



## OcNOS™ 1.3.4

### Product Overview

OcNOS™ is a networking solution built with traditional networking components along with components to transition to the new disruptive technologies. OcNOS supports disaggregation of network hardware and software to reduce CAPEX, OPEX and increase flexibility.

OcNOS allows for investment protection by maintaining the operational and interop requirements for deployments with traditional networking gear.

OcNOS heavily borrows from the popular ZebOS® line of products, it takes advantage of a OcNOS-based network node to be rich feature density and robustness that has built up over the years. OcNOS provides industry-standard CLI, supports all standard MIBs and other standard operation and management tools. Its integrated centralized management and provisioning layer allows for transaction based configuration and device feature modelling. The management layer exposes Netconf, besides custom CLI generation capability. All of this allows an OcNOS system to be configured, managed and controlled by the Network Management System for scaled topologies and in more than one way.

OcNOS is a modular, multi-tasking network operating system, with tight integration capabilities on commodity hardware. This design allows for scaled and performance critical deployments. The niche coupling with merchant silicon utilizes key hardware capabilities for better performance and feature set.

#### Availability

- Device and protocol level redundancy: OcNOS provides standards based redundancy protocols like VRRP, BFD, Multi-chassis LAG, and graceful restart mechanisms. These provide a guaranteed network level redundancy.
- Easy upgrades: The modularity of OcNOS allows for individual process/protocol level upgrades and restarts without disturbing the running system. OcNOS supports software update with minimal service disruption.
- Process survivability: OcNOS has a built-in process heartbeat monitoring and restart feature in a 1U format. This leads to minimal downtime and unavailability at critical deployments.

#### Serviceability

- Troubleshooting and diagnostics: OcNOS supports event and process logging both local and remote, using standard mechanisms like syslog and traps. It also supports several system level diagnostics for health monitoring. These can provide useful data for troubleshooting and diagnostics.
- Traffic Monitoring: OcNOS can monitor traffic using standard port mirroring techniques. It can also do sample based traffic monitoring using widely implemented sFlow protocol.

#### Features and Benefits

- **Common software for multiple deployments and hardware:** OcNOS is designed using several inbuilt abstraction layers. These abstraction layers allow the software to run over multiple control plane CPU and forwarding chipset hardware. The system calls are also well abstracted allowing to switch across operating systems if required. It has been integrated with verified with multiple commodity hardware, which again allows for easier transition.
- **Interoperation and ease of use:** The OcNOS solution is built using standards based definitions, as well as has popular vendor specific extensions. The operation and management is provided using CLI, SNMP and Netconf. This allows the OcNOS-based network node to be easy to operate and interoperate with another vendor node.
- **Modular software design:** OcNOS software design is highly modular with multiple processes handling individual key protocols. The processes are managed and contained by a process handler framework, which also monitors the processes, restarts and maintains event logging for them. OcNOS can be built and packaged with minimal software features, reducing CapEx and device footprint.
- **Support for disruptive networking technologies:** OcNOS supports technologies required for bandwidth scaling at data centers and interconnects. It has a centralized transaction based modelling layer which allows for multiple management interfaces, this, in turn, allows for a central service level provisioning and chaining across multiple devices. It supports technologies required for SDN and NFV.



- **System Configuration and Management:** OcNOS provides well known mechanisms for device control such as boot parameters, password recovery.

## Manageability

- **Programmable and Flexible Management Layer:** OcNOS has an internal transaction based management layer with open programmable upper layer. This allows it be programmed using NetConf, SNMP, HTTP traditional CLI mechanism.
- **Simple Network Management Protocol (SNMP):** OcNOS complies with SNMPv1, v2c, and v3.

A comprehensive collection of MIBs is supported.

