Neptune 1050

High Availability Access Router for the Access Edge

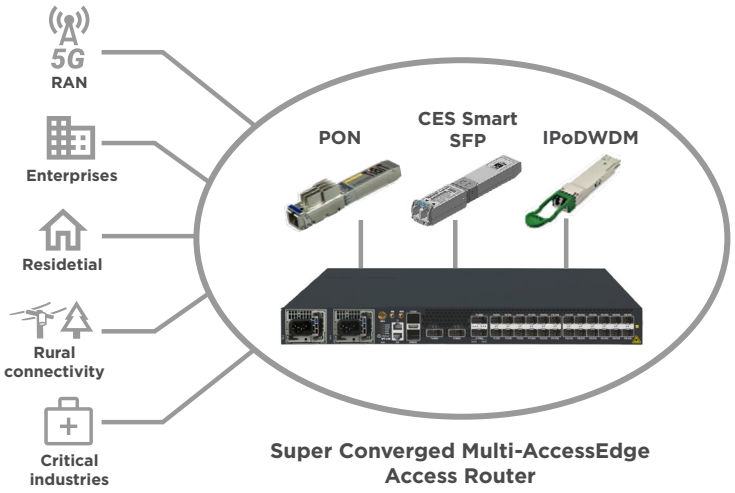
Neptune 1050 is a fully redundant, modular, access router, with support for multiple access technologies it is purpose- built for ooperators wanting a converged edge platform for new and legacy services.

Neptune 1050 provides 300Gbps packet switching and a port fan-out of 380G with and 100G interfaces in a 1RU form factor. It provides an extensive set of interfaces for multiple access technologies such as Ethernet, MPLS, PON and legacy TDM(CES), making it the ideal solution for deployment at the access edge. With a full set IP/MPLS, transport capabilities, the Neptune 1050 can efficiently aggregate and route the services over the network, meeting their service performance needs (SLAs) on a service by service basis. Full redundancy and support for segment routing and MPLS-TP make the Neptune 1050 a perfect fit for operators delivering business and mission-critical services.

Neptune 1050 supports a full set of optical interfaces including 100G ZR/ZR+ coherent optical pluggables, this allows it to support both single layer, hop-by-hop IPoDWDM and multilayer IP and Optical transport. The operator can choose which approach best meets their needs, or they can run both in a hybrid approach.

With such a rich and robust feature-set, Neptune 1050 is well suited for a wide variety of applications and networking scenarios, these include;

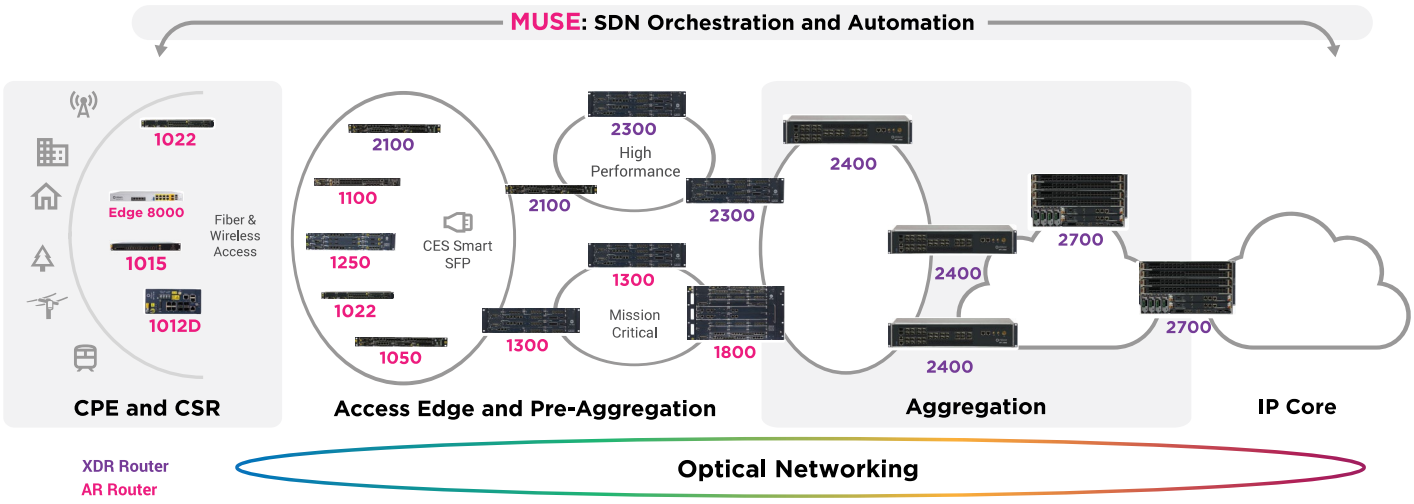
- Mobile Backhaul
- TDM migration: supporting voice trunk and legacy service migration with circuit emulation services (CES) mapping a full range of legacy TDM interface speeds onto the packet switched network (PSN)
- Access Edge for Business services: a full range of Ethernet interfaces and full set of IP protocols ensure services are transported to meet the SLA's on a per service basis
- PON infill: with a 10GSFP+ OLT Optics pluggable module providing XGS-PON/EPON connectivity supporting up to 128 ONUs per OLT



