

Challenges in Mobile Fronthaul measurement

Juraj Urminsky

ESDC
Anritsu EMEA

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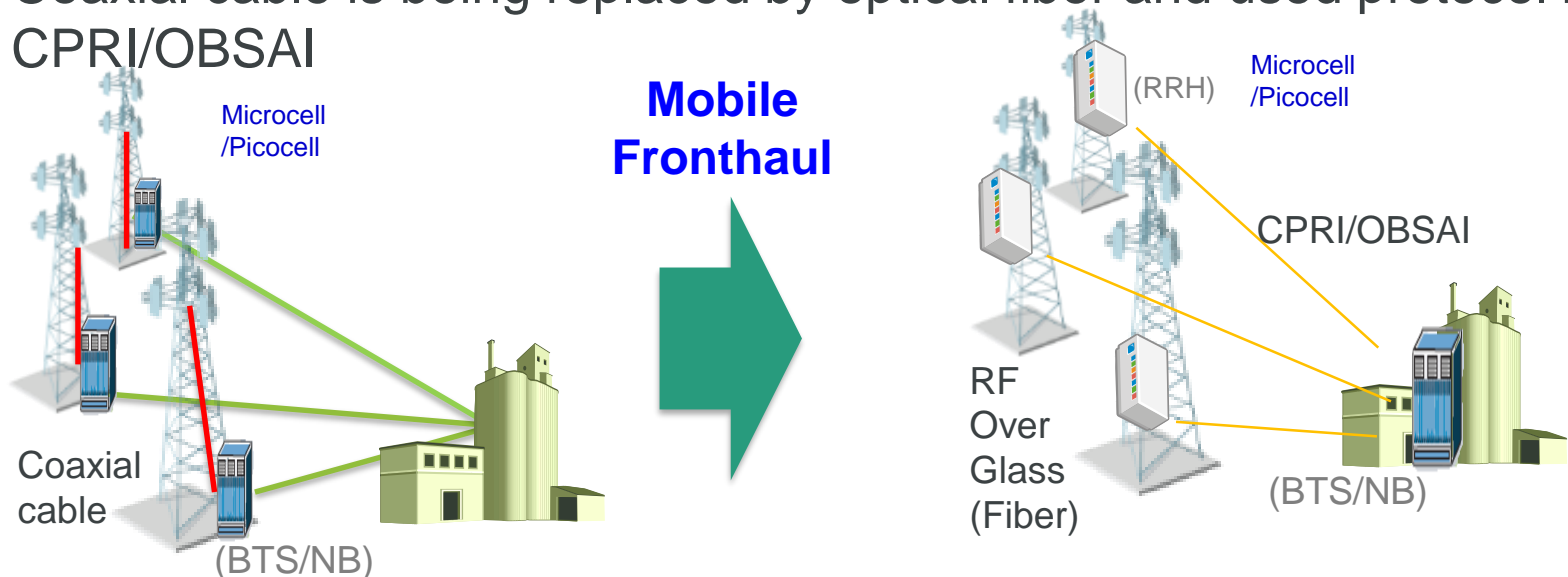
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Introduction

- Operators need to support explosive spread of smartphones and tablets that requires increasing bandwidth of mobile communications networks

