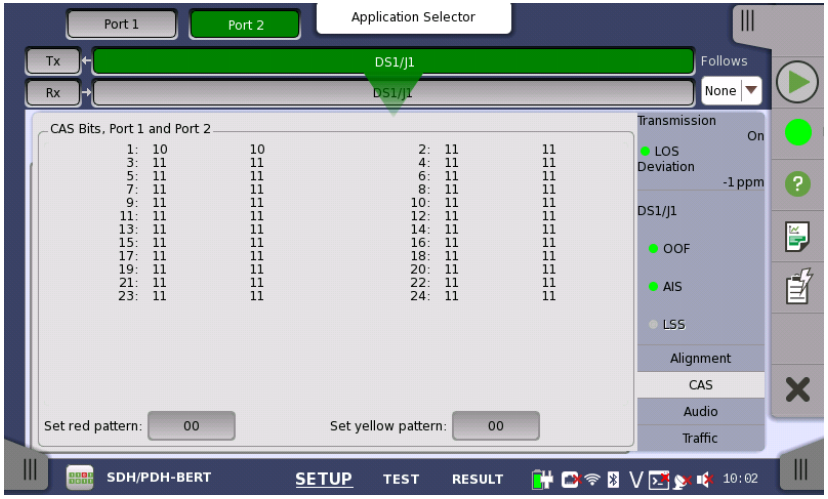


MT1100A DS1 Alignment and CAS Displays

Back to Index page

- Information on F-bits and S-bits
- Information on CAS bits
  - User-selectable bit pattern for red and yellow colors





MT1100A E1/DS1 Channel Status Display

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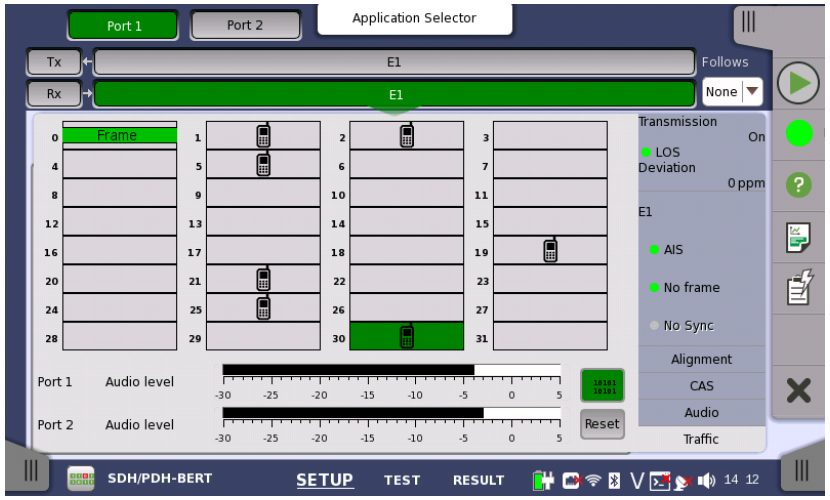
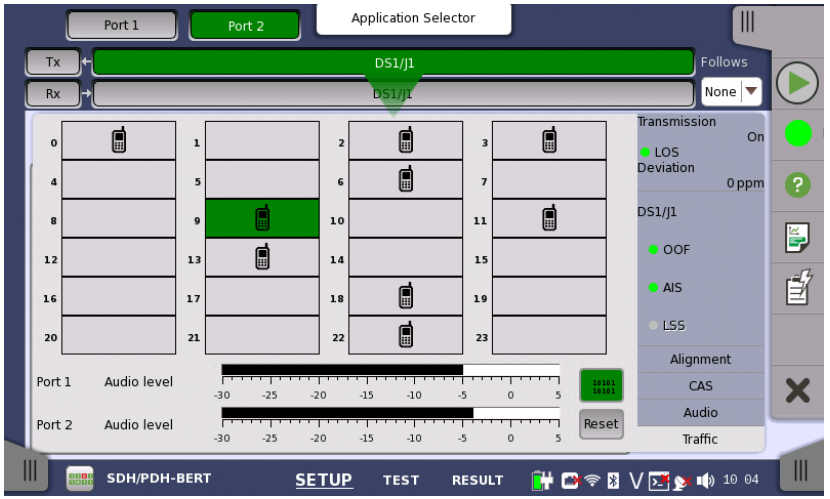
- Fast overview of E1/DS1 line status





MT1100A E1/DS1 Audio Display

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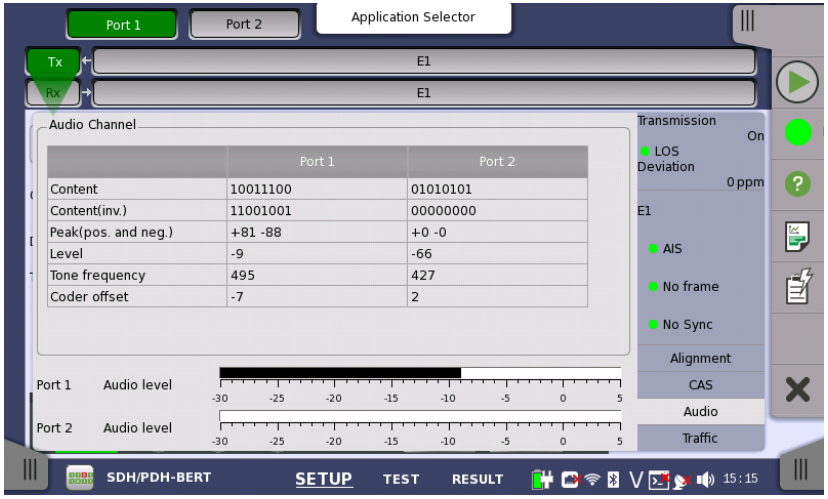
- Details on contents of one selected traffic channel
  - Displays information from two ports for bidirectional monitoring



Network Master Flex MT1100A

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- Optical Transceiver Analysis

Optical Transceiver analysis

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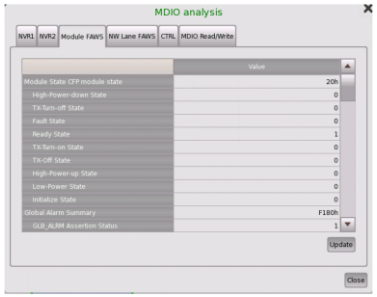
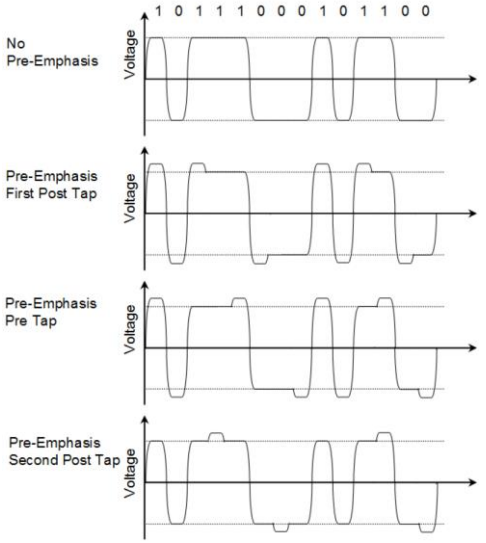
- MDIO analysis
  - Transceiver information display
    - Alarm, Wavelength, Bit rate, Compliance, Vendor information
  - Output control
  - Power monitor
  - For CFP, CFP2
    - NVR1, NVR2, Module FAWS, NW Lane FAWS, CTRL
    - MDIO Read/Write
- PCS electrical interface control
  - CFP: VOD, Pre-Emphasis, RX Equalizer
  - CFP2: Attenuation, Pre-Emphasis, RX Equalizer



CFP

CFP2



Optical Transceiver analysis

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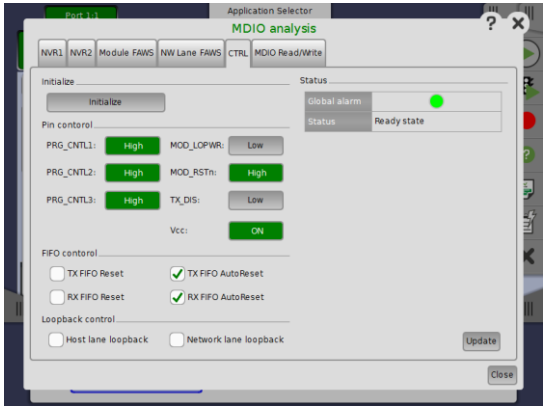
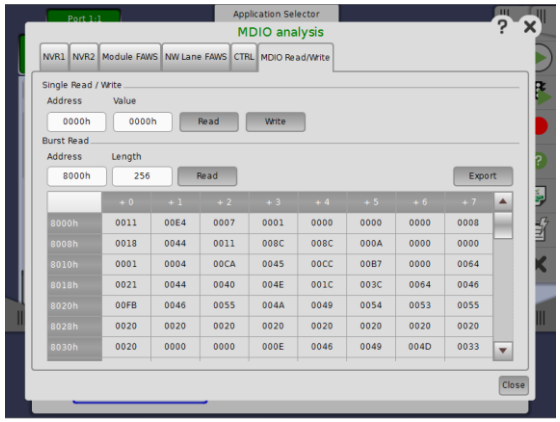
- Added functions for manual control of optical module hard pins and for dumping internal register data to MDIO Analysis function for displaying CFP/CFP2/CFP4 optical module data and confirming faults



■ Applications
- Forced reset and initialization tolerance test
- Confirmation of hardware pin status operation
  User can analyze whether start sequence completed or faulty, and sequence transitions
- Fault troubleshooting using CFP initialization and internal FIFO reset

■ Extended Functions
- Initialization of CFP/CFP2/CFP4 module (restart start sequence)
- Control of hardware pins
- Reset internal FIFO



■ Applications
- Test CFP/CFP2/CFP4 internal register access
- Compare internal register status and basic settings
  User can find unintended settings, status, and operations

■ Extended Functions
- Displays burst register read/write and results
  - Reads up to 1024 registers
  (about same size as one internal register group, such as NVR1, defined by MSA)
  - Sets read start address
  - Outputs read results in csv file format