- Converged Multi-access Edge: Supporting 5G, broadband backhaul, business services, PON and TDM migration all from a single converged access edge platform

Neptune 1050 Key Product Highlights

- Multi-access Edge supporting Ethernet,XGS-PON, EPON, TDM with CES
- 1RU small form factor with a 243mm depth
- 100G ZR/ZR+ optics support
- Precise frequency and phase/time synchronization using the latest industry standards
- Rich quality-of-service capabilities for different SLAs
- Security-Trust Anchor module infrastructure, secure boot, image signing, run-time defense
- Open NE for 3rd Party Management
- Advanced Management Capabilities provided by Muse Software



Key Neptune 1050 Product Specifications

Platform

Description	Specification
CPU	• 8-cores PPC
Memory	• 8G DRAM
Storage	• 16GB eMMC
Interfaces	• 23 x 10/100/1000 Base-T • 38 x 100/1000 Base-X • 20 x 10G or 12 x 10G OTN • 3 x100G
Performance	• Switch capacity Up to 300 Gbps
Power Supplies	• 2 hot swappable with 1+1 redundancy
Cooling	• 1 Fan, • Airflow – right to left
Timing	• SyncE with ESMC • 1588v2 • External timing 1PPS and TOD • Internal stratum 3E clock (holdover state) • Primary and secondary sources (supports SSM bits) • ACR, DCR • Loop timing on SAToP, TDM bits (T3/ T4), and SNTP • G.8262.1, G.8275.1 • G.8273.2 – class B
Physical Specification	• 1RU • Dimension: 465 mm (W) x 243 mm (D) x 44mm (H) • Weight : 3.3Kg

Multi-access Edge Capabilities

Description	Specification

L2/L3 VPN Sevices	• L2VPN - MEF 3.0 (IP-MPLS and MPLS-TP)
	  • E-Line
	  • E-LAN
	  • E-Tree
	  • E-Access
	• Ethernet Virtual Private Network (EVPN)
	  • Virtual Private Wire Service (EVPN-VPWS, EVPN-ELINE)
	  • Virtual Private LAN Services (EVPN-VPLS, EVPN-ELAN)
	  • Anycast IRB with IPv4 and IPv6 support
	  • Multihoming – Active-Active, Single-Flow-Active, Port-Active
	  • PW Virtual Ethernet Segment
	• L3VPN
	  • IPv4 VRF
	  • 6VPE
	  • IRB, PHT

IP Over DWDM	• CWDM • DWDM • Amplifiers • 100G coherent interfaces • ZR, OPENZR+ application • QSFP_DD for 100G

TDM Services	• Circuit Emulation Services (CES)
	  • SAToP
	  • CESoPSN
	  • CEP

TDM Pluggables	• E1/T1 • E3/DS3 • STM-1/OC-3 • STM-4/OC-12 • STM-16/OC-48

TDM Interfaces	• Max. Interfaces:
	  • 96 x E1/T1
	  • 12 x STM-1/OC-3
	  • 3 x STM-4/OC-12
	  • 1 x STM-16/OC-48 (per smart SFP)

PON Pluggables	• Smart SFP 10G XGS-PON - 10G SFP+ OLT optics modules

Software features provided by the Neptune's IP Wave rNOS

Description	Specification
Layer 2	• Layer 2 forwarding and bridging • Bridge Domains (BD) • Flexible VLAN-Tagging • IEEE 802.1Q VLANs and Q-in-Q • Ethernet Link Aggregation Group (LAG) • Link Aggregation Control Protocol (LACP) 802.3ad • G.8032 • Spanning Tree Protocol • Jumbo frames on all ports
Layer 3	• IPv4 and IPv6 unicast routing • Layer 3 interfaces: physical interfaces and logical interfaces (Units). • Virtual Routing and Forwarding (VRF) • Open Shortest Path First (OSPFv2, OSPFv3) • Intermediate System to Intermediate System (ISIS) • Multiprotocol Border Gateway Protocol (MP-BGP) • Equal-Cost Multipath (ECMP) • Bidirectional Forwarding Detection (BFD), MH-BFD • Virtual Router Redundancy Protocol (VRRP) • Integrated Routing Bridging (IRB), Anycast IRB • Pseudowire Headend Termination (PHT)
MPLS	• Label switching (LER, LSR) • Label Distribution Protocol (LDP) • BGP Labeled Unicast (BGP-LU) • MPLS-TP • MPLS Traffic Engineering with RSVP-TE, SR-TE • Point-to-point L2VPN – Static, T-LDP, EVPN-VPWS • Multipoint L2VPN – VPLS, EVPN • EVPN with Anycast IRB • 6VPE • IP Loop-Free Alternate (LFA) Fast Reroute (FRR) • RSVP-TE Fast Reroute (FRR) and Path-Protection