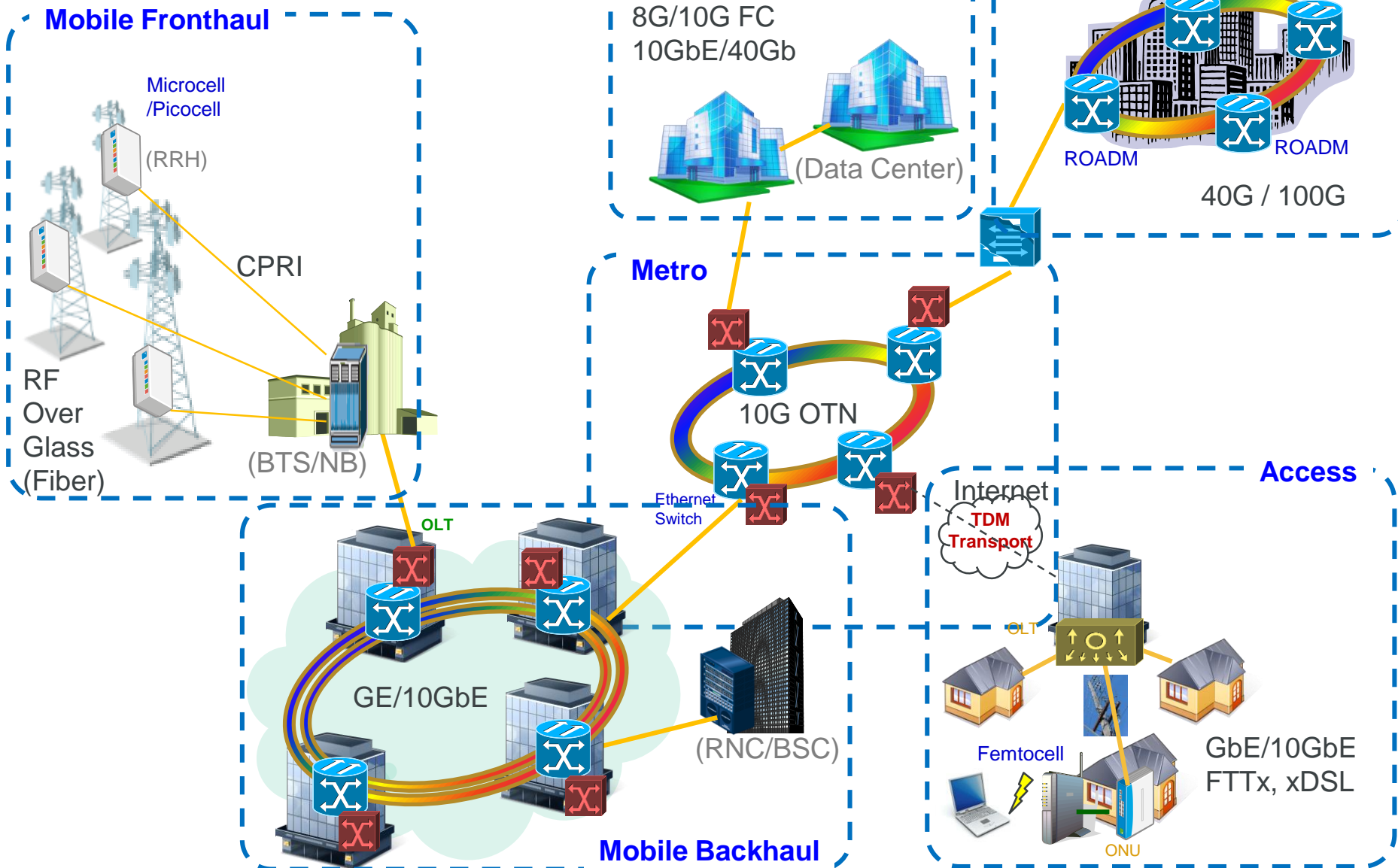
Operators requirements

- Minimizing number of BBUs 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
- Coaxial cable is being replaced by optical fiber and used protocol is CPRI/OBSAI