Network Master Flex MT1100A

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- PCS Lane Testing

PCS Lane Testing with CAUI/XLAUI Interface

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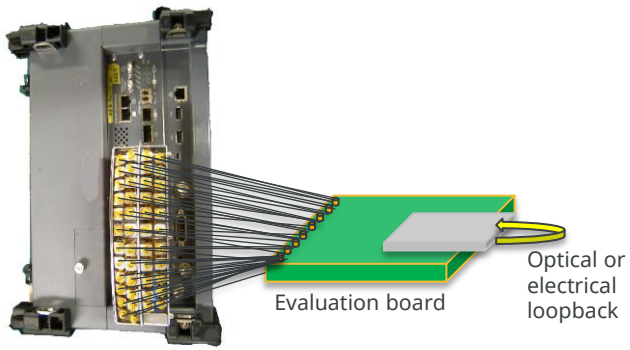
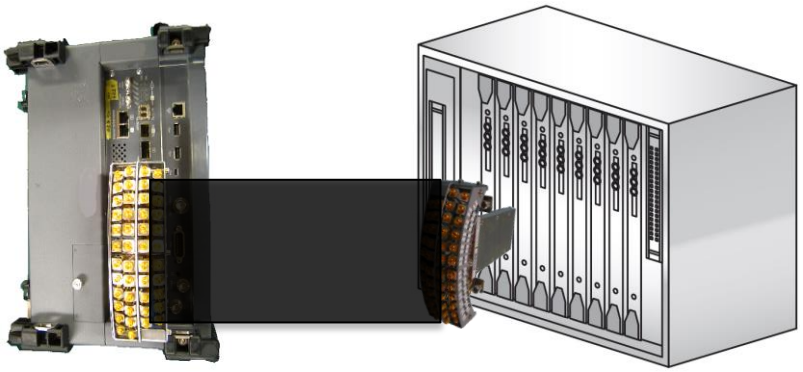
- 10-lane extender MZ1223C
  - Attachment for MU110011A CFP connector
  - Captures CFP electrical input/output signals using MT1100A's optional accessory cables
  - No software version dependency

- Application
  - Evaluating devices such as optical transceivers, framer ICs, network equipment CAUI/XLAUI electrical interface





Test PCS Lanes using CAUI4 Interface

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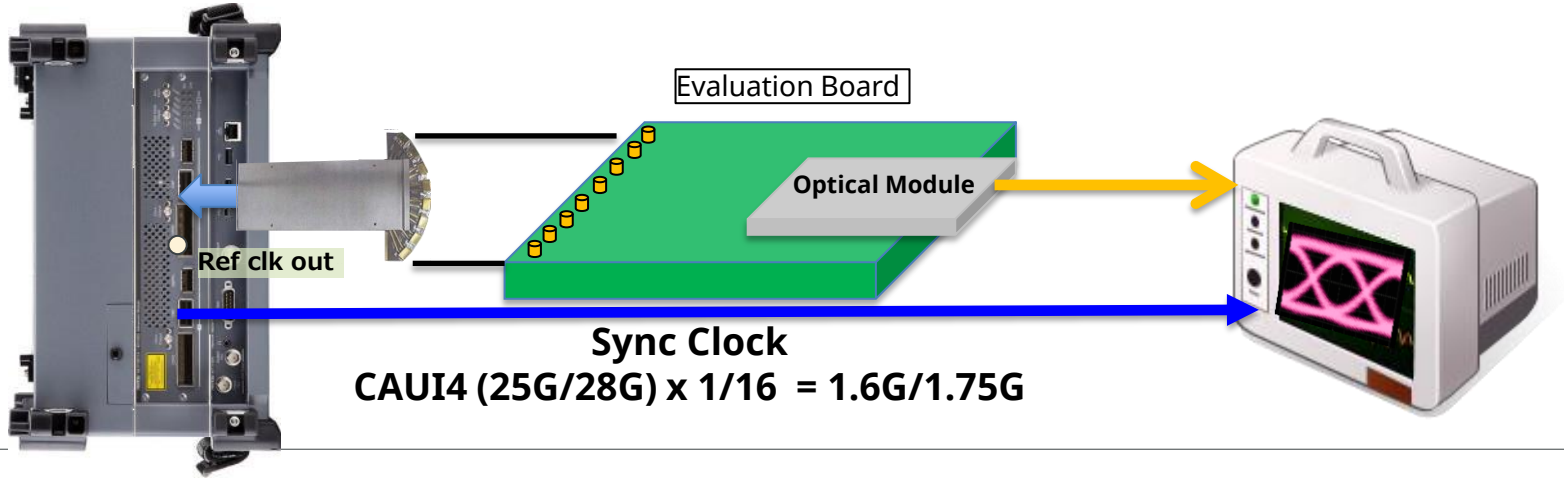
- 4-Lane Extender for CFP2 J1666A
  - Mounted on MU110013A CFP2 connector
  - Uses MT1100A application part to extend CFP2 CAUI4 electrical I/O signals externally

- Application
  - For evaluating optical transceivers, Frame ICs, transmission equipment using CAUI4 interface



Network Master Flex MT1100A

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- VIP: Video Inspection Probe

VIP: Video Inspection Probe

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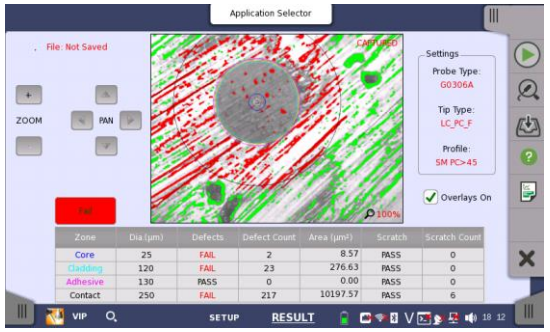
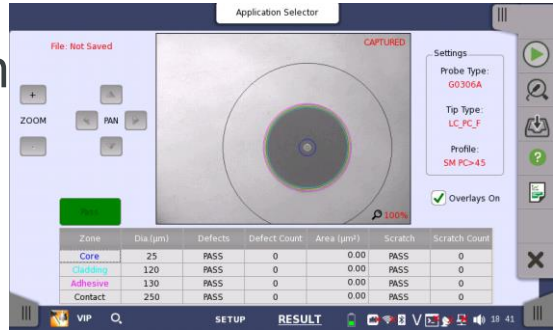
- VIP Video Inspection Probe
  - Judge quality of optical fiber and module endface
  - Find trouble in optical fiber and module endface Reduce degraded signal transmission and effect on measurement results
  - Prevent connected optical fiber and module endface damage
- Dirty connector endface…
  - Dirty connector endface causes more reflection
  - Cleaning connector endfaces maintains good connection
- Damaged connector endface…
  - Damaged connector endface has greater reflection and larger ORL (Optical Return Loss)
- MT1100A supports G0382A/G0306B VIP option
  - From the Table View, you can identify “defects” or “scratches”
  - The automatic pass/fail determination is made in accordance with the IEC61300-3-35 standard on the end of the fiber.



Clean up



VIP – Order items 1/2 –

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Model No.	
G0382A	Autofocus Video Inspection Probe
- Standard accessories*1 -	Soft Bag Seven Connector Tips - 1.25mm PC Male, - 2.5mm PC Male, - 2.5mm APC Male, - 1.25mm PC Female(LC), - 2.5mm PC Female(FC), - 2.5mm PC Female(SC), - 2.5mm APC Female(SC) Quick Reference Guide

Application Parts			
Model No.		**Model No.**	
H0382A	2.5PC-M (2.5mm PC Male)	H0395A	FC-APC-F (FC APC Female)
H0383A	1.25PC-M (1.25mm PC Male)	H0385A	LC-PC-F (LC PC Female)
H0387A	2.5APC-M (2.5mm APC Male)	H0393A	LC-PC-F-L (LC PC Long Female)
H0388A	1.25APC-M (1.25mm APC Male)	H0394A	LC-APC-F-L (LC APC Long Female)
H0384A	SC-PC-F (SC PC Female)	H0396A	ST-PC-F (ST PC Female)
H0398A	SC-APC-F (SC APC Female)	H0397A	MU-PC-F (MU PC Female)
H0386A	FC-PC-F (SC PC Female)	H0390A	E2000-PC-F (E2000 PC Female)
		H0392A*2	MPO-PC/APC-F (MPO PC/APC Female)

*1: Operation manual and MX900031A Autofocus VIP Software (For PC) can be downloaded from Anritsu public Web site.

*2: H0392A MPO tip does not have Autofocus and Pass/Fail functions.

VIP – Order items 2/2 –

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Model No.	
G0306B	400x Video Inspection Probe
- Standard accessories -	Operation manual (Printed) Soft Bug Seven Connector Tips - 1.25mm PC Male, - 2.5mm PC Male, - 2.5mm APC Male - 1.25mm PC Female(LC), - 2.5mm PC Female(FC) - 2.5mm PC Female(SC), - 2.5mm APC Female(SC)

Application Parts

Model No.		**Model No.**	
H0360A	2.5PC-M	H0366A	SC-APC-F
H0361A	1.25PC-M	H0372A	E2000-PC-F
H0362A	2.5APC-M	H0373A	FC-APC-F
H0363A	LC-PC-F	H0374A	MU-PC-F
H0364A	FC-PC-F	H0375A	ST-PC-F
H0365A	SC-PC-F	H0376A	1.25APC-M
		H0380A	LC65-PC-F

H0380A

Network Master Flex MT1100A

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- Operation and Presentation

MT1100A Operation and Presentation

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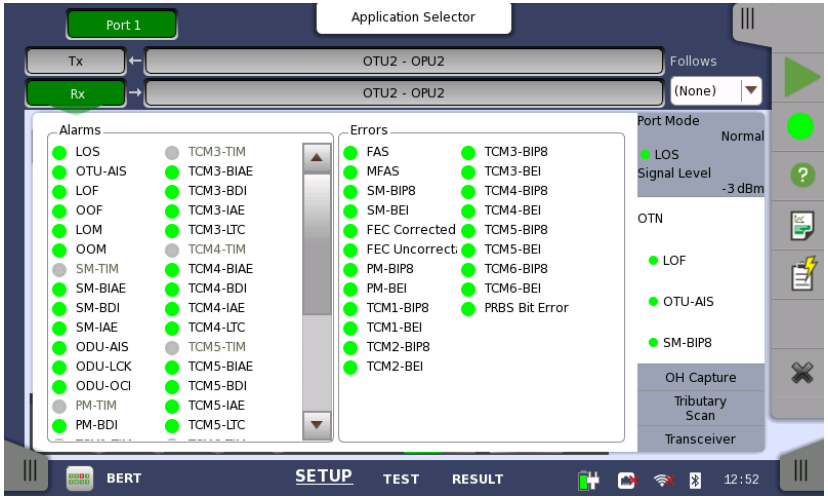
- Easy operation
  - Simple, intuitive GUI
  - Loading and transferring configurations
  - Go/No Go testing
- Touch-screen based operation
- Remote operation
  - Via Ethernet interface
- Setup transfer/data transfer/firmware upgrade
  - Via USB interface



MT1100A GUI

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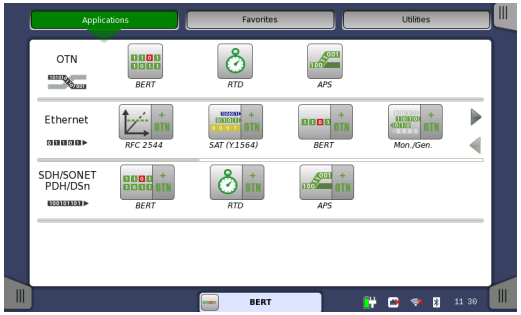
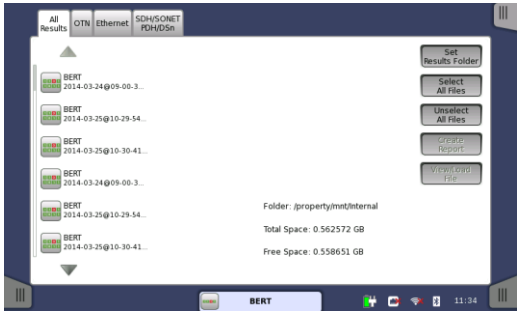
- Five main groups

