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Application Note

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4X100GE DR4 Breakout Testing

ONT-800–800G Flex / N-Port Modules

As Internet Content Providers drive the need for higher bandwidth at their Hyperscale Data Centers without the luxury of unlimited power and rack space, Network Equipment Manufacturers continue searching for ways to increase port density without significantly increasing the footprint of their equipment. For example, NEMs are leveraging the emergence of smaller pluggable form factors for 400GE optical modules, like QSFP-DD, that are backwards-compatible with lower rate form factors They are also supporting space-saving, new optical interfaces such as DR4 (IEEE 802.3 bs to split optically the 400GE bandwidth into 4 separate and independent 100GE signals that can be connected to 4 separate 100GE QSFP28 ports at the other end). A network element equipped with 32 QSFP-DD can be configured to carry 128 100GE signals in a reasonable amount of space compared to the rack space a switch with 128 100GE QSFP28 ports currently occupies.

Further benefits of such breakout systems can include driving a 100G/lambda based 100G Ethernet technology which should drive lower cost and power (moving from a 4 optical lane system to 1 lane) and getting better alignment between switch ASIC bandwidth and front panel bandwidth delivery.

400GE DR4 Standard

IEEE 802.3 bs Clause 124 defines a DR4 PMD (Physical Media Dependant) for parallel single-mode (PSM) fiber to transport 400 Gbps of bandwidth for point to point connections, as well as multiport connections via an optical breakout that carries four individual 100GE signals. These signals will be terminated on 4 separate and independent 100GE-DR QSFP28 ports, covering up to 500 meters of distance.

100G-DR (500 m on a single mode fiber) is part of the IEEE standard 802.3 cd for 100GE serial transmission. A 100G-DR transponder carries the 100GE signal on a single lambda, using a rate of 53.125 GBaud with PAM-4 modulation and KP4 FEC - RS(544, 514) forward error correction.

The new ONT-800 mainframe and modules can be used to test DR4 breakouts from both sides: The 4 x 100GE DR4 QSFP-DD side can be tested using the 800G FLEX or 800G Ethernet Module. The 4 individual 100GE-DR QSFP28 ports can be tested using the 4 ports of an ONT N-PORT Module or ONT N-PORT Ethernet Module.

It is important to stress that the four 100G Ethernet links are independent and may be on different clock domains. Furthermore, since they are entirely independent, it is possible that each of the 4 links may not necessarily be active, and so any module may be exposed to different optical LOS conditions on ingress ports. These events must not impact traffic on the other ports.

Please refer to our KP4 FEC N-Port white paper for more details regarding simultaneous tests of 4 independent 100GE ports with QSFP-28 100G-DR optics.

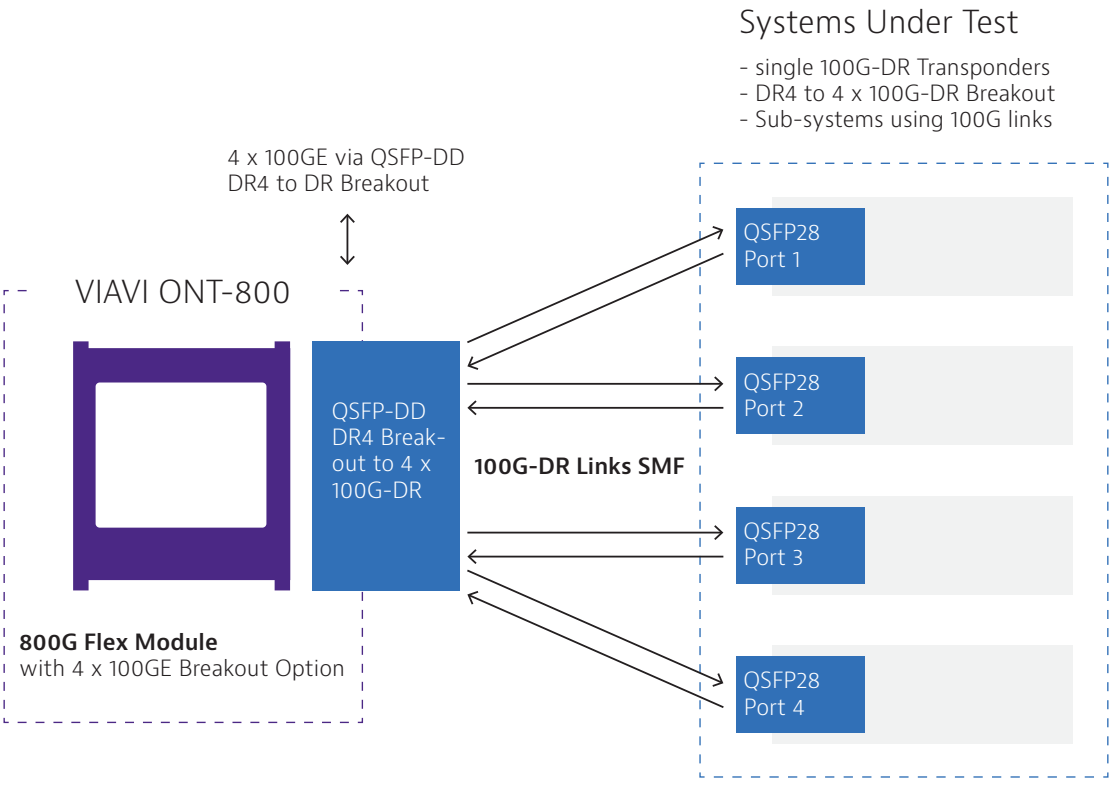
Test cases include:

