

First switching, routing and SDN open network operating system.

IT Business Drivers

- ➔ Enable rapid service creation in order to grow topline revenue
- ➔ Extend automation and common tools across teams, including cross training to bridge operational silos
- ➔ Drive technology alignment opportunities by leveraging supply chain best practices across functional areas

Open Networking Value

- ➔ Networking now follows the open supply chain as the server industry
- ➔ Bare metal hardware ecosystem and standards are maturing, driven by the Open Compute Project (OCP)
- ➔ Hardware-agnostic Linux based network software is transforming network economics and innovation just like the server side of the data center
- ➔ Foundational and fundamental for delivering a unified view of automation and policy driven networks with the best economics

PICOS Overview

Pica8 pioneered open networking with PicOS™, the first network operating system that enables customers to easily migrate from standard networking to software-defined networking (SDN) using commodity bare metal switches. PicOS supports all major routing and switching protocols and delivers SDN solutions through Pica8's adoption of Open-vSwitch (OVS).

Smooth integration of SDN - Choose how much and when

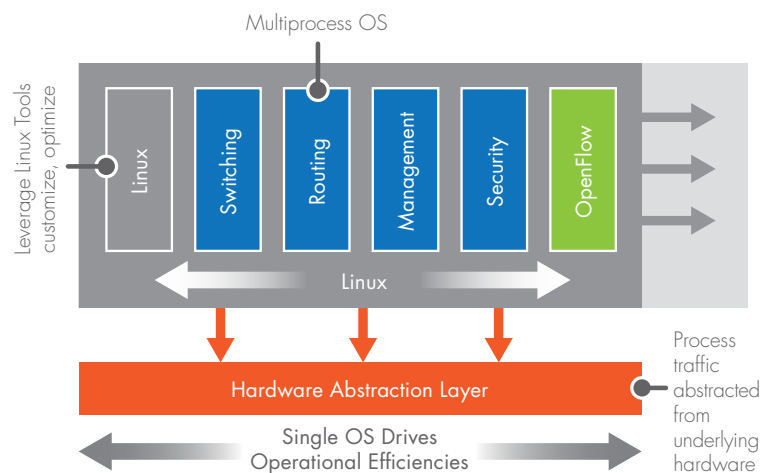
- Switching and routing support is key for easy integration into existing network topologies
- PicOS delivers SDN solutions through Pica8's adoption of Open-vSwitch (OVS)
- OVS provides the SDN functionality and northbound interface that DevOps users expect
- CrossFlow technology enables the stitching of OpenFlow into traditional switching and routing networks

The best of both worlds - Choose how to manage

- PicOS offers a comprehensive and flexible configuration management environment from a feature-rich command line interface (CLI) or a Linux shell
- PicOS runs as an application on an un-modified Linux kernel, enabling automation tools such as Chef or Puppet run natively
- Ensure rapid service provisioning through multiple open programming interfaces

Its software! - Choose how you want it delivered

- PicOS is easy to install, leveraging the open-source Open Network Install Environment (ONIE) boot loader as well as Zero-Touch Provisioning (ZTP) tools
- PicOS is qualified on multiple bare metal switches and from a variety of manufacturers
- Licensing options include perpetual (one time), site, and pre-loaded systems where Pica8 delivers a fully integrated package



PicOS - Three Editions to Leverage



A base configuration starts with the Linux Switching OS package. For additional functionality, select either the Routing or OpenFlow Editions, or the PicOS Bundle depending on your use case.

Features Included	Required PicOS Editions		
	Linux Switching OS	Routing	OpenFlow
<ul style="list-style-type: none"> • Network operation system using user space standard Debian Linux environment • Leverage vast array of standard Linux tools as a common management and operations framework • Zero Touch Provisioning (ZTP) functionality coupled with ONIE delivers a true bare metal to application environment • Rich Layer-2 protocol stack with MLAG, seamlessly integrating into existing architectures • Full Layer-2 & Layer-3 ACL support • IPv4 & IPv6 Static Routing 	✓		
<ul style="list-style-type: none"> • Rich OSPF and BGP protocol stacks integrating into existing spine / leaf architectures • IPv6 routing protocol support (OSPFv3, MBGP) • Multicast PIM Support (PIM SM, PIM SSM) • MPLS Support (Labeled-BGP) • NAT (depends on ASIC support) • VXLAN network virtualization (depends on ASIC support) 	✓	✓	
<ul style="list-style-type: none"> • Leading OpenFlow 1.4 support through OVS 2.3 • Deliver true seamless migration to SDN through CrossFlow mode (Layer-2 / Layer-3 and OpenFlow simultaneously) • Leveraging OpenFlow to control MPLS, GRE, NVGRE or VXLAN tunnels, delivering on the promise of open programmability • Support for all major OpenFlow controllers (for example: OpenStack Neutron ML2, OpenDaylight, Ryu) 	✓		✓
<ul style="list-style-type: none"> • PicOS Bundle 	✓	✓	✓

Pica8 Support

Pica8 provides world-class support and services to help our customers and partners fully leverage the power of open systems. We provide a full range of support services that include access to our Support Portal and online support tools 24/7/365, advanced RMA for selected hardware ecosystem partners, and onsite support for customers. We want to ensure our customers and partners can quickly and easily manage and troubleshoot solutions from Pica8. For more information, visit <http://www.pica8.com/support/>