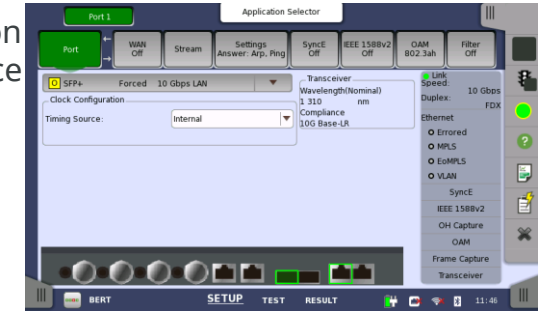
Application Selector



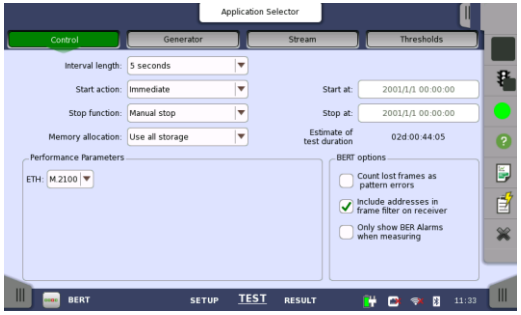
Results Files



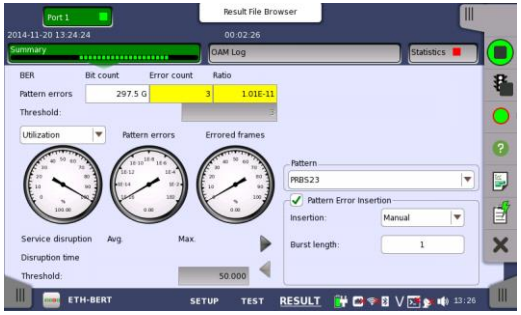
Application work space



Port Setup



Test Setup



Test Results

MT1100A GUI

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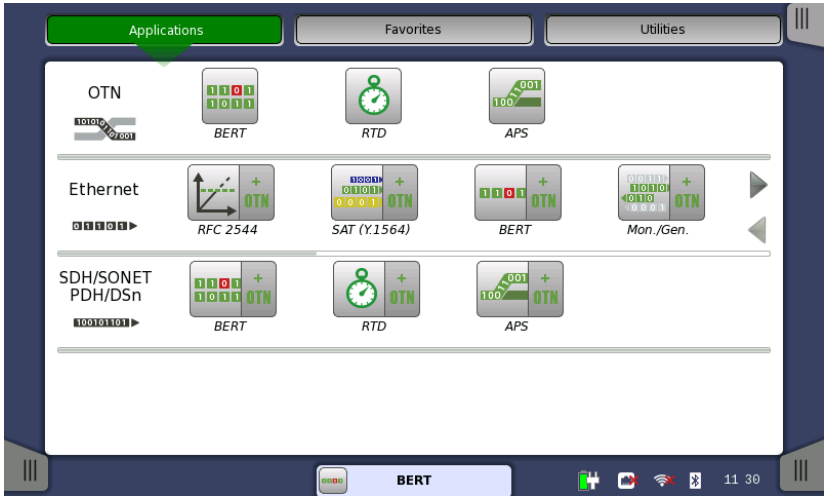
- Application selector
  - Intuitive launch of new test
  - ”Double” keys for starting tests of client signals in OTN
    - Right side of key starts test of client signals in OTN
    - Left side of key starts test of client signals directly



MT1100A GUI

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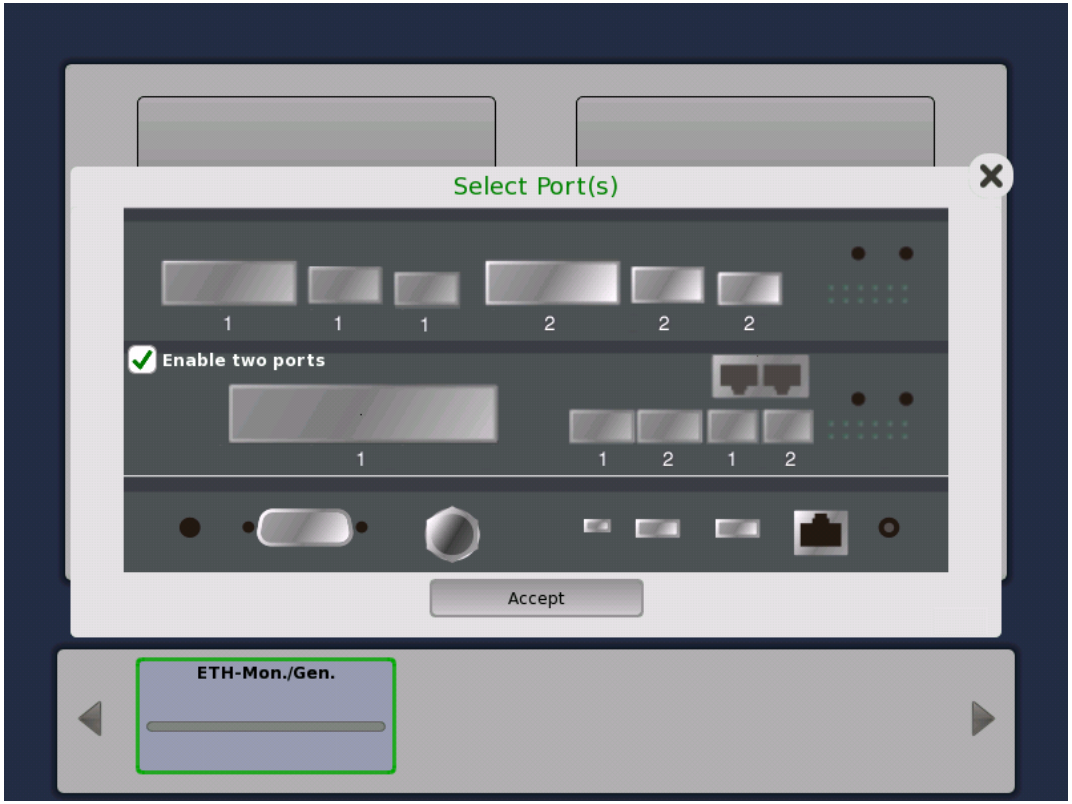
- Select Port display
  - Displayed after selecting application
    - Select one port – or two if available – and press Accept



MT1100A GUI

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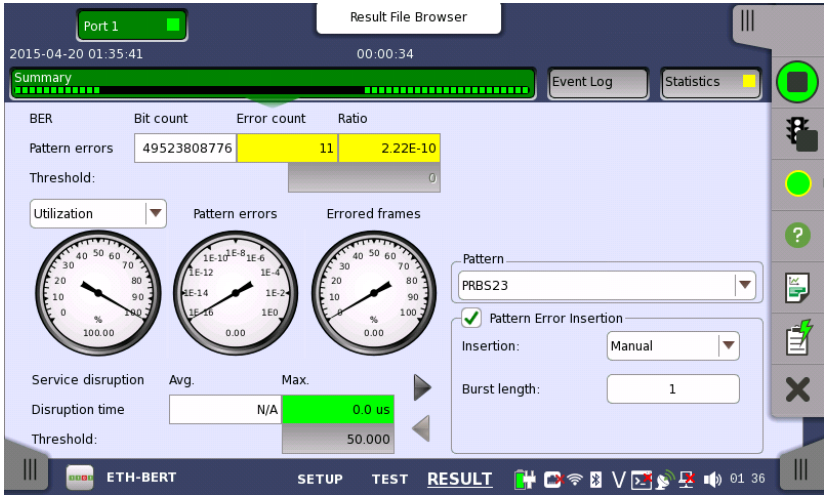
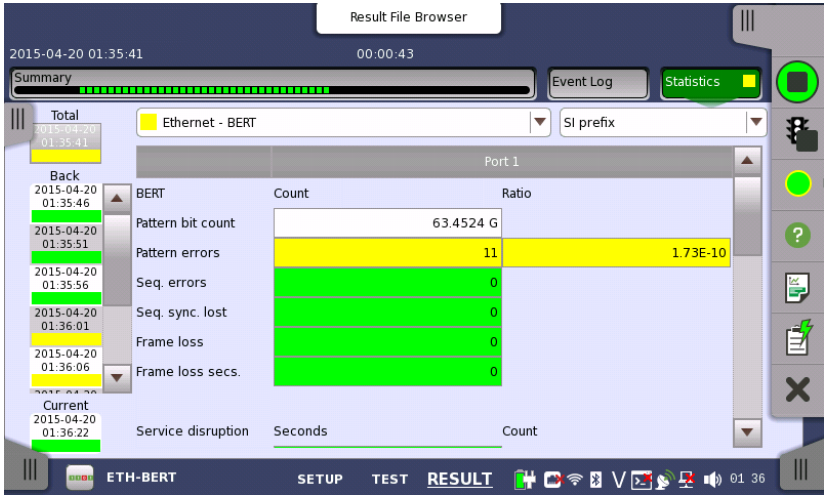
- Result pages:
  - Summary page
  - Event log
  - Statistics page(s)
    - Color-coded GO/NO GO indications





MT1100A GUI

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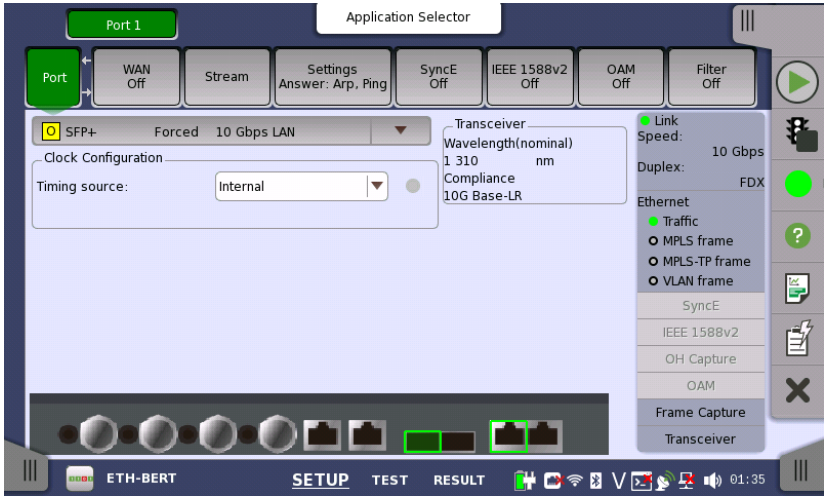
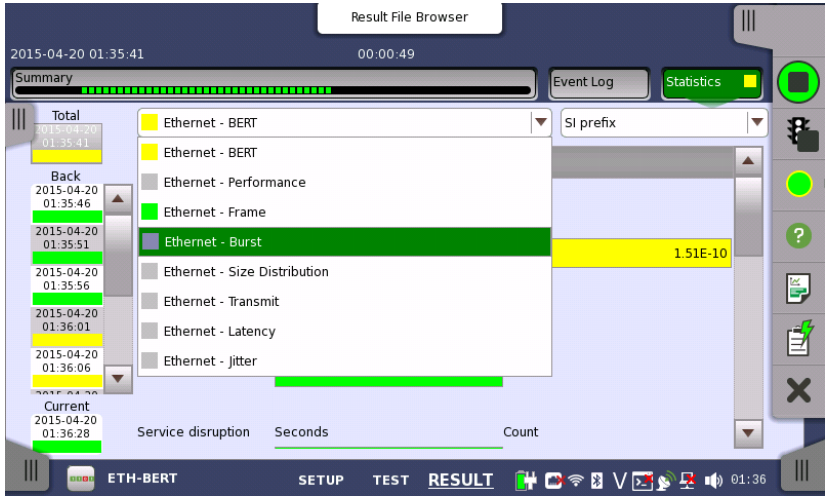
- Several pages in each main group
  - Selected with tabs
  - Selected from drop-down menu