- Assure correct functionality of the DUT's FEC algorithm when receiving correctable errors on both sides.
- Validate behavior of transponder and associated support circuitry when receiving uncorrectable FEC errors.

This must also be done in cases which include other impingements including clock offset, dynamic skew & dynamic LOS events. These stressor conditions must be correctly reported and mitigated; modules must correctly report fault conditions and correctly recover from those conditions.

- Verify PCS and MAC layer transparency for each individual 100GE link.

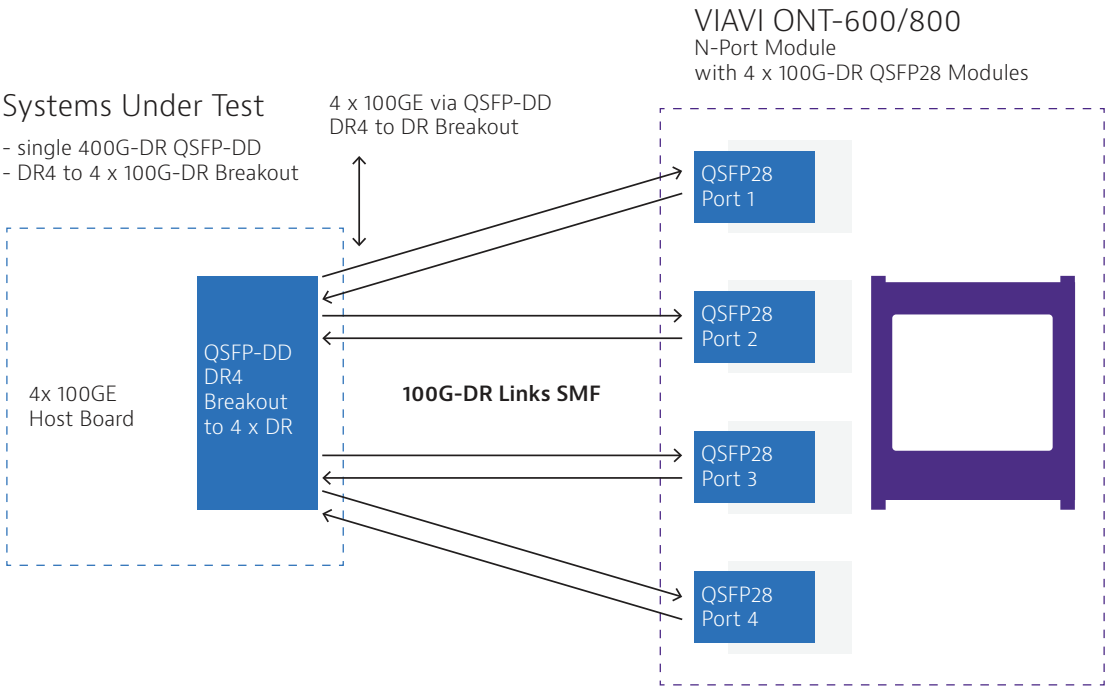
PCS alignment must be verified on each individual port to ensure that any existing offsets caused by different clock domains will not impact the alignment process for upper layers. Post FEC performance is specified in terms of Frame Loss Ratio, and MAC layer synchronization must be ensured in order to detect lost frames or similar events (duplicated frames, misinserted frames and so on).



Typical Test Setup

Case 1: From 4 x 100GE host board via QSFP-DD port + breakout to individual ports

Case 2: From 4 independent 100GE QSFP-28 ports using 100G-DR optics to 4 x100GE host board with QSFP-DD breakout



Key Benefits

- 4 x 100GE (100GAUI-2) fully independent signals transmitted via single QSFP-DD port
- Comprehensive RX FEC Error Statistics with all important performance metrics like errored symbols/ codeword clearly reported.
- Advanced TX FEC Error Generation including multiple modes – Single, Rate, Burst,
- Programmable and dynamic Frequency offset generation up to +/- 500 ppm per individual 100GE link
- Dynamic skew generation to test skew variation tolerance of individual 100GE QSFP28 ports