- **Configuration verification and rollback (Alpha):** With OcNOS, the system operator can verify the consistency of a configuration and the availability of necessary hardware resources prior to committing the configuration. A device can thus be preconfigured and the verified configuration applied at a later time. Configurations also include checkpoints to allow operators to roll back to a known good configuration as needed.
- **Role-based access control (RBAC):** With RBAC, OcNOS enables administrators to limit access to switch operations by assigning roles to users. Administrators can customize access and restrict it to the users who require it. The authentication and authorization is supported using both RADIUS and TACACS+.

## Traffic Routing, Forwarding, and Management

- **Ethernet switching:** The solution supports the complete feature set required to run it as pure Layer2 or Layer2-3 switch. This feature set includes IEEE 802.1D-2004, Rapid Spanning Tree Protocol (RSTP), Multiple Spanning Tree Protocol (MSTP) IEEE 802.1w and 802.1s, QinQ, IEEE 802.3ad link aggregation, Multi-Chassis Link Aggregation, IEEE 802.1AB Link Layer Discovery Protocol (LLDP), PVLAN, BPDU Guard, Loop guard, Switched VLAN Interface support, EVB and DCB support.
- **Data center features:** OcNOS supports multiple standards based multi-path

Ethernet technologies for the data center. They are TRILL and Multi-chassis Link Aggregation Group. Apart from these it also supports Data Center Bridging (DCB), QCN, ETS and PFC for true unified Ethernet backplane. These technologies are well supported by the related integrated hardware, resulting in line rate performance. For Layer-3 based data center deployments, OcNOS has BGP, OSPF support with a very large ECMP fan out.

- **IP routing:** OcNOS supports a wide range of IPv4 and v6 services and routing protocols. Notably;
  - Open Shortest Path First (OSPF) Protocol Versions 2 (IPv4) and 3 (IPv6)
  - Intermediate System-to-Intermediate System (IS-IS) Protocol for IPv4
  - Border Gateway Protocol (BGP) for IPv4 and IPv6
- **Routing Information Protocol Version 2 (RIPv2)** The implementations of these protocols are fully compliant with the latest standards, providing modern enhancements and parameters such as 4-byte autonomous system numbers (ASNs), NSF graceful restart (NSF-GR) is supported by all unicast protocols. All protocols support all interface types, including Ethernet interfaces, switched virtual interfaces (SVIs) and subinterfaces, Portchannels, tunnel interfaces, and loopback interfaces. The great variety of routing protocols and functions is complemented by a broad collection of IP services, including the following:
  - VRF-lite and MPLS VPNs as described in RFCs 2547 and 4364
  - Dynamic Host Configuration Protocol (DHCP) Helper
  - Unicast Reverse Path Forwarding (uRPF)
  - Virtual Router Redundancy Protocol (VRRP)
  - Unicast graceful restart for OSPFv2, OSPFv3, LDP and BGP
- **IP Multicast:** OcNOS provides a feature rich in multicast. The OcNOS implementation lays the foundation for the future development of a comprehensive portfolio of multicast-enabled network functions. In a way similar to its support for the unicast routing protocols, OcNOS

includes implementations of the following multicast protocols and functions:

- Protocol-Independent Multicast Version 2 (PIMv2)
- Source-Specific Multicast (SSM) for IPv4 and IPv6
- PIM Sparse Mode (Any-Source Multicast [ASM] for IPv4 and IPv6)
- Anycast Rendezvous Point (Anycast-RP)
- RP-Discovery using bootstrap router (BSR): Auto-RP and static
- Internet Group Management Protocol (IGMP) Versions 1, 2, and 3 router role
- IGMPv2 host mode
- IGMP snooping
- Multicast Source Discovery Protocol (MSDP) (for IPv4 only)
- IGMP group-specific queries to router ports only
- Debug filters for IGMP snooping

Quality of service (QoS): OcNOS supports standard QoS mechanisms, including classification, marking, queuing, policing, and scheduling. Hierarchical and Modular QoS is supported.

- **Multiprotocol Label Switching (MPLS):** OcNOS supports a comprehensive set of MPLS features including label switching, Layer 3 VPNs, MPLS Traffic Engineering with Fast Reroute (FRR).