MT1100A Histograms for General Statistics

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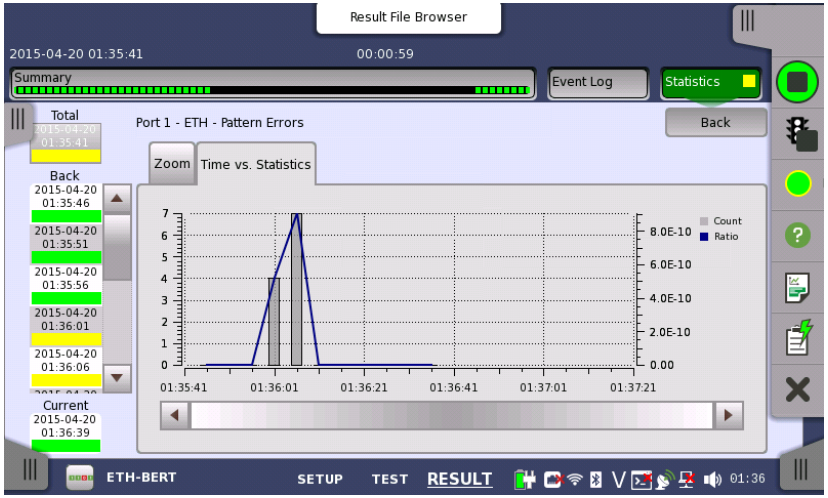
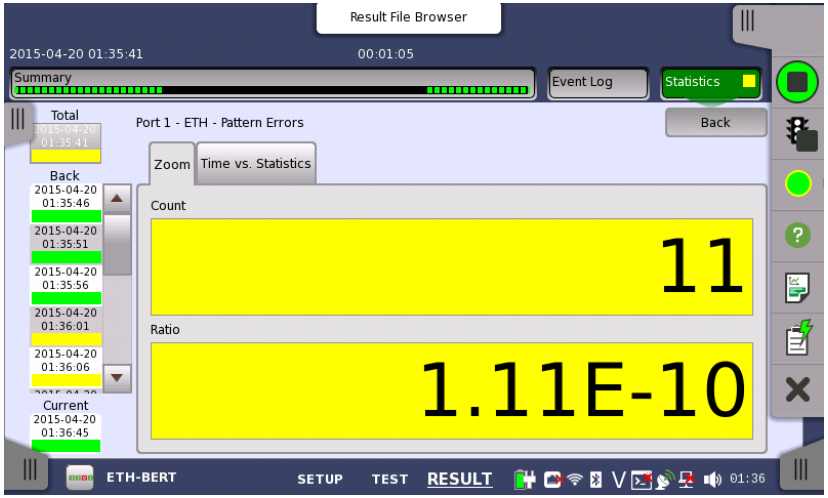
- User sees distribution over time for selected parameter easily
  - Click parameter and select histogram
  - Click Zoom: Large numeric makes distance reading easy





Test Applications Summary

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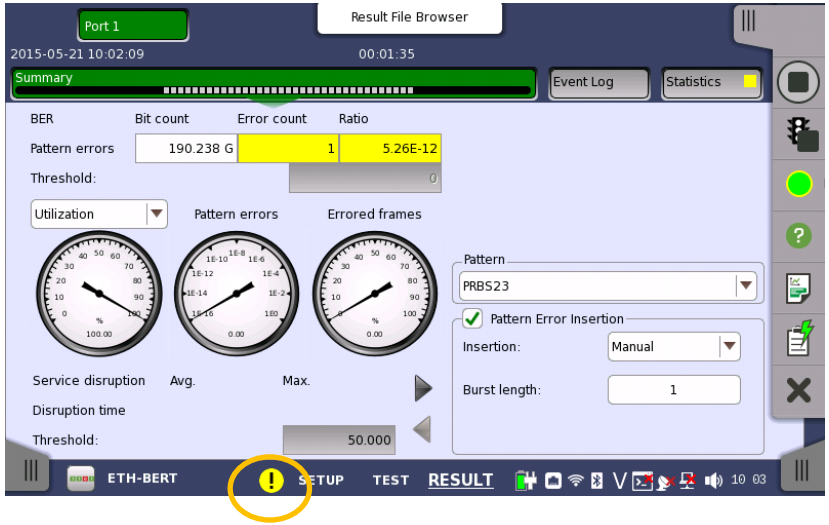
- Summarizes measurement results for all current Test Applications (applications using port resources) **belonging to one user –** using the Remote GUI software up to four users can use the MT1100A
- Test Application Summary and Overall Test Status only updates during testing:
  - Green: No trouble
  - Yellow: Errors (and no alarms) are pending or occurred in the past.
  - Red: Threshold violation or Alarms are pending or occurred in the past.



Shows worst Status of all test applications.

All applications are OK

One or more applications have Yellow Test Status (and no Red)

One or more applications have Red Test Status

- Clicking the Test Applications Summary icon opens the Overall Test Status screen

Overall Test Status

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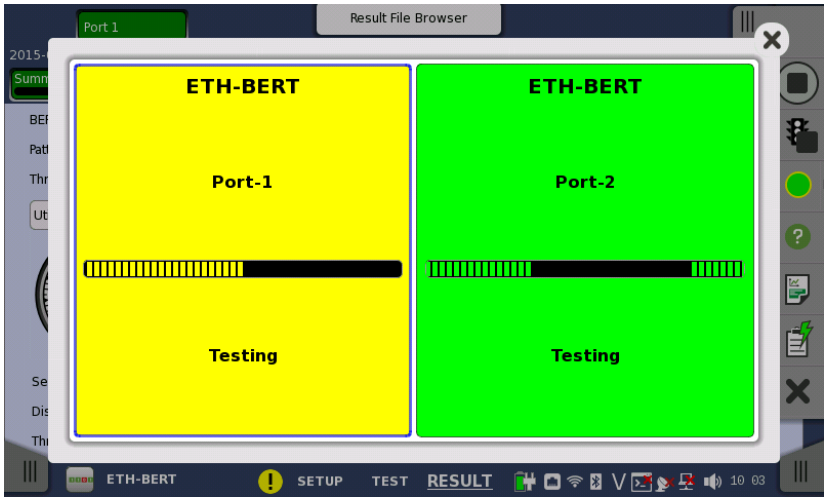
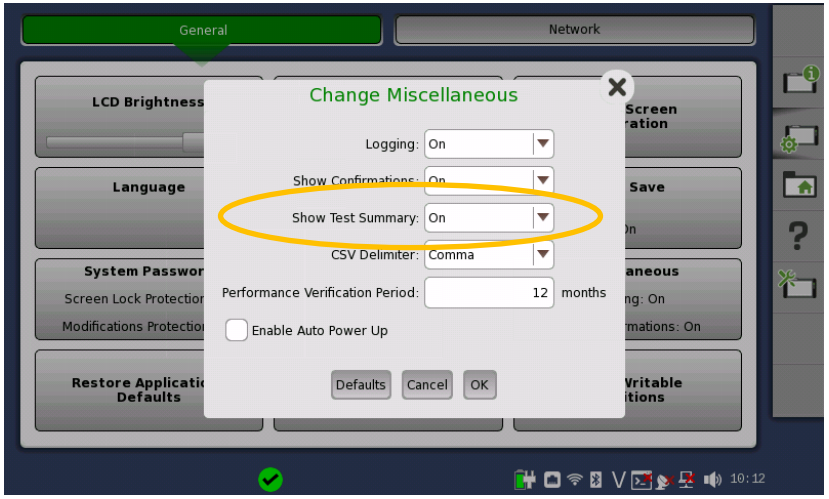
- For viewing test status for all current Test Applications from a distance
- Test Application Summary and Overall Test Status has no current/history distinction - basically they show history.
- To ”clear” Test Status: Restart the test.
- User configurable to show the Test Application Summary indicator – and to get access to the Overall Test Status screen





- Overall Test Status only updates during testing:
  - Green: No trouble
  - Yellow: Errors (and no alarms) are pending or occurred in the past.
  - Red: Threshold violation or Alarms are pending or occurred in the past.

Event Log

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- Event Log gives users powerful means to analyze problems of long -term testing
- Records what/when problem happened and how long/often been happening

Event Log

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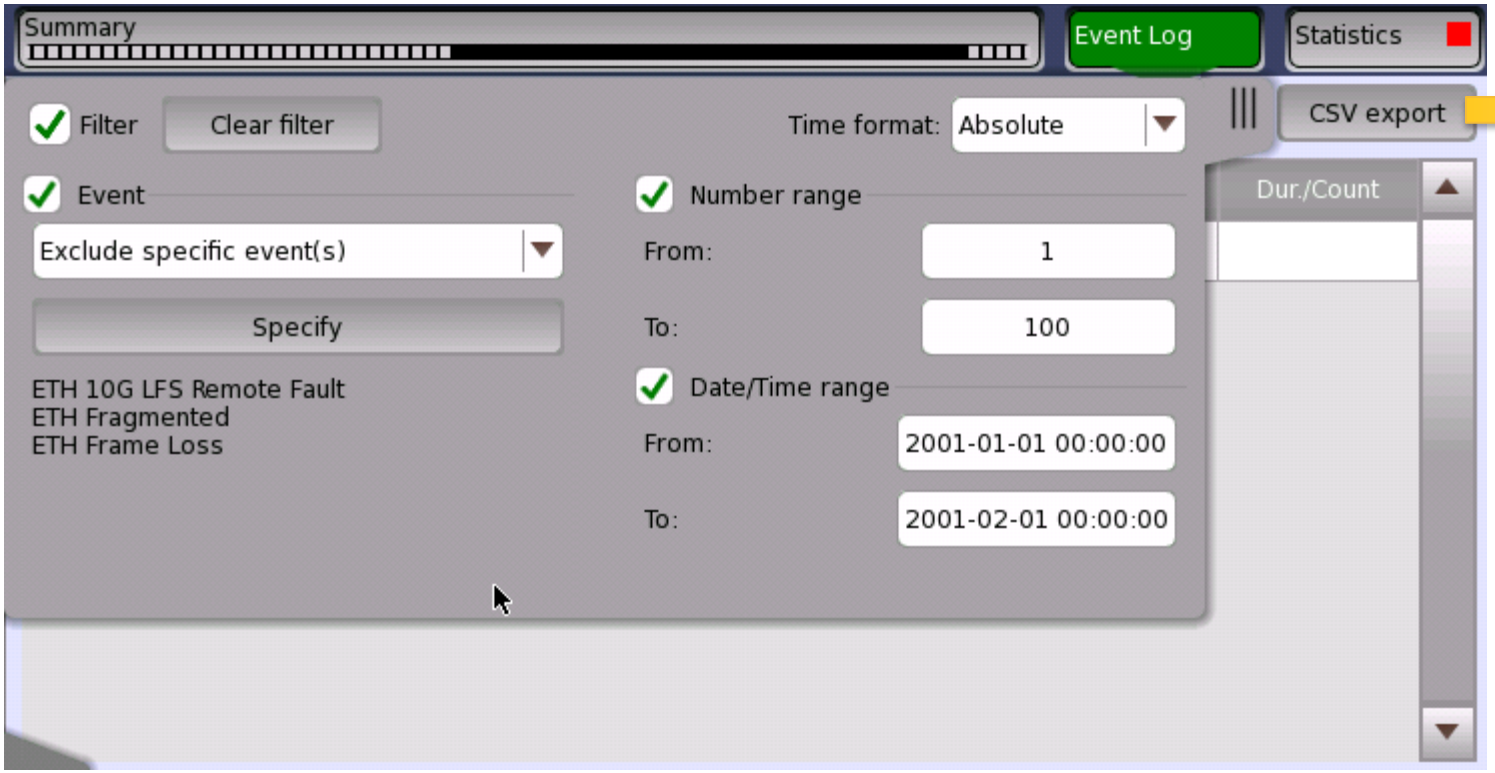
- GUI filter function and CSV export