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Layer 2 Features

- Jumbo frames up to 9,216 bytes
- Provide non-blocking wire speed L2 switching
- Flow control
 - IEEE 802.3x for full-duplex mode
 - Back-pressure flow control in half-duplex mode
- Broadcast, unicast, and multicast storm protection
- IGMP snooping, up to 1K groups
- VLAN support
 - IEEE 802.1Q VLANs
 - 4,094 VLANs
 - Port-based VLANs
- Spanning Tree
 - IEEE 802.1D STP
 - IEEE 802.1w RSTP
 - IEEE 802.1s MSTP
 - Per-VLAN Spanning Tree (PVST)
- Link aggregation
 - Up to 48 trunk groups
 - Up to 8 ports per trunk group
 - IEEE 802.3ad Link Aggregation & LACP
- Port mirroring (many-to-one)
- Port security
- LLDP
- Q-in-Q
- Multi-chassis Link Aggregation (MLAG)
- MLAG with Spanning Tree support
- VXLAN Tunnel Endpoint (VTEP) support
- 802.1X support

Layer 3 Routing Features

- ECMP: 32 next hops
- ECMP resilient hashing (depends on ASIC support)
- RIPv2
- OSPFv2
- MP-BGP (IPv4, IPv6)
 - Static MPLS LSP
 - Labeled BGP (RFC3107)
- VRRP
- DHCP-relay including DHCP option-82 and ARP inspection Layer 3 Multicast
- PIM-SM and PIM-SSM
- IGMPv1/v2/v3
- VXLAN Tunnel Endpoint (VTEP)
- 802.1X support

IPv6 Layer 3 Routing Features

- RIPv6
- OSPFv3
- MBGP for IPv6 NLRI
- IPv6 routing

Security

- User/password protected system management
- L2/L3/L4 ACLs
- TACACS+ AAA
- SSHv1/v2
- SSLv3/TLS v1
- DoS attack protection

Quality of Service

- IEEE 802.1p-based CoS
- 8 priority queues per port
- DSCP-based CoS
- Policy-based DiffServ

Network Management

- Command line interface (CLI)
- Telnet and SSH remote login
- Centralized control plane policing and filtering
- SNMPv1/v2c
- AAA Radius support
- IPFIX (NetFlow) / sFlow

OpenFlow Implementation

- Based on Open-vSwitch (OVS) 2.3
- Compatible with OpenFlow 1.4 specification
- TCAM Flow Optimization for better scalability and performance
- Web interface / GUI for OVS configuration
- Interoperable with RYU, OpenDaylight, ONOS, RYU, Kulcloud, Floodlight, Trema and NOX
- OpenFlow encapsulation: L2oGRE, L3oGRE, NVGRE, PBB, VXLAN, MPLS (depending on ASIC support)
- Network Address Translation (NAT) depending on ASIC support

Operational Programming Tools

- Automate PicOS installation via ONIE
- Auto provisioning with scripting capacity (Zero Touch Provisioning)
- Debian 7.0 Linux distribution
- Modular PicOS: Service daemon for L2/L3 Mode and OVS Mode
- Standard Debian Based package upgrade (apt-get)
- Extensible CLI with Scripts and APIs
- Configuration Commit / Check / Rollback
- C/C++, Ruby, Python, Perl
- Configuration Management: Puppet, Chef, CFEngine (user-installed)
- Support for 802.1ag Connectivity Fault Management (CFM) is incorporated in PicOS OVS / OpenFlow mode.
- VLAN push/pop operation in an MPLS action

Standards Compliance

- 802.1D Bridging and Spanning Tree Protocol
- 802.1s Multiple Spanning Tree Protocol
- 802.1w Rapid Spanning Tree Protocol
- 802.1p QOS/CoS
- 802.1Q VLAN Tagging
- 802.1X Port-based Network Access Control (PNAC)
- 802.1ah PBB (MAC in MAC)
- 802.3ad Link Aggregation with LACP
- 802.3ab 100BASE-T
- 802.3z Gigabit Ethernet
- 802.3ae 10 Gigabit Ethernet
- 802.3ba 40 Gigabit Ethernet

RFCs MIBs

- RFC 1157 SNMPv1
- RFC 1212 Concise MIB definition
- RFC 1213 MIB II
- RFC 1215 SNMP traps
- RFC 1256 ICMP router discovery
- RFC 1493 Bridge MIB
- RFC 1573 Interface Evolution MIB
- RFC 1643 Etherlike MIB
- RFC 1901 Community based SNMPv2
- RFC 1905 Protocol Operations for SNMPv2
- RFC 1906 Transport Mappings for SNMPv2
- RFC 1907 Management Information Base for SNMPv2
- RFC 1908 Coexistence between SNMPv1 and SNMPv2
- RFC 1997 BGP Communities Attribute
- RFC 2021 RMON2 probes
- RFC 2096 IP Forwarding table MIB
- RFC 2233 The Interface Group MIB using SNMPv2
- RFC 2439 BGP Route Flap Damping
- RFC 2545 Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing
- RFC 2665 Ethernet-like Interfaces
- RFC 2796 BGP Route Reflection - An Alternative to Full Mesh IBGP
- RFC 3065 Autonomous System Confederations for BGP
- RFC 3392 Capabilities Advertisement with BGP-4
- RFC 4893 BGP Support for Four-octet AS Number Space
- RFC3107 - Labeled BGP
- RFC4607 - PIM SSM
- RFC3376 - IGMPv3
- Pica8 Private MIB