## Network Security

- **Network security features:**
  - Authentication, authorization, and accounting (AAA) and TACACS+
  - Secure Shell (SSH) Protocol Version 2
  - SNMPv3 support
  - Port security
  - IEEE 802.1x authentication and RADIUS support
  - Policies based on basic and extended ACLs

## Features on OcNOS Release

The tables below list the software features in OcNOS available release. **Note, the following mentioned features are only indicative and the detail feature list may vary. Please refer to Feature Matrix for complete feature list.**

## System Level Features

Description
Support for OcNOS patch upgrades
Hardware Diagnostics
Supports Digital diagnostics monitoring for SFP
Support for variable size hardware forwarding table
Auto-shutdown
Dynamic 50G/25G/40G/10G link split
Ingress and Egress Filtering
DHCP Snooping and Relay
Flow control: IEEE 802.3x and back-pressure
IP Source Guard
Proxy ARP
Traffic Mirroring and sFlow support
Hardware Revision Check

## Layer2 Features

Description
IEEE STP/MSTP/RSTP
BPDU Protect
Root Guard
Routed VLAN interface
Private VLAN Support
IEEE QinQ Support
IEEE 802.3ad-LAG
IEEE 802.1ab-LLDP
4K VLAN Support
Uplink Failure Detection and Trigger fail over
Authentication 802.1x
Multi-chassis LAG
Authentication 802.1x
VXLAN with VPN with Multihoming support
MC-LAG support with PB
EVC Tag support for VXLAN

## Multicast Features

Description
IGMP v1,v2, v3
IGMP Snooping v1, V2, V3
IGMP Report Suppression
IGMP Snooping Querier
IGMP Filter
IGMP Snooping Proxy
PIM-SM/SSM/DM
MSDP

## Layer3 Features

Description
Static Routing
RIPv2
IPv6 Support
BFD Hardware Offload
BFD Demand Mode
BFD single hop & multi hop support
BFD over v4: BGP, ISIS, OSPF & Static Route
BGP 4
BGP 4 multipath support
BGP 4 Soft Reset
BGP Support for Next-Hop address tracking
BGP support for the L2VPN Address Family
BGP - Add Path Support
BGP - Remove/Replace Private AS Filter
BGP VPLS auto discovery support on route reflector
BGP selective FIB install
ISO specification of IS-IS
Use of OSI IS-IS for Routing in TCP/IP and Dual Environments
ISIS for MPLS BGP VPN
Open Shortest Path First Version 2 and v3
OSPF-TE: traffic engineering (TE) extensions
OSPF graceful restart
OSPF Database Overflow Support
OSPF for MPLS BGP VPN
OSPF-Loop Free Alternative
Segment Routing Support OSPF
VRRP Support
VRRP Interface tracking
Unicast Reverse Path Forwarding

## Data Center Features

Description
IEEE 802.1Qbb - PFC, IEEE 802.1Qaz - ETS
IEEE 802.1Qaq - QCN
TRILL
DCBX



## QoS Features

Description
L2 and L3 Modular and Hierarchical QoS
Rate Limiting - three rate coloring, policing, marking
Shaping per queue, per port
802.1p remarking
Trust IEEE 802.1p feature
Egress QoS(Remarking/Policing)

## Management Features

Description
CLI based both in and out of band support
SNMP v1, v2, v3 support
RADIUS and TACACS+ support
Netconf support
VRF isolation for management and operation protocols
Ansible support for Data Center configurations
OpenDay light and Openstack integration(Alpha)

## MPLS Features

Description
Label Distribution Protocol
RSVP protocol
RSVP with IETF Integrated Services
RSVP-TE Extension to RSVP for LSP Tunnels
Fast Reroute Extensions to RSVP for LSP Tunnels
Pseudowire Setup and Maintenance using Label Distribution Protocol
Static Pseudowire Setup and Maintenance
Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling
Virtual Private LAN Service (VPLS) Using BGP for signaling and auto-discovery
BGP MPLS IPv4 VPN
OAM for MPLS Networks
VRF Lite
MLAG support at VPLS(LDP) edge
MPLS Service Mapping

## System Level Features

### Patch Upgrades

OcNOS supports minor version or software patch upgrade via a CLI command, upon patch application the software initiates a graceful restart with its peer, while the forwarding entries get corrected. If the patch upgrade is not successful the system automatically degrades back to its old revision. User configuration is not lost in the process. Note: patch upgrades does not guarantee the switch will not drop traffic while the procedure is on.