Event Log

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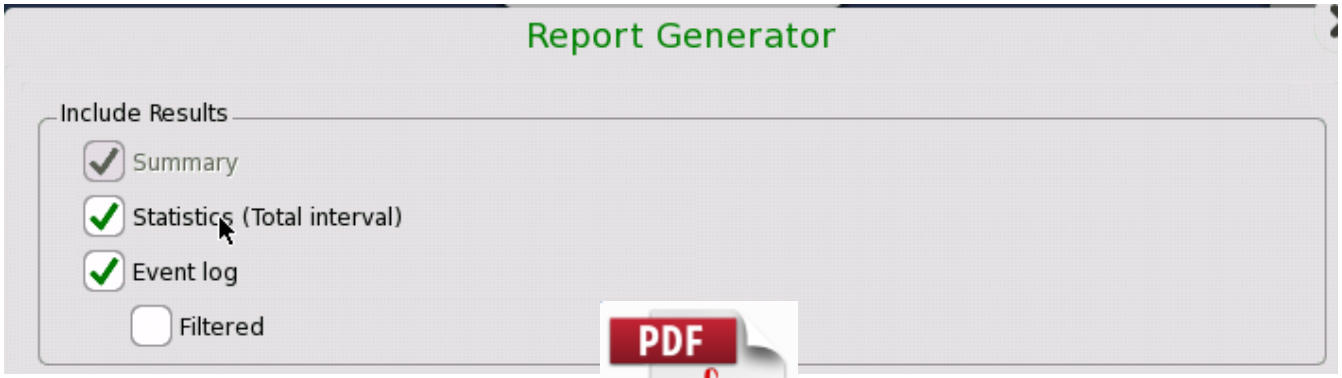
- Logged events included in report



2015-03-28 07:55:53

Event Log

No.	Time	Port	Type	Src.	Description	Dur./Count
1	2015-03-28 07:41:40		Test	Test	Started	
2	2015-03-28 07:41:49	1	Alarm	ETH	10G LFS Remote Fault	00:00:03
3	2015-03-28 07:41:49	1	Error	ETH	Invalid blocks	73.566 k
4	2015-03-28 07:41:50	1	Alarm	ETH	Frame Loss Secs.	00:00:03
5	2015-03-28 07:41:51	1	Error	ETH	Invalid blocks	22
6	2015-03-28 07:41:52	1	Alarm	ETH	Seq. Sync. Lost	00:00:01

Event Log

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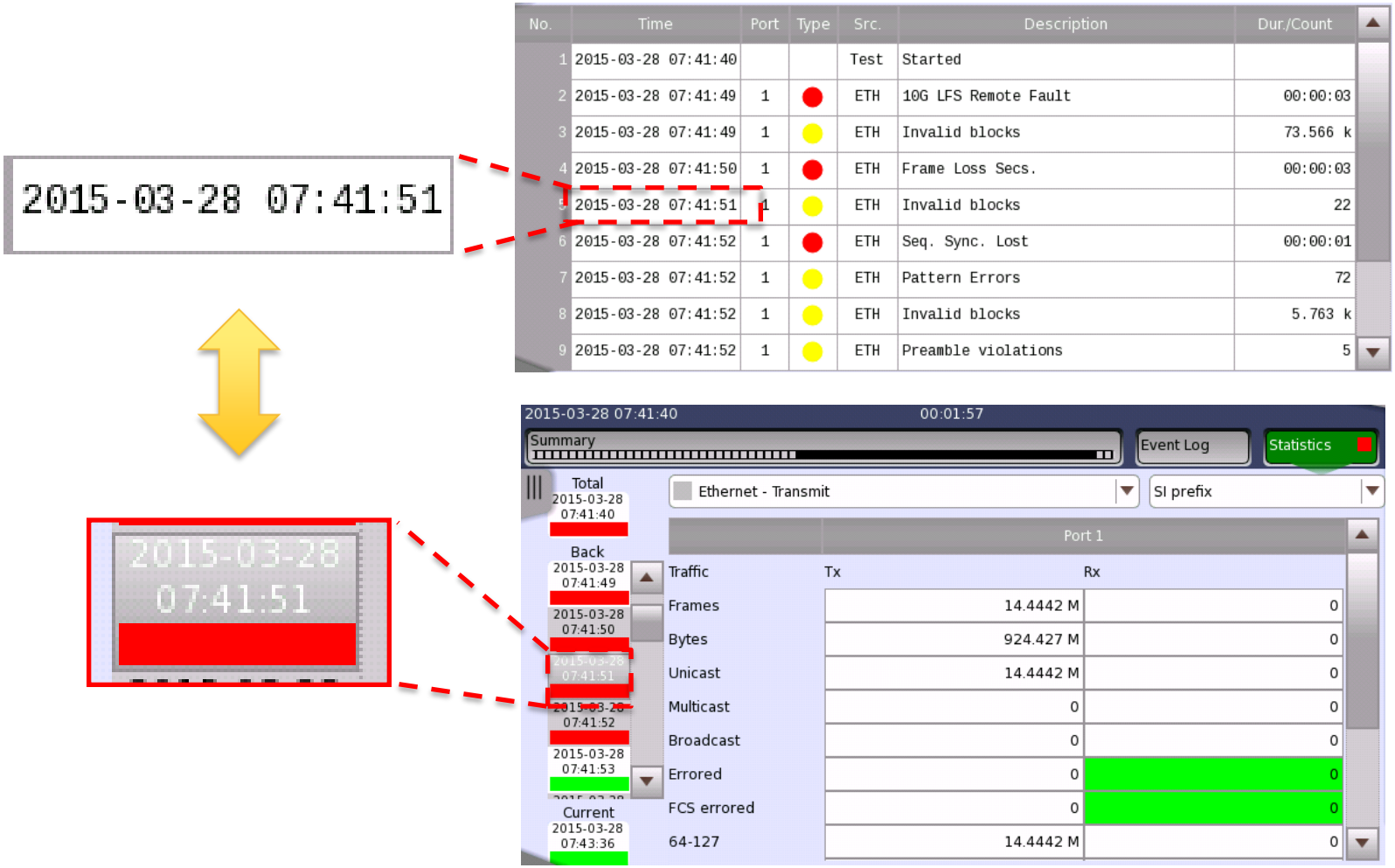
- Time stamp shows relation between event and statistics



MT1100A GUI

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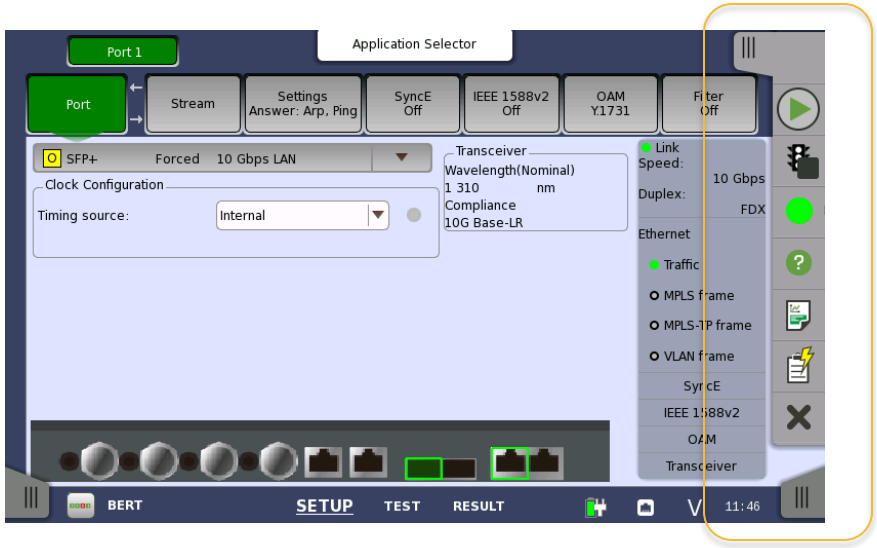
- Control panes
  - Control applications in work space



MT1100A GUI

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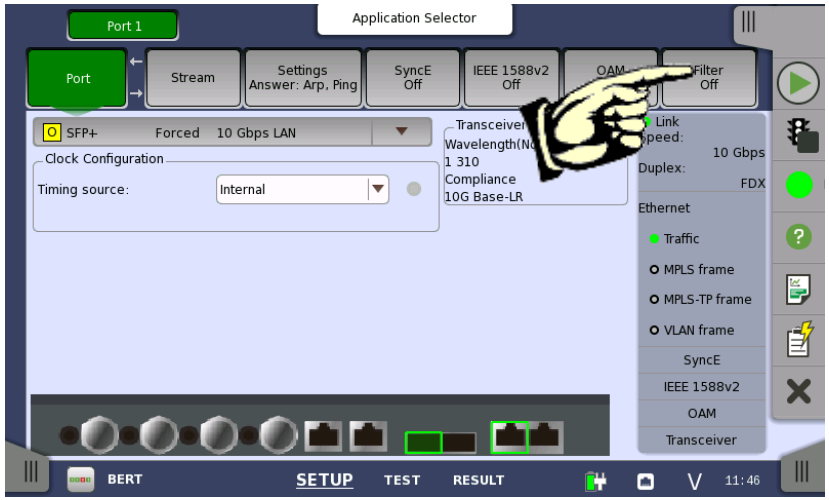
- Control panes
  - Control applications in work space
    - Click to expand