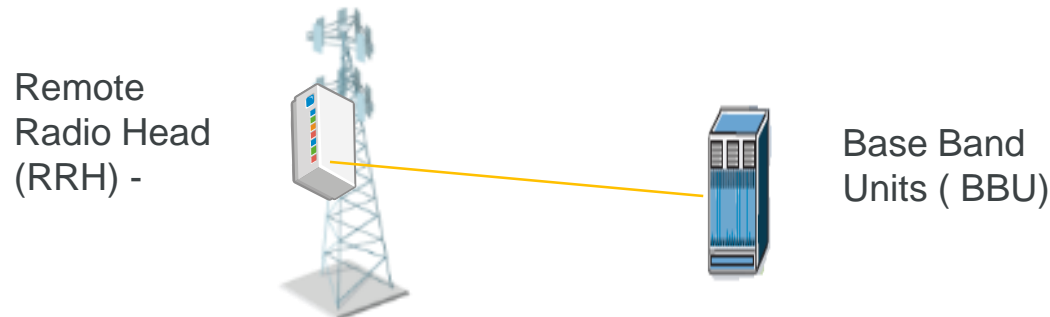
Market Segmentation

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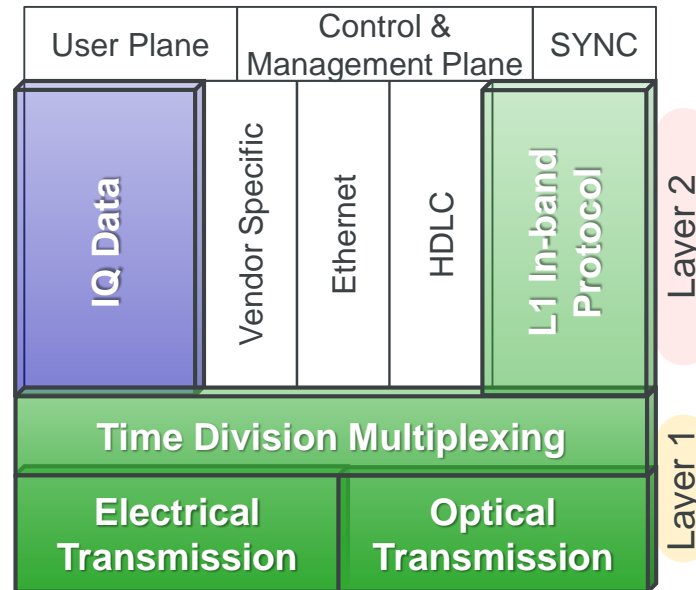
CPRI/OBSAI Background

- CPRI – Common Public Radio Interface
 - Industrial cooperation created by Ericsson, Huawei, NEC, Nokia Siemens, ALU
- OBSAI – Open Base Station Architecture Initiative
 - Provide framework to facilitate Radio Equipment products development for mobile telco systems
 - Driving complete change in mobile communications systems
 - Adoption of Centralized-Radio Access Networks (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



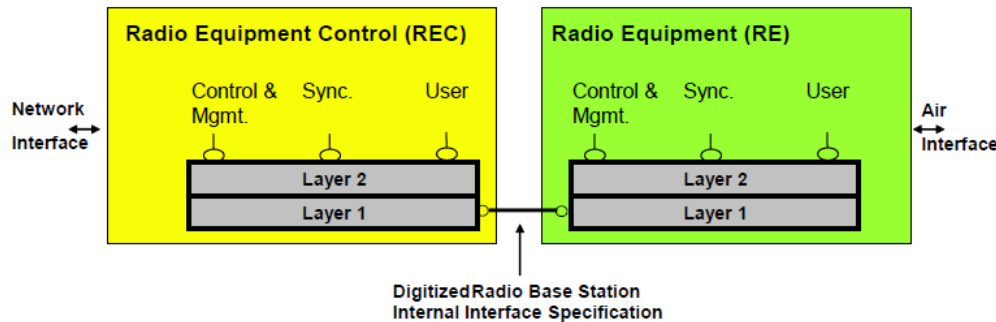
- CPRI runs over C-RAN with two main layers:
 - Layer 1: Physical transport
 - Layer 2: Several areas

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



CPRI

- Bit Synchronous interface, Symmetrical serial data link between REC (Radio Equipment Controller) and RE (Radio Equipment)
- TDM of Antenna IQ data samples
- Ethernet or HDLC stream for C&M
- CPRI bit rates are referred to as “option #”
- There are 8 options (CPRI Specification V6.0) supported by MT1000
- MT1000A up to Option 8, 10.1376 Gbps,...