### Hardware Diagnostics

With hardware diagnostics, user can monitor peripheral component status and switch state. It can be used for technical troubleshooting.

### Digital Diagnostics Monitoring for SFP+

OcNOS supports reading MSA certified Digital optical monitoring. It is supported on qualified optics and helps to monitor optical characteristic of the SFP, temperature and set thresholds for warning.

### Support for Variable Forwarding Table Size

On supported platforms, OcNOS can switch varying in size the number of L2 entries, L3 entries and Host entries. This helps in profiling the switch for higher L3 route table size with low L2 tables, vice-versa or a balanced profile. Note: Refer to Configuration Guide to see applicability towards each platform.

### Auto-shutdown

Upon the system getting overheated, fan supplies, not working OcNOS automatically shuts down the switch to prevent any damage.

### Dynamic 50G/25G/40G/10G Port Split

OcNOS supports dynamically splitting a port into sub-bandwidths without restarting the system. Note: Refer to Configuration Guide to see applicability towards each platform.

### Ingress and Egress Filtering

OcNOS supports basic and extended IP ACL and MAC ACL to allow it on Ingress and Egress path. Note: This feature is not supported on management port. Refer to Configuration Guide and Installation Guide to see the list of matched items for classification and the maximum number of rules possible.

### DHCP Snooping and Relay

OcNOS supports DHCP Relay agent for IPv4 and IPv6. It also supports DHCP Snooping to help secure only authorized DHCP clients and server sessions. Note : DHCP Snooping can be enabled currently only on a per VLAN basis. Refer to OcNOS Configuration Guide for more details.

### Flowcontrol

OcNOS supports IEEE 802.3X on Ethernet receive and transmit side, thus sending pause frames during congestion.

### IP SourceGuard

IP source guard feature along with DHCP snooping feature, disallows untrusted port side to receive packets without expected IP address.

### Proxy ARP and Local Proxy ARP

OcNOS supports local proxy ARP by which it can respond to ARP for connected subnets and thus avoids forwarding the ARP to another subnet, whereas IP Proxy ARP allows OcNOS to proxy for another host in the same subnet.



## Traffic Mirroring and sFlow support:

OcNOS supports SPAN and RSPAN feature, it supports it in both Ingress and Egress directions. The matching port can be either physical, on a VLAN basis or based upon a rule match. When configured for RSPAN, the mirrored traffic will be encapsulated in a dedicated VLAN and egressed out of a specific configured port.

## Layer2 Features

### IEEE STP/MSTP/RSTP

OcNOS supports IEEE standards based STP, MSTP and RSTP protocol.

### BPDU Protect

This feature is used to control access ports from wrongly processing BPDU packets.

### BPDU Filter

This feature is again a secondary control to prevent an access port from sending BPDU packets.

### Routed VLAN Support

Layer-3 IPv4 and IPv6 VLANs address can be provided to VLANs.

### Private VLAN Support

OcNOS supports private VLAN as recommended by RFC 5517, refer to OcNOS Configuration Guide for restrictions.

### IEEE QinQ Support

OcNOS supports 802.1Q standards compliant Provided Backbone switching. The total number of available VLANs are however restricted.

Refer to Release Notes for supported numbers.

### IEEE 802.3ad – LAG

Support for IEEE compliant dynamic and static link aggregation group, with choice of load sharing fields. Refer to OcNOS Configuration Guide for choice of fields and restrictions.