MT1100A GUI

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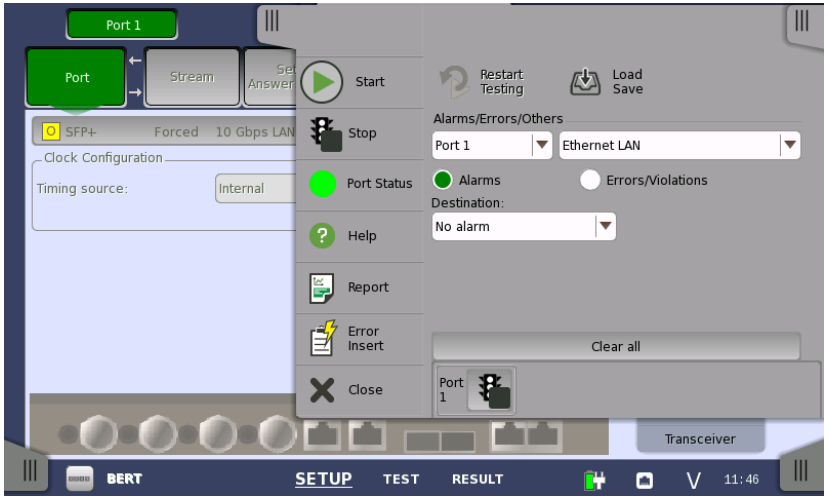
- Control panes
  - Control applications in work space – expanded



MT1100A GUI

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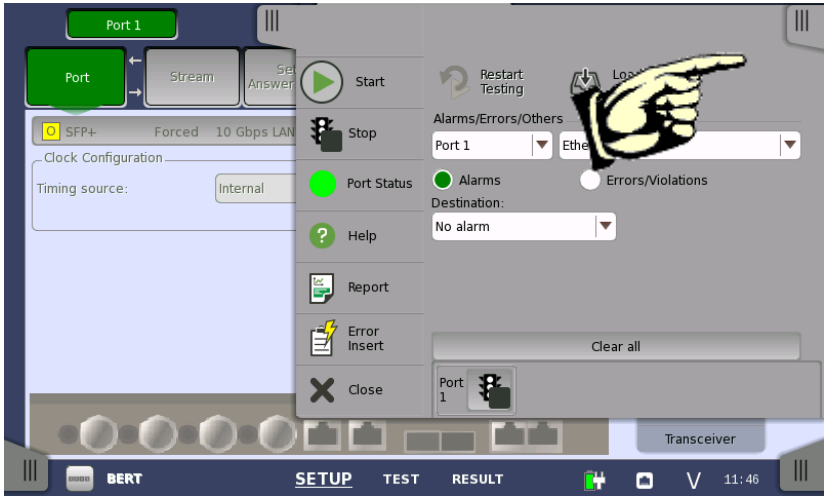
- Control panes
  - Control instrument in application work space – expanded
    - Click to expand instrument control



MT1100A GUI

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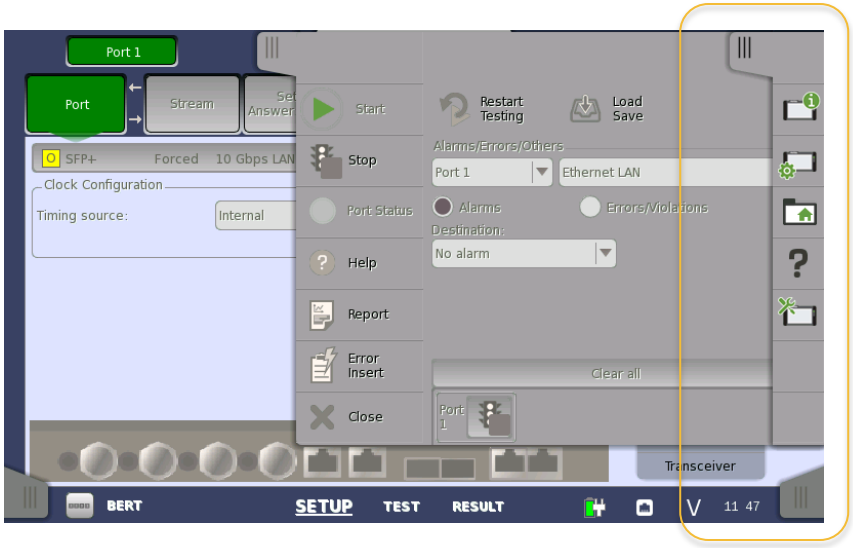
- Control panes
  - Control instrument in application work space



MT1100A GUI

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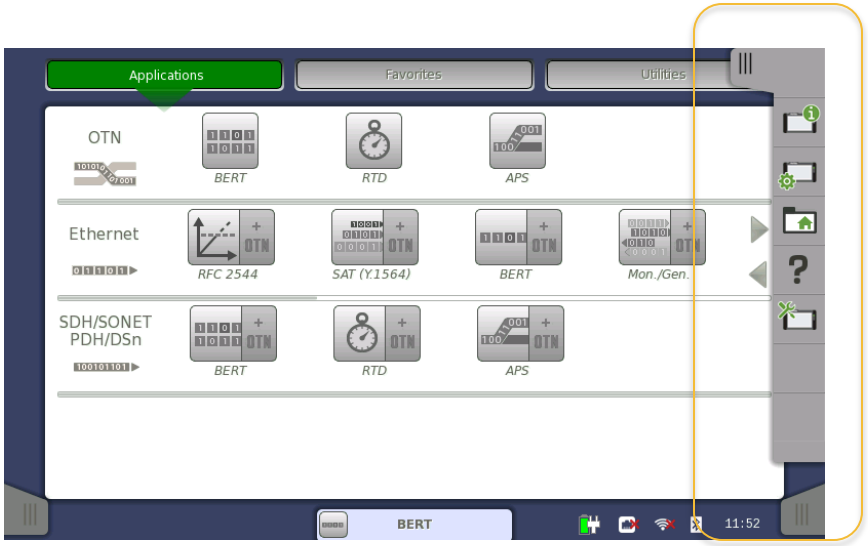
- Control panes
  - Control instrument in Application selector and test Result pages



MT1100A GUI

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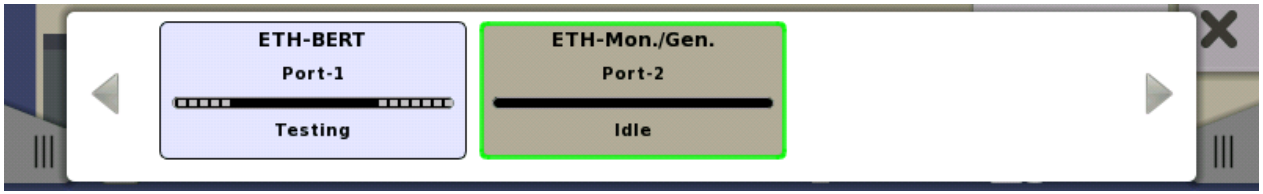
- Power button menu
  - Pressing Power button while instrument on displays menu to:
    - Switch applications (when two applications running)
    - Take screen shot
    - Activate screen lock – can be password protected
    - Power-down

    - Switch applications by clicking running applications at screen bottom
    - Running applications window always accessible



MT1100A Instrument Setup

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- Password protection
  - Prevent unintended changes to parameters and measurement start/stop
  - Enabled/disabled by user

Network Master Flex MT1100A

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- Report Generation

Report Generator

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- Generates reports:
  - Summary page only
  - Summary and Statistics pages
  - Port setup and Application setup included as option
  - User-customized report including:
    - Logo in .png format
    - Customer ID, Operator ID, notes, and similar information in measurement .pdf reports
  - Output report in .pdf, .CSV or .XML format to USB port

Report Generator

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2015-05-26 14:08:55

Document Information

Report Name	BERT
Customer	Customer 001
Project	Testing of line 1
Operator	Operator 001
Notes	This is a sample report

Module Type	Serial no	Software Version
MT1000A	6D60000101	3.01
MU100010A	6D60000087	

Report Layout

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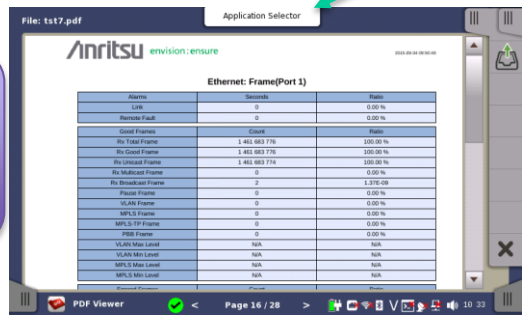
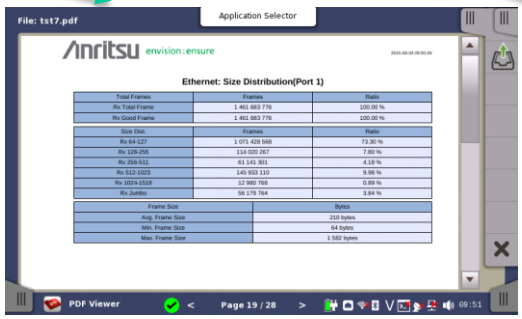
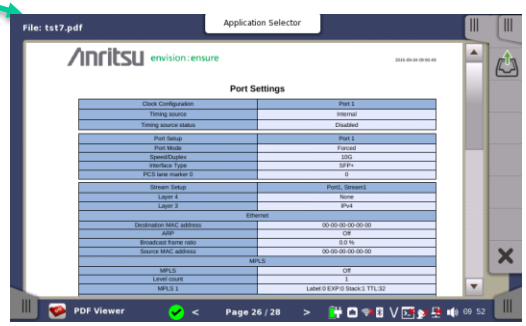
- Look of pages like Ethernet stats, event log and port settings

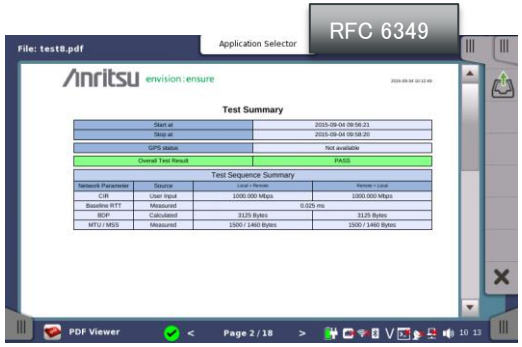
PDF reports are displayed with the built-in PDF viewer

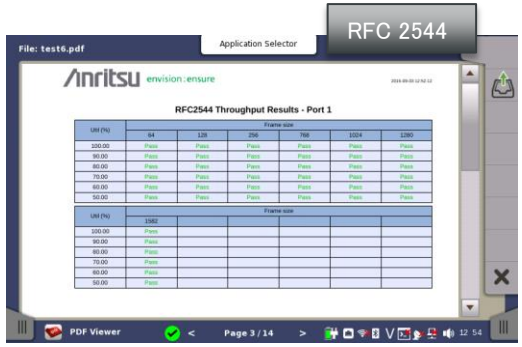




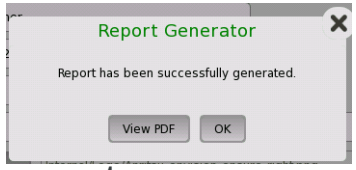


- Look of reports from other applications.