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

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

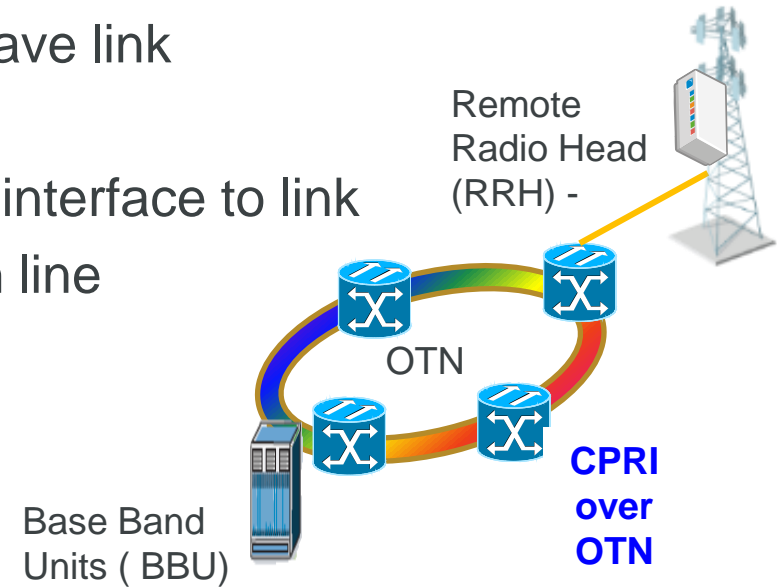
- Four OBSAI bit rates are defined.
- MT1000A supports 6.144 Gbps, reflecting marketing requirement of supporting exploring mobile network bandwidth.
-

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

CPRI/OBSAI - Test cases

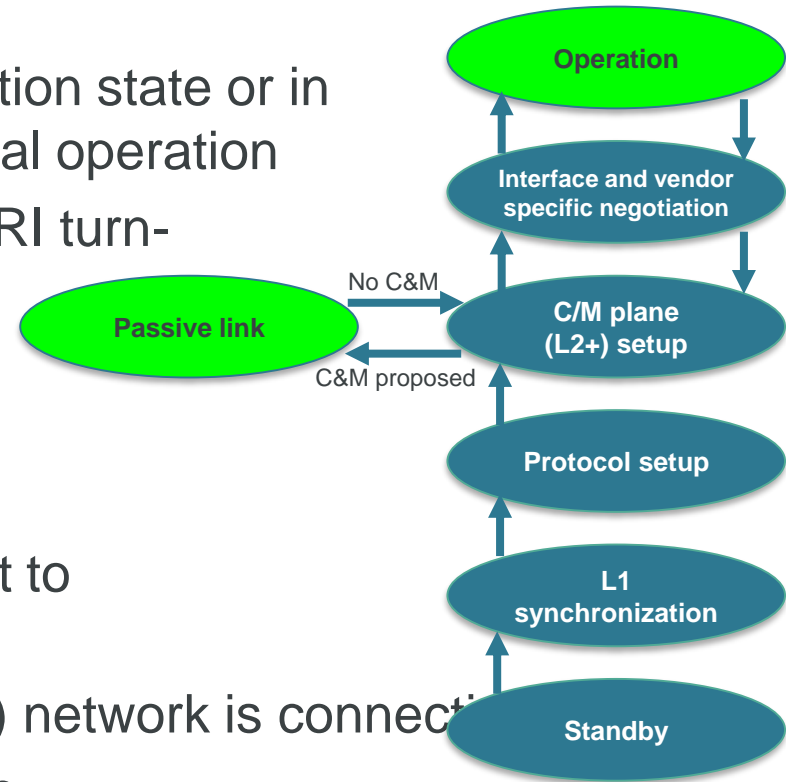
- Test case 1
 - Test line between REC(s) and RE(s)
 - System testing
 - Installation testing
 - Line can be
 - Optical
 - Carried over radio link or microwave link
 - CPRI over OTN
 - Instrument connected via optical interface to link
 - Terminate both sides of transmission line
 - BER test (Framed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

Test case 1



CPRI/OBSAI - Test cases

- Test case 2
 - CPRI Specification V6.0 defines
 - When both devices are in Operation state or in Passive link state, link is in normal operation
 - Operators find that up to 80% of CPRI turn-up issues occur in lowest layers
 - Essential during installation to: confirm RRH/RE can communicate to ground even without BBU/REC
 - Confirming RRH/RE can connect to Passive link state
 - Confirming HDLC layer (Layer 2) network is connected
 - Completing above minimizes chance of issues during BBU/REC installation