Key Applications

- Development and validation of QSFP-DD DR4 optics
- System validation and Software development of network elements supporting breakout modes
- Validation of Switch ASICs (including SERDES and PCS/FEC functionality)
- Next generation 100G/lambda module development, validation and vendor qualification

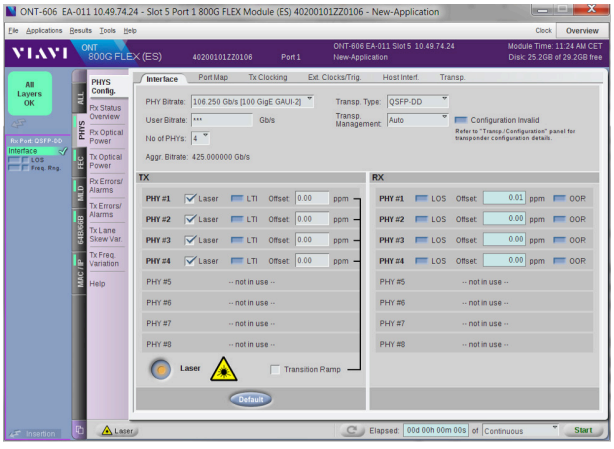


Figure 1 – 800G Flex Module PHYS Interface screen with 4 x 100GE independent signals

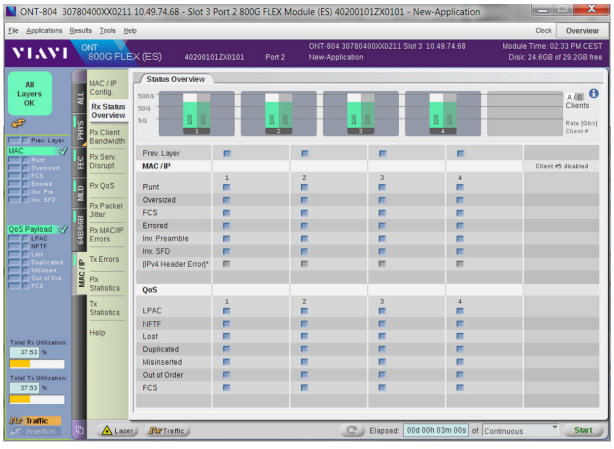


Figure 2 –ONT-804 with 800G Flex Module, MAC Rx Status Overview per 100GE link

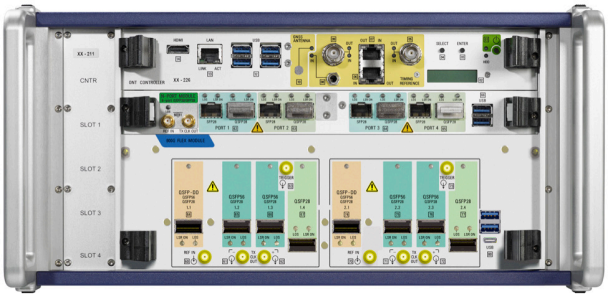
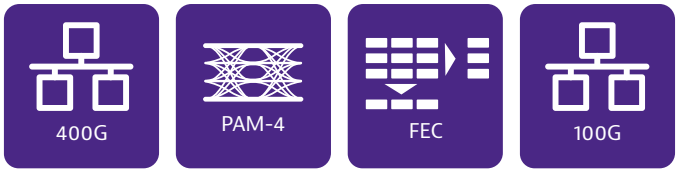


Figure 3 –ONT-804 with 800G Flex and N-Port Modules



How to order?

Modules

Part Number	Module	For Mainframe
3078/04	ONT-804D Mainframe with Display	
402-002.01	800G FLEX V2 Module	ONT-800
402-002.02	800G Ethernet V2 Module	ONT-800
401-001.01	N-PORT Module for ONT-800 platform 1 slot 4 ports	ONT-800
401-001.02	N-PORT Module for ONT-600 platform 2 slots 4 ports	ONT-600
401-002.01	N-PORT Ethernet Module for ONT-800 platform 1 slots 4 ports	ONT-800
401-002.02	N-PORT Ethernet Module for ONT-600 platform 2 slots 4 ports	ONT-600

800G FLEX / 800G Ethernet Modules Software Options

Part Number	Module
402-180.61	4x100GE - 802.3cd - PAM4 - QSFPDD - Port 1
402-180.62	4x100GE - 802.3cd - PAM4 - QSFPDD - Port 2
402-805.60	Hardware Validation - Module Option
402-806.60	Dynamic Skew - Module Option
402-820.60	100G Ethernet FEC Validation - Module Option

N-PORT / N-PORT Ethernet Modules Software Options

Part Number	Module
401-120.50	100GigE incl. Clause 91 FEC – quad port
401-121.50	100GigE – 802.3cd – 100GAUI4 – NRZ – quad port
401-820.60	Ethernet FEC Validation – Module Option

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