- Reports can be viewed in the built-in PDF viewer immediately after they are generated
  - This makes it simple and easy for the user to inspect the report



Filtering Results Display at Report Output

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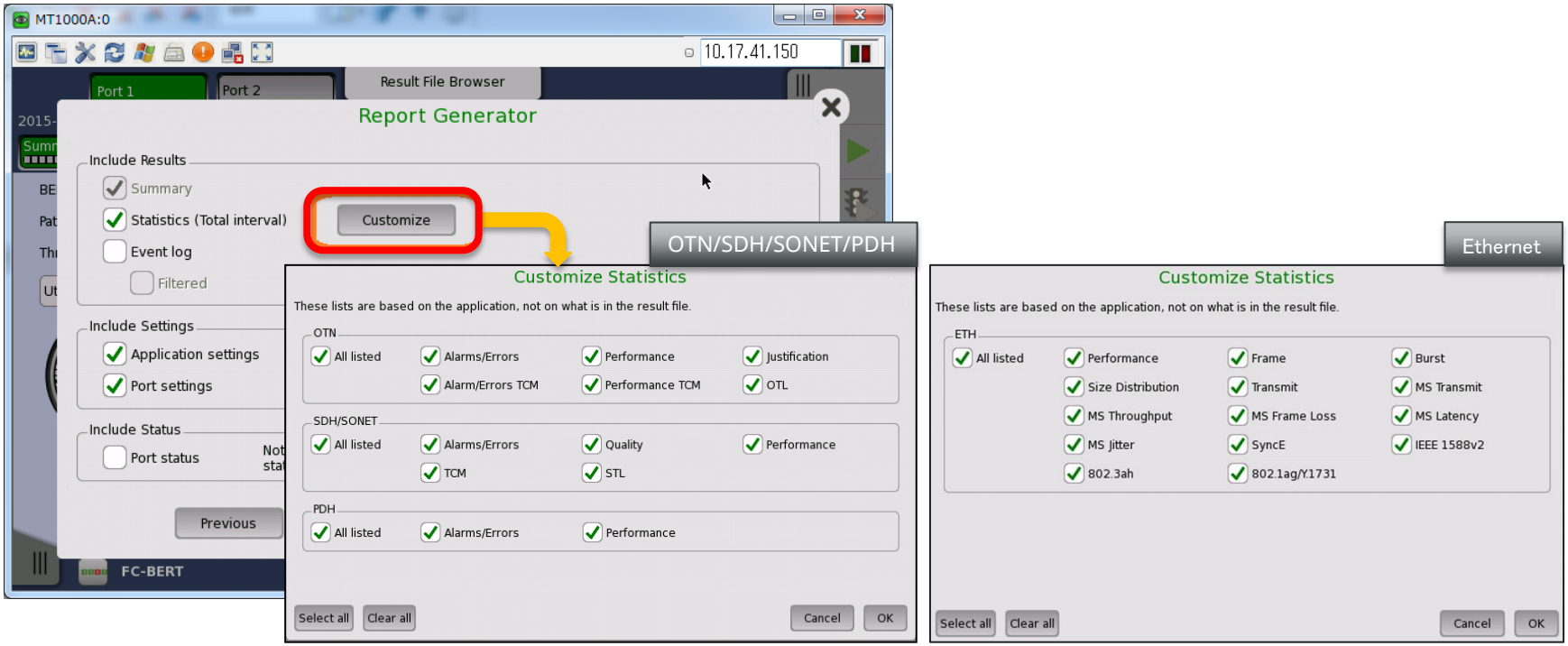
- The user can select the information to output when reporting statistical test results. As a result, file save times are shortened and files sizes are smaller.



Report Generator

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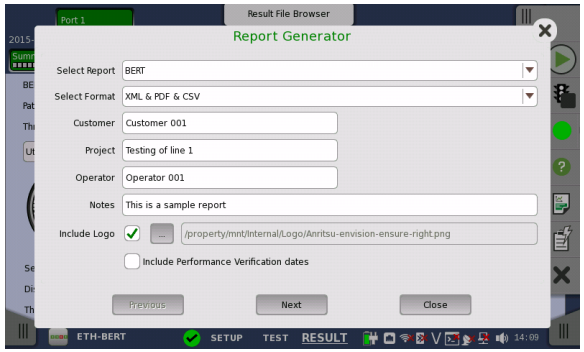
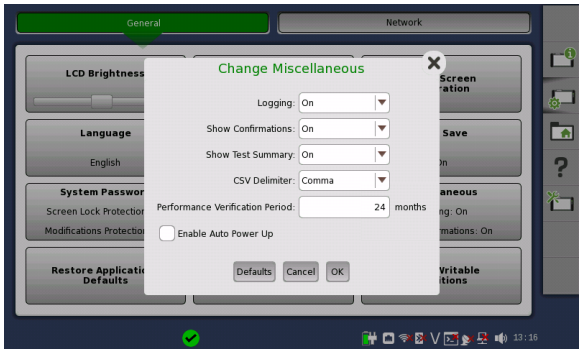
- Optionally include Performance Verification information in reports
  - Performance verification period is user programmable





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2015-05-26 14:11:03

Document Information

Report Name	BERT
Customer	Customer 001
Project	Testing of line 1
Operator	Operator 001
Notes	This is a sample report

Module Type	Serial no	Performance Verification Date	Performance Verification Due Date	Software Version
MT1000A	6D60000101	2014-05-06	2016-05-06	3.01
MU100010A	6D60000087	2014-05-06	2016-05-06	

Network Master Flex MT1100A

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- Remote Operation

Three Remote Control Types

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	Function	Multi-user	File Sharing
VNC	Control from remote site	No	No
Remote GUI	Control from remote site Port sharing File sharing	OK	OK
SCPI	Automation Control from remote site	OK	OK
One Button	Automatic test at the scenario mode of the MT1100A	No	No

MT1100A Remote Operation – Applications

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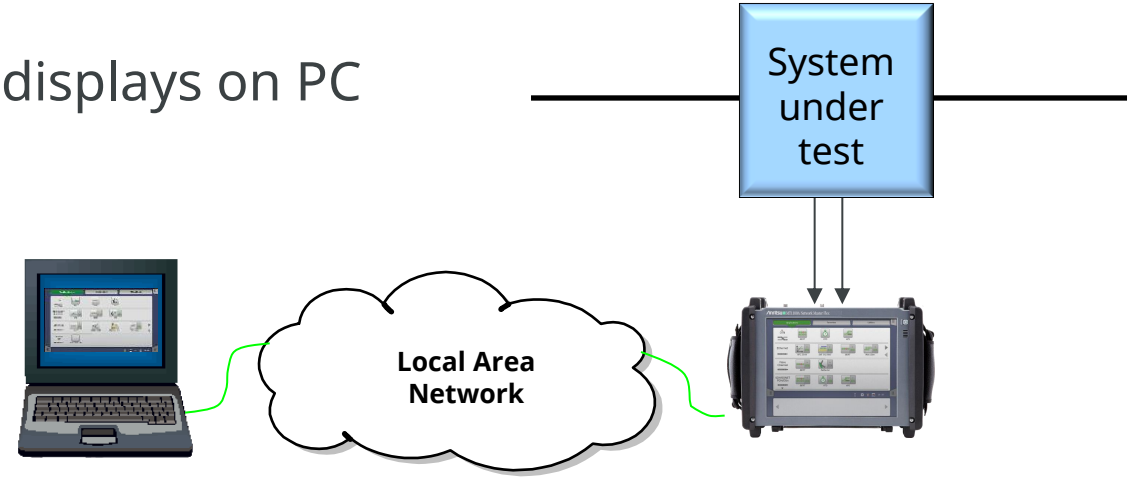
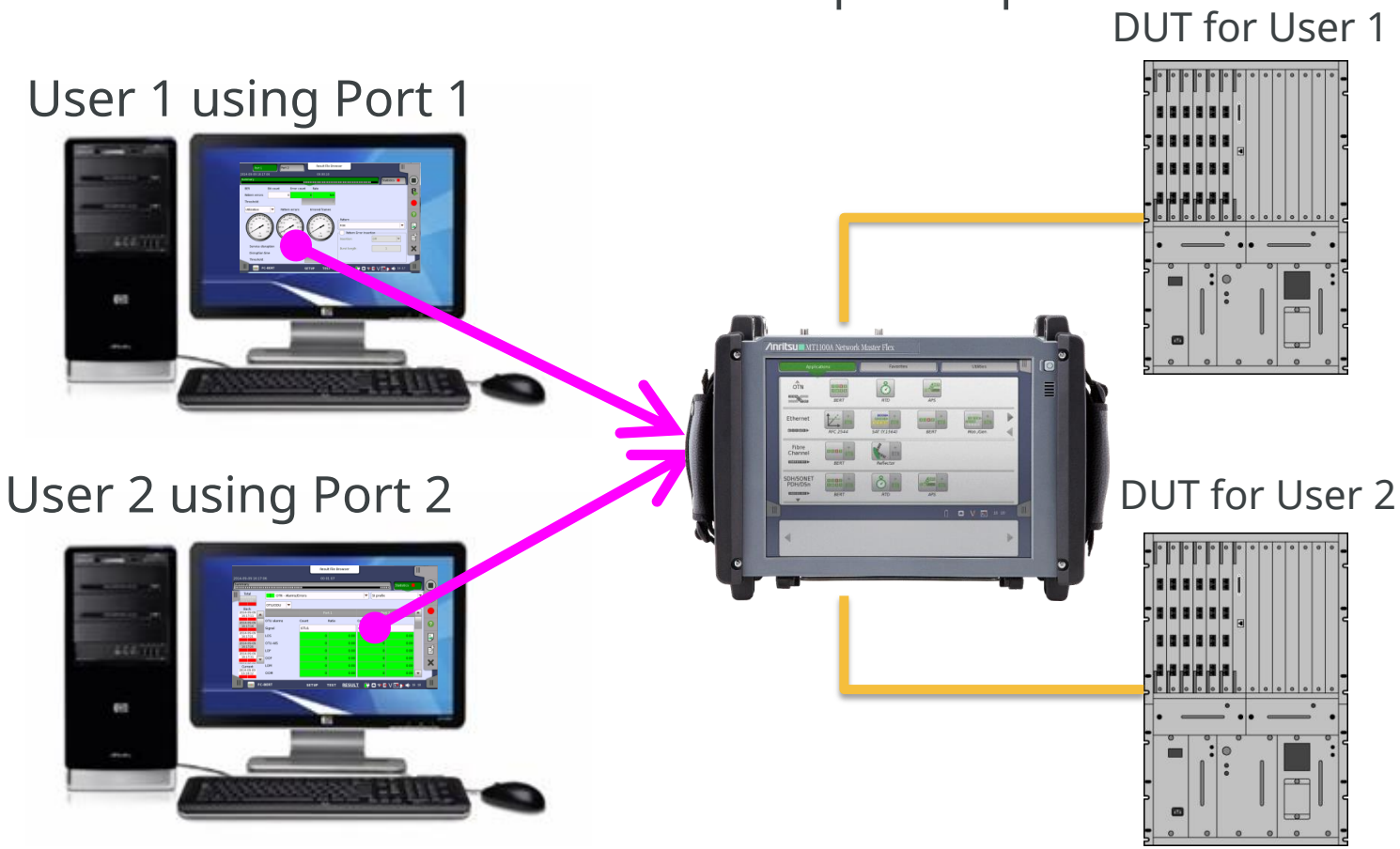
- Remote access
- Troubleshooting spurious errors
- Long-term surveillance and stability tests
- Multi-site surveillance
- Multi-user access
- Display screens via projector
- Documentation and training
- Operate MT1100A from PC with VNC client or new Remote GUI app
- View MT1100A displays on PC



What Can User Do with Remote GUI?