### IEEE 802.1ad – LLDPv2

Support for LLDP version as per IEEE 802.1ab 2009.

### Uplink Failure Detection and TFO

This feature helps in tying up a critical uplink failure to disable a down-link for quick convergence. Refer to Configuration Guide for restrictions and limitations.

## 4K VLAN Support

OcNOS supports close to 4K VLANs; depending upon the platform a certain number of VLANs are reserved for internal usage. Refer to Release notes and used referred platform for exact number of available VLANs.

## IEEE 802.1x Authentication

OcNOS supports port based authentication as per 802.1x, with optional MAC address based authentication.

## Multi-chassis LAG

Up to two OcNOS switches can work together and provide multi-chassis LAG. Only restricted protocols are supported over Multi-chassis LAG. Refer to Feature Matrix guide to see restrictions with MLAG. The MLAG protocol is proprietary in nature and does not interoperate with non-OcNOS switches.

## VXLAN with EVPN

OcNOS support VxLAN with BGP EVPN. EVPN allows for automated control plane discovery of end nodes, host paths and control. Refer to Feature Matrix for limitations.

## Multicast Features

### IGMP v1, v2 ,v3

OcNOS supports IGMP used for Layer-2 multicast traffic distribution.

IGMP Snooping, Report suppression, Querier, Filter and Snooping Proxy.

OcNOS also supports adjacent features with basic IGMP in compliance with usage.

**Please refer to OcNOS Configuration Guide for feature and its restrictions.**

### PIM-SM/SSM/DM

OcNOS supports multiple variations of PIM Sparse Mode, Source Specific Mode and Dense Mode.

### MSDP

Multicast source discovery protocol is used with PIM-SM to have inter-domain multicast routing.

## Layer3 Features

IPv4 Routing – (Static, RIPv2, ISIS, OSPFv2, BGP4).

OcNOS supports standard IPv4 static & dynamic routing protocols. Refer to Feature Matrix to note limitations.

Refer to Performance Data Sheet to note scaling numbers.

## IPv6 Routing – (Static, RIPv2, OSPFv3, BGP4)

OcNOS supports standard IPv6 static and dynamic routing protocols. Refer to Feature Matrix to note limitations.

## MP-BGP

OcNOS supports Multi-protocol BGP which support for multiple address families. Additionally it supports BGP Add-path, Private AS filter removal useful for designing BGP based CLOS fabric. BGP also supports address families for VPLS, L3VPN and EVPN. Refer to Feature Matrix to note complete feature support and limitations.

## OSPF-TE & ISIS-TE

OcNOS also supports OSPF-TE and ISIS-TE for traffic engineering, it is to be used in conjunction with MPLS/RSVP for traffic engineering. Refer to Feature Matrix for limitations.

## Graceful Restart

BGP and OSPFv2/v3 support Graceful restart, this is used to control planned maintenance. Refer to Feature Matrix for limitations.

## BFD

OcNOS supports single hop and multi-hop BFD. Additionally it also supports protocol BFD. On supported hardware it also supports hardware BFD offload. Refer to Feature Matrix to see supported platforms for offload BFD.

## VRRP

OcNOS supports VRRP version for IPv4 with next-hop tracking for faster detection, in addition it works in conjunction with MLAG to work as MLAG gateway.

## Segment Routing

OcNOS supports Segment Routing for OSPFv2. Please refer Feature Matrix for limitations.

## Data Center Features

OcNOS supports PFC, IEEE 802.1Qbb, with this technology Ethernet uses the PAUSE frames in a per class basis, as one way to achieve lossless Ethernet. Refer to Feature Matrix to see supported platforms.



## Enhanced Transmission Selection (ETS)

This feature IEEE 802.1 Qaz allows for an algorithm change across the 802.1p marked traffic classes in fair manner, such that low priority traffic does not get throttled out. This helps in one way to achieve lossless Ethernet. Refer to Feature Matrix for supported platforms.