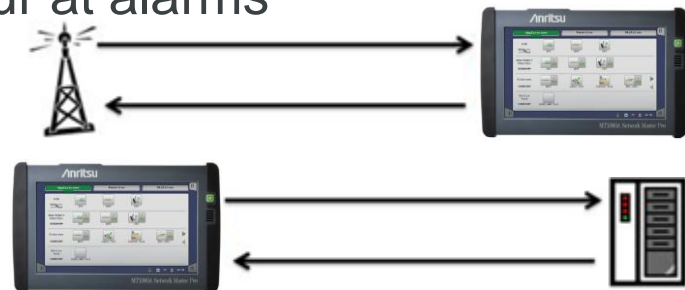


*Extract from Figure 30 in CPRI Specification V6.0:
Start-up states and transitions*

CPRI/OBSAI - Test cases

- Test case 2
 - Connect to actual equipment (REC or RE) to verify alive
 - Signal level and frequency measurement
 - Optical cable ends can be checked with Video Inspection Probe (VIP)
 - Monitor control word K30.7 – indicates error in 8B/10B line code (CPRI option 1-7 only) – and 8B/10B code violations
 - Check equipment behavior
 - Check that equipment can reach Passive link state
 - Confirm HDLC layer (Layer 2) network connecting
 - Check equipment behaviour at alarms

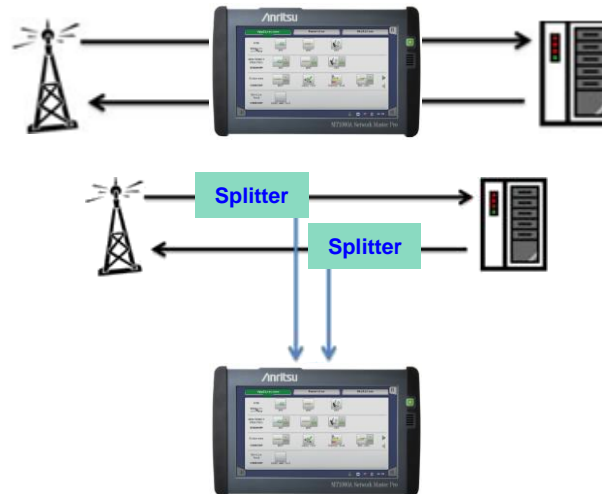
Test case 2



CPRI/OBSAI - Test cases

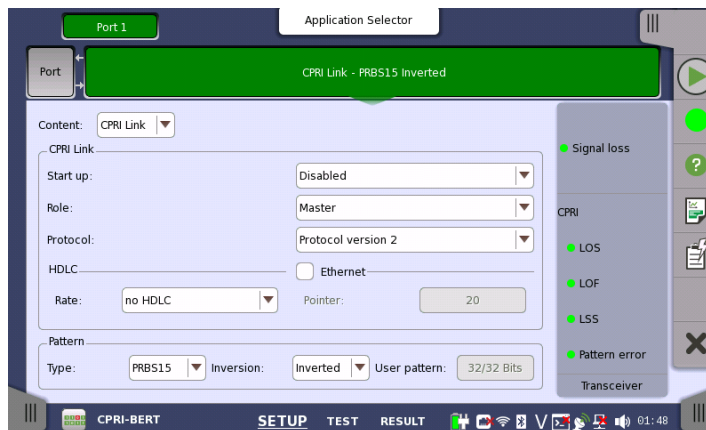
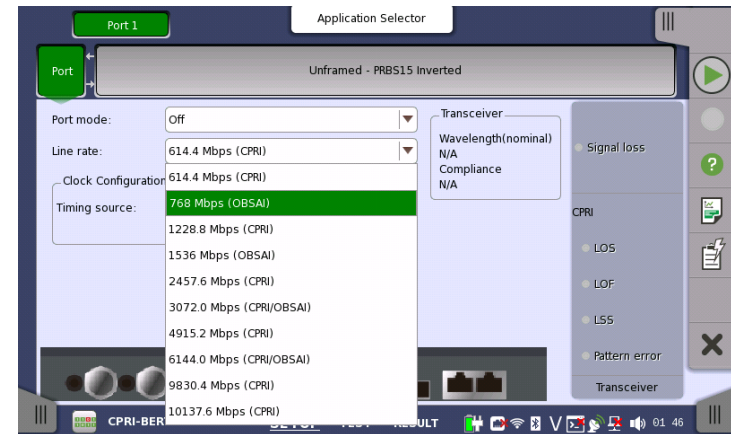
- Test case 3
 - Monitoring actual line between REC (Radio Equipment Control) - (master) and RE (Radio Equipment) - (slave)
 - Using dual port in Pass-through mode or monitor
 - Monitor interactive behaviour of equipment
 - For maintenance or in-service troubleshooting