Back to Index page

- Remote GUI application runs on Windows 7/8/8.1
- Port-oriented connection not unit-oriented
- Multiple users share same unit and use separate ports



What Can User Do with Remote GUI?

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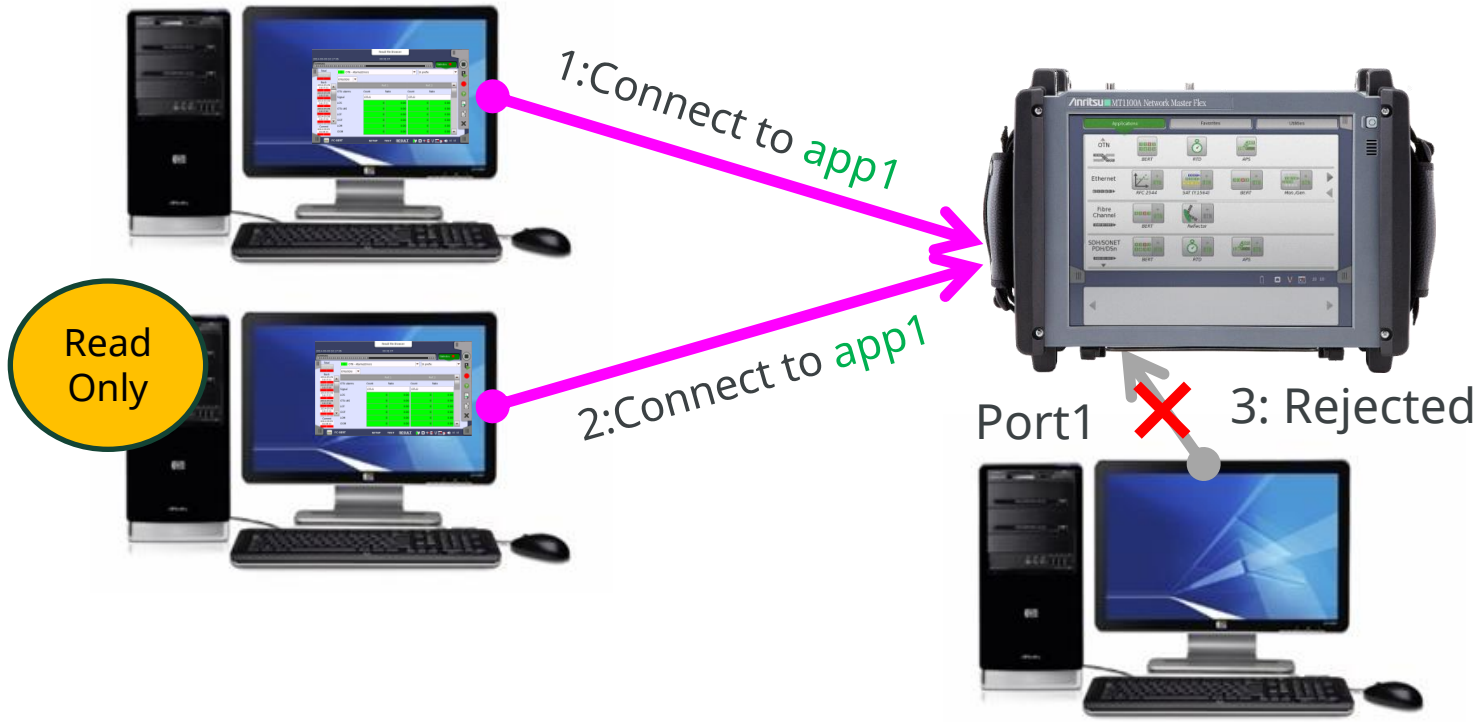
- Connect one application to up to two GUIs



- Only one GUI can change settings and start test (Read/Write)
- Next user just observes (Read only)
- Any user can take right to change settings with exchangeable rights

What Can User Do with Remote GUI?

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- Remote GUI can run as ‘Standalone’ viewer
- Users can:
  - Generate report(s)
  - Analyze results offline
  - Create setup file(s) for deployment

- Remote GUI supports
  - Firmware update via LAN
  - Remote unit reset

What Can User Do with Remote GUI?

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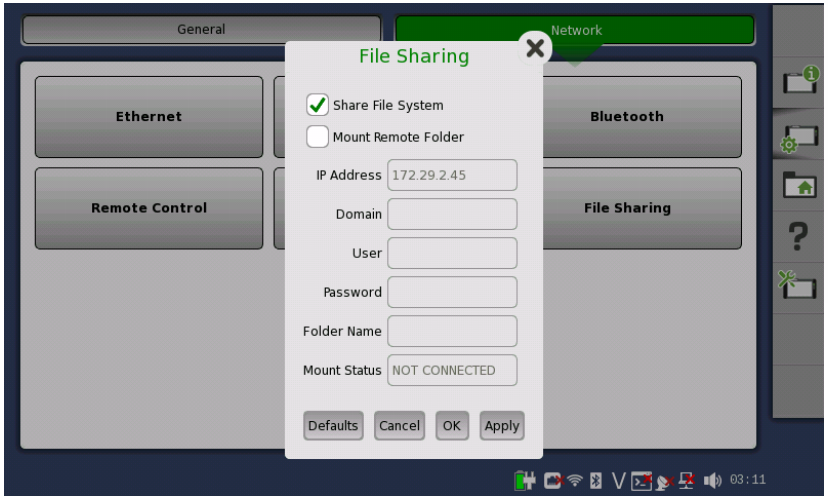
- Share file system—user can access file system from Windows Explorer
- Access PC file system—user can save/load file to/from Windows memory



- Remote GUI supports:
  - Firmware update via LAN.
  - Remote unit reset

Result files
Setting files
Report files
Capture files

Network Master Flex MT1100A

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- Remote Control – Scripting

Remote Control Scripting Option

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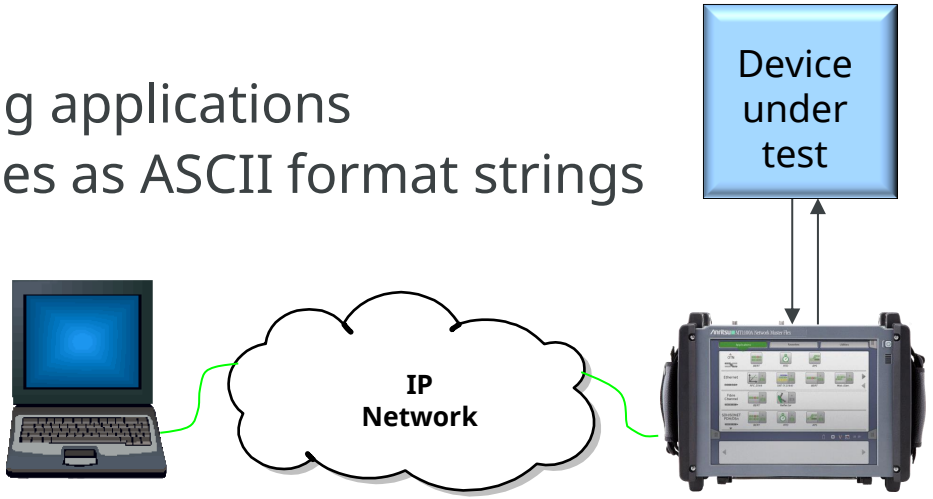
- Automated testing for developing applications
- Remote control commands/replies as ASCII format strings
  - SCPI 1999.0 compliant with IEEE 488.2 mandatory common commands
- Fast command response
  - Execute up to 8 commands per second
    - Reduces test time at mass production
- Communication between controller (PC) and MT1100A:
  - Via MT1100A Ethernet Service Interface
    - TCP/IP connection
      - Test facility can be isolated LAN
  - Via WLAN
  - Via GPIB
- Includes documentation and scripting example
- LabVIEW driver sample



J1667A GPIB-USB Converter available for automated environments based on GPIB.

Network Master Flex MT1100A

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- Remote Control – GUI & Scripting

Remote Control GUI & Scripting Option

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- Execution became possible simultaneously about remote GUI (MX100001A) control and SCPI control for each ports.
  - Customer can use one facility more effectively by being able to use two kinds of control commands at the same time.

Network Master Flex MT1100A

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- One Button Test

One Button Test Function

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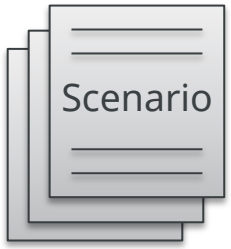
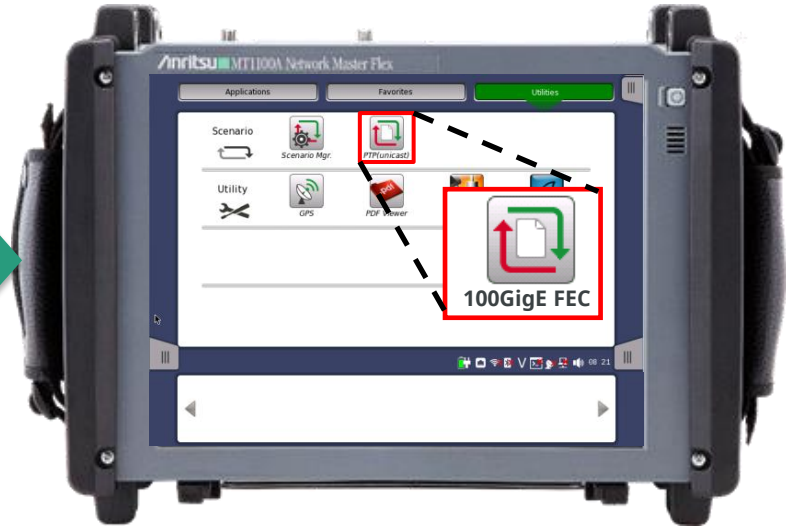
- Execute Specified Tests with One Button
  - Manual testing requires setting of many parameters. To simplify set-up, the MT1100A can test the DUT repeatedly by executing a scenario file containing a predetermined set of tests.

MX100003A Scenario Edit Environment Kit (SEEK)





- ✓ Create scenarios using drag and drop dedicated GUI
- ✓ At-a-glance results evaluation with OK/NG indications
- ✓ Support for complex tests under branching conditions incorporating SCPI commands

- ✓ One-button testing after loading scenario into MT1100A
- ✓ Remote output of test results saved in MT1100A for analysis

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