## Quantized Congestion Notification (QCN)

With QCN (IEEE 802.1 Qaq) protocol bridges send congestion notification messages to the end hosts and servers, such that the congestion is controlled from end to end. It is again used to achieve lossless Ethernet transport goal. Refer to Feature Matrix to see supported platforms.

## Data Center Bridging (DCBX)

Data Center Bridging is an extension over IEEE 802.1AB LLDP which helps switches discover each other capabilities for PFC, ETS and other capabilities.

## TRILL(Transparent Interconnection of Lots of Links)

OcNOS supports TRILL, it allows multiple switches to interconnect pass traffic between end points with all active load distribution for unicast, broadcast, multicast traffic.

## Management Features

### CLI & SNMPv2, v3

OcNOS supports industry standard CLI for easy configuration. It also supports all standard MIBS, Refer to OcNOS SNMP MIB Documentation for complete list of MIB support and limitations.

## NETCONF

OcNOS supports NETCONF with full transaction support for integration with custom management controllers. Refer to Release Notes and Feature Matrix for support of NETCONF on SKUs/platforms and limitations.

## RADIUS & TACACS +

OcNOS supports RADIUS and TACACS based authentication and authorization. Refer to OcNOS Feature Matrix and Configuration Guide to see limitations and restrictions.

## QoS Features

### Hierarchical QOS

Hierarchical QoS allows for traffic shaping distribution based on bandwidth available and consumed from other flows. It allows for a fine grained QoS flows.

### Ingress and Egress Policing:

OcNOS supports industry standard 2-rate, 3-color policing and marking. Refer to Configuration Guide for features and limitations.

### Marking and Metering:

OcNOS supports traffic remarking (IEEE 802.1p) to various classes.

### Scheduling:

OcNOS supports Strict priority, WRR egress queue scheduling. QoS support varies with supported hardware, refer to Release Notes and Configuration Guide for exact support.

## MPLS Features

### Label Distribution Protocol (LDP)

OcNOS supports LDP based IPv4 tunnel setup with ECMP. Refer to Feature Matrix for limitations.

### Resource Reservation Protocol (RSVP) with TE (Traffic Engineering)

OcNOS supports RSVP-TE protocol using OSPF-TE for constrained TE MPLS tunnel setup. Refer to Feature Matrix for limitations.

### FRR (Fast Reroute)

OcNOS supports FRR 1:1 for fast restoration when using RSVP based MPLS TE LSPs.

### Virtual Pseudowire Service (VPWS)

OcNOS supports VPWS session setup using LDP and BGP. Refer to OcNOS Configuration Guide and Feature Matrix for sub-features and limitations.

### Virtual Pseudowire LAN Service (VPLS)

It also supports LDP and BGP based VPLS setup. Refer to OcNOS Configuration Guide and Feature Matrix for sub-features and limitations.

### Layer 3 Virtual Private Network (L3VPN)

OcNOS supports BGP based VPN address family IPv4 Layer-3 VPN configuration and setup. Refer to OcNOS Configuration Guide and feature matrix for sub-features and limitations.

### VRF Lite

OcNOS can also be configured to setup non-MPLS use, IP-based VRF segregated network. Refer to OcNOS Configuration Guide for steps.



#### About IP Infusion

IP Infusion, the leader in disaggregated networking solutions, delivers the best network OS for white box and network virtualization. IP Infusion offers network operating systems for both physical and virtual networks to carriers, service providers and enterprises to achieve the disaggregated networking model. With the OcNOS™ and VirNOS™ network operating systems, IP Infusion offers a single, unified physical and virtual software solution to deploy new services quickly at reduced cost and with greater flexibility. Over 300 customers worldwide, including major networking equipment manufacturers, use IP Infusion's respected ZebOS platform to build networks to address the evolving needs of cloud, carrier and mobile networking. IP Infusion is headquartered in Santa Clara, Calif., and is a wholly owned and independently operated subsidiary of ACCESS CO., LTD. Additional information can be found at <http://www.ipinfusion.com>.

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