Test case 3



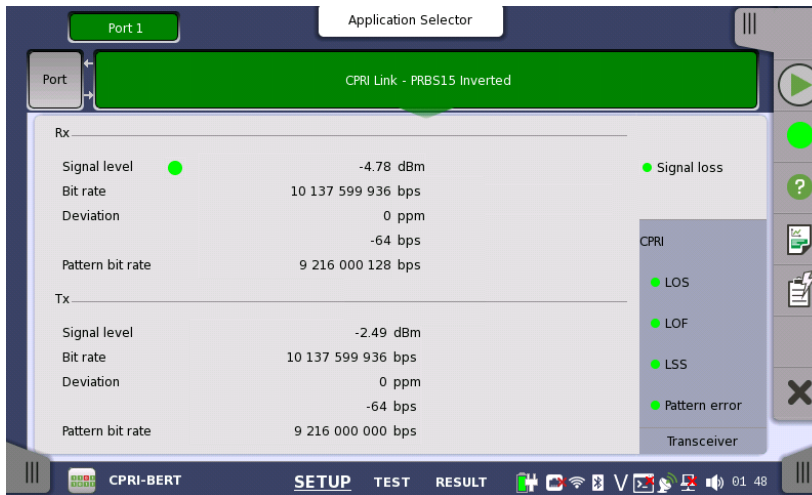
MT1000A CPRI Wire Line Testing

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



MT1000A CPRI Wire Line Testing

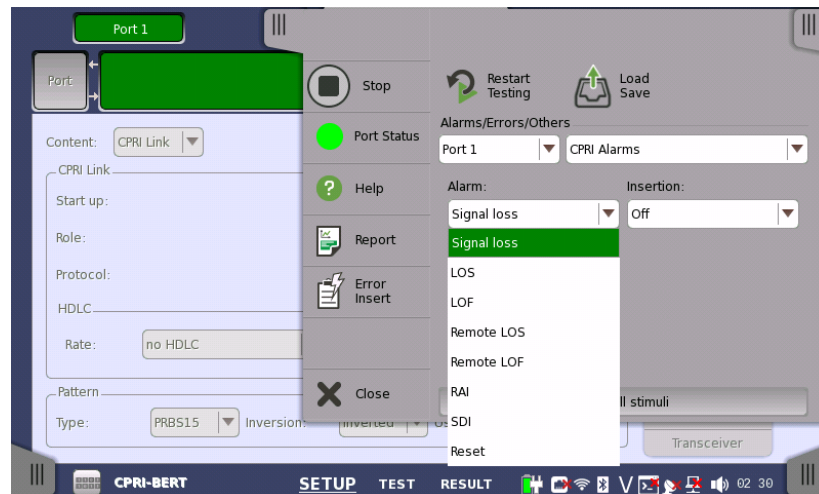
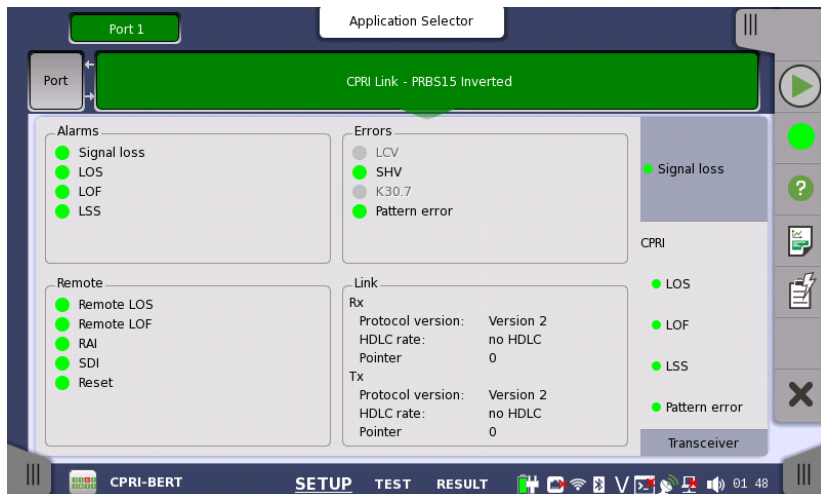
- Displayed signal level and bit rate gives first verification of received-signal condition



