



# Dell Force10 Operating System (FTOS)

## Z-Series, E-Series, C-Series, and S-Series, System Software

Best-in-class stability and reliability; NetBSD Modular OS; one FTOS Code Train for all platforms

### Optimized for portability, resiliency and scalability

Dell FTOS, the Force10 Operating System, is a powerful and robust operating system that runs on the Dell Force10 switch/router product lines. It is architected for high performance, resiliency, and portability. The Hardware Abstraction Layer (HAL) makes FTOS applications portable across product lines. Its modular design dramatically increases code reuse and accelerates the delivery of applications. FTOS is based on NetBSD, with application code developed and maintained by Force10.

### Key features

- Out-of-the-box stability, resiliency, performance, and security advantages
- Increased software portability and modularity to bring high performance application features to all switch/router product lines
- Based on NetBSD, an industry's leading, freely available open source operating system. NetBSD is highly reliable, portable and efficient

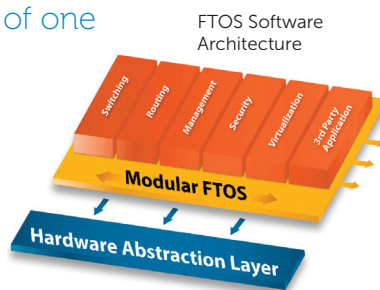
### FTOS: The power of one

#### Rich functional coverage

The primary FTOS attributes, modularity and extensibility, allows an accelerated evolution in different domains, including Layer 2 and Layer 3 services, as well as management functions, security services and other FTOS features.

FTOS leverages a distributed, multiprocessor architecture that delivers highly scalable protocols and reliability in each product line. Z-Series and E-Series Route Processor Modules (RPMs) are designed with separate control plane CPUs for Layer 2, Layer 3 and management functions, with distributed processing on line card CPUs. The C-Series RPMs and S-Series switch/routers use one control plane CPU, with distributed processing on C-Series line cards and S-Series stack members.

The NetBSD kernel provides a stable operating system and unparallel resource management thanks to its renowned Hardware Abstraction Layer (HAL) architecture. Highly optimized it provides superior levels of concurrency, memory allocation, and process scheduling. All other applications run as independent and modular processes in their own protected memory space.



### Consistency

Dell Force10's switch/router platforms derive from a single code base which follows a linear, sequential release path. It allows the Z-Series, E-Series, C-Series, and S-Series to deliver uniform solution sets. Dell Force10 ensures that customers benefit from stable code, consistent configuration environment, and simpler software management.

FTOS reliability and scalability characteristics provide the foundation for always-on networks and deliver substantial reliability and scalability advantages.

### Flexibility and faster time-to-market

The trend towards increased service innovation requires decreased time-to-market. FTOS modular architecture allows for further expansion of enhanced applications to meet current and future key propositions, and thus, achieving further operational efficiencies.

### Stable code

- The drive and benefits of a single code base and a single release train enables Dell Force10 to perform more robust and comprehensive rigorous functionality and scalability testing
- Customers benefit from more stable, reliable software and consistent CLI
- All platforms can benefit from a single maintenance release, which greatly simplifies software maintenance

FTOS leverages a distributed, multiprocessor architecture delivering highly scalable protocols and reliability in each product line

## Scalable protocols

- FTOS control plane inherits a high degree of maturity and stability from its roots in NetBSD's high performance IPv4 and IPv6 stacks
- Advanced inter-process communication (IPC) mechanisms enable a scalable and distributed control plane
- Switching and routing protocols have been extensively tested and hardened through deployment in large global networks
- FTOS can accommodate the most demanding environments, reliably scaling to support very large, high performance networks

## Streamlined Management

- Common management functionality and common user interface across Dell Force10 product lines make operating the network easier
- Simpler product training and learning curve because system configuration, diagnostics, troubleshooting and software maintenance are identical across platforms
- Support for the same CLI, SNMP, and XML management models throughout the network greatly simplifies life-cycle management of the infrastructure

## Specifications: FTOS

### IEEE Compliance

802.1AB	LLDP
802.1ad	Q-in-Q
802.1ag	Connectivity Fault Management
802.1D	Bridging, STP
802.1p	L2 Prioritization
802.1Q	VLAN Tagging, Double VLAN Tagging, GVRP
802.1s	MSTP
802.1w	RSTP
802.1X	Network Access Control
802.3ab	Gigabit Ethernet (1000BASE-T)
802.3ac	Frame Extensions for VLAN Tagging
802.3ad	Link Aggregation with LACP
802.3ae	10 Gigabit Ethernet (10GBASE-X)
802.3af	Power over Ethernet
802.3ak	10 Gigabit Ethernet (10GBASE-CX4)
802.3ba	40 Gigabit Ethernet (40GBase-X) on optical ports
802.3ba	100 Gigabit Ethernet on optical ports 100 GBase-LR4/-SR4
802.3i	Ethernet (10BASE-T)
802.3u	Fast Ethernet (100BASE-TX)
802.3x	Flow Control
802.3z	Gigabit Ethernet (1000BASE-X)
ANSI/TIA-1057	LLDP-MED
Force10	FRRP (Force10 Redundant Ring Protocol)
Force10	PVST+

### RFC and I-D Compliance

#### General Internet Protocols

768	UDP
793	TCP
854	Telnet
959	FTP
1321	MD5
1350	TFTP
1661	PPP
1989	PPP Link Quality Monitoring
1990	PPP Multilink Protocol
1994	PPP CHAP
2474	Differentiated Services
2615	PPP over SONET/SDH
2698	Two Rate Three Color Marker
3164	Syslog
4254	SSHv2
draft-ietf-bfd-base-03	BFD

#### General IPv4 Protocols

791	IPv4
792	ICMP
826	ARP
1027	Proxy ARP
1035	DNS (client)
1042	Ethernet Transmission
1191	Path MTU Discovery
1305	NTPv3
1519	CIDR
1542	BOOTP (relay)
1812	Routers
1858	IP Fragment Filtering
2131	DHCP (server and relay)
2338	VRRP
3021	31-bit Prefixes
3046	DHCP Option 82
3069	Private VLAN
3128	Tiny Fragment Attack Protection

#### General IPv6 Protocols

1981	Path MTU Discovery (partial)
2460	IPv6
2461	Neighbor Discovery (partial)
2462	Stateless Address Autoconfiguration (partial)
2463	ICMPv6
2464	Ethernet Transmission
2675	Jumbograms
3587	Global Unicast Address Format
4291	Addressing
4443