Segment Routing (SR)	• SR-MPLS
	• ISIS, OSPF, BGP extensions to segment routing
	• TI-LFA
	• Segment Routing Traffic Engineering (SR-TE, SR Policies)
	  • PCE, PCC initiated SR Policies
	  • Path Protection
	  • TI-LFA Local Repair Protection
	  • Anycast SID
	  • Binding SID
	• SR, SR-TE OAM
	• Flexible Algorithm
	• BGP Color Extended Community

Software features provided by the Neptune's IP-Wave rNOS (continued)

Description	Specification
Multicast	• IPv4 and IPv6 Multicast Routing • PIM-SM, PIM-SSM, PIM-ASM • IGMPv3, MLDv2 • MSDP • Anycast RP • BGP IPv4 Multicast
Quality of Service (QoS)	• Class-based 3-level Hierarchical QoS • Virtual Output Queueing (VOQ) • Policing, Shaping • Multi-level priority queuing • Classification based on L2/L3/L4 fields • Remarking • Weighted Random Early Detection (WRED) • Deep packet buffer
OAM	• Ethernet OAM - IEEE802.3ah, IEEE 802.1ag and ITU-T Y.1731 PM • IP OAM - BFD, Ping, Trace-route, TWAMP • MPLS-TP OAM - G8113.2, RFC5860, BFD • MPLS OAM – Ping/Traceroute MPLS • RFC 2544 Generator, Y.1564 • LLDP • DHCP Relay • Streaming Telemetry • sFlow • Link Delay-Measurement
Security	• Control-plane and management plane protection • Authentication, Authorization, and Accounting (AAA) • RADIUS • Terminal Access Controller Access-Control System Plus (TACACS+) • Secure Shell (SSH) • Layer 2 and Layer 3 ingress Firewall filters (ACL) • Unicast Reverse Path Forwarding (Unicast RPF) • IEEE802.1x
Manageability	• CLI • LCT • SNMP MIB • NETCONF/gRPC - XML, JSON, GPB • YANG models - OpenConfig, IETF • Muse software suite (SDN orchestration and control) • LightSOFT® NMS • Zero-Touch Provisioning (ZTP)

Environmental

Description	Specification
Operating Environment and Altitude	-25°C to +70°C (-13°F to 158°F)
Operating Humidity	5% to 95%
Altitude	Up to 4000 m
Acoustics	NEBS GR-63-CORE
Power over Ethernet (PoE+)	Up to 30W
Power input	-40 VDC to -72 VDC, 110 VAC to 230 VAC
Power dissipation	Typical : 188W

Standards compliance

Description	Specification
Regulatory	Products should comply with CE markings according to directives 2014/30/EC and 2014/35/EC
NEBS	Certified with GR-63, GR-1089 and GR-3160
Safety	• IEC 62368-1 • UL 62368-1 • IEC 60825-1 for lasers • IEC 60825-2 for lasers
EMS Standards	• FCC CFR 47 Part 15 Subpart B ANSI C63.4 • IEC 61850-3 • IEEE 1613 • ETSI EN 50121-4 • IEC 62236-4 • FTZ 1TR9
EMC Immunity	• ETSI EN 300 386 • IEC 61000-4 series
ETSI	• ETSI EN 300 019 - Storage: Class 1.1, Transportation: Class 2.3, In-Use/Operational: Class 3.1 • QM 333 • ETSI EN 300 753
RoHS	Compliance per EU RoHS, RoHS 2 directive 2011/65/EU and amendment 2015/863/EU directives.

Specifications subject to change without notice

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About Ribbon

Ribbon Communications (Nasdaq: RBBN) delivers communications software, IP and optical networking solutions to service providers, enterprises and critical infrastructure sectors globally. We engage deeply with our customers, helping them modernize their networks for improved competitive positioning and business outcomes in today's smart, always-on and data-hungry world. Our innovative, end-to-end solutions portfolio delivers unparalleled scale, performance, and agility, including core to edge software-centric solutions, cloud-native offers, leading-edge security and analytics tools, along with IP and optical networking solutions for 5G. To learn more about Ribbon visit rbbn.com.