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

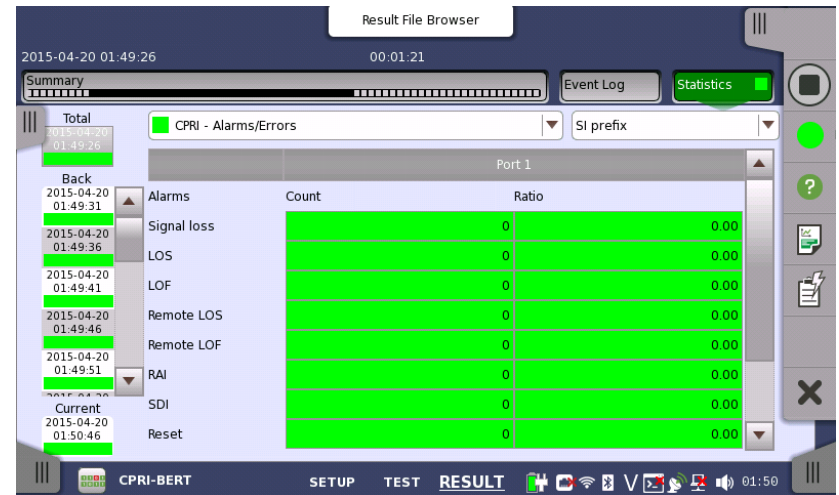
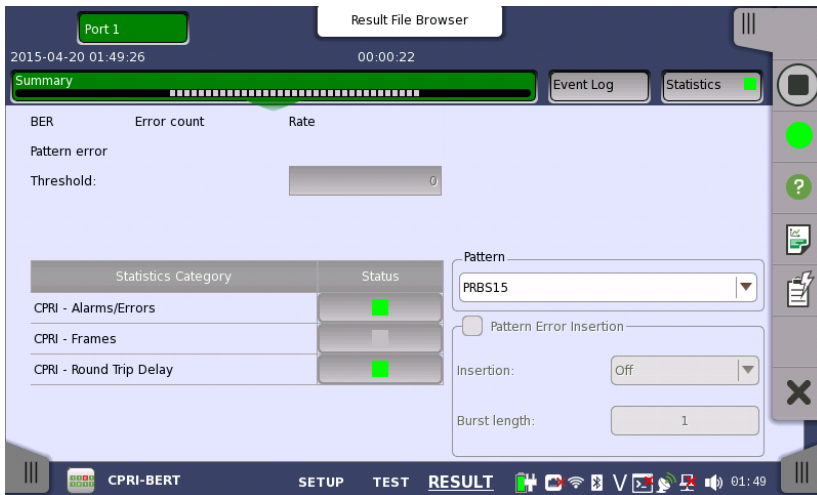
MT1000A CPRI Wire Line Testing

- 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



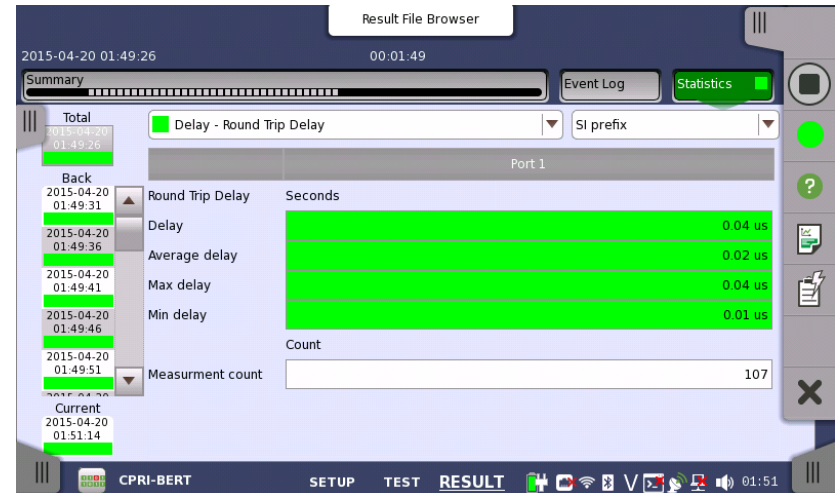
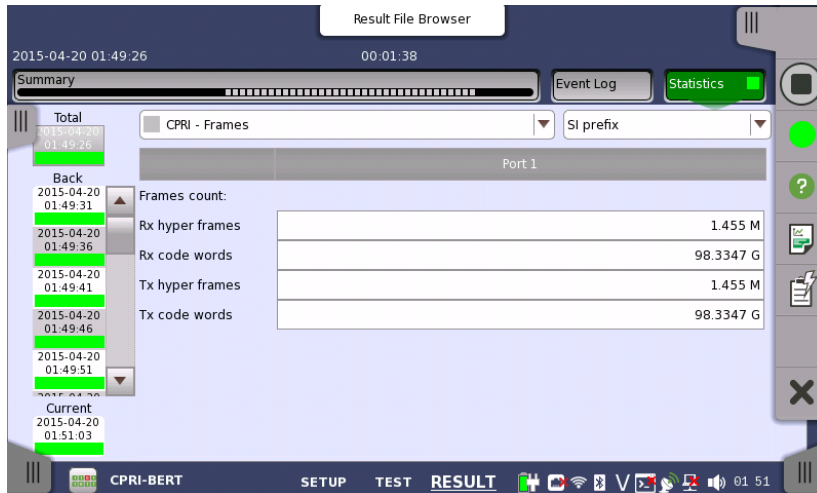
MT1000A CPRI Wire Line Testing

- 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



MT1000A CPRI Wire Line Testing

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



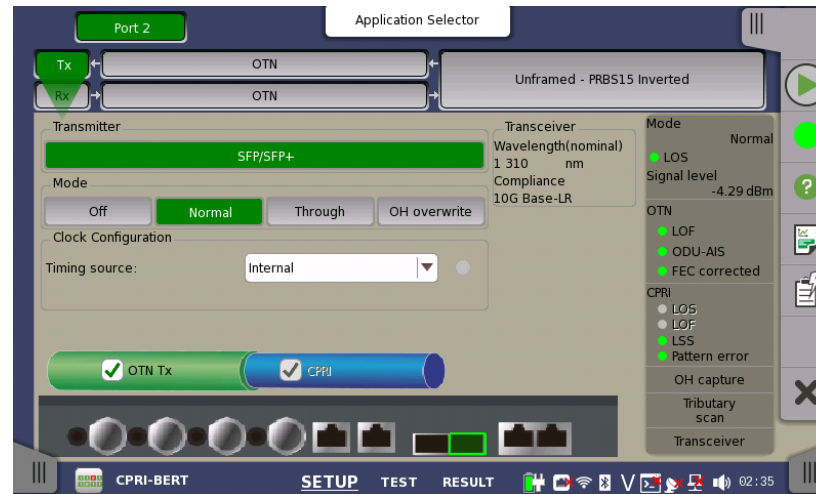
CPRI over OTN

– 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

MT1000A CPRI Wire Line Testing

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



Input Requirements for CPRI

- Timing and Synchronization
 - Max Frequency Error contribution : 0.002ppm
 - Max. Bit Error Ratio: 10^{-12}
 - Link delay accuracy: $\pm T_c / 32$
 - Max. round trip delay (excluding cable): 5 μ s

Network Master Family



- 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 dual-port transport tester supporting from 1.5 Mbps to 10 Gbps including OTN, Ethernet, 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 μ OTDR
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

QUESTIONS?

Anritsu
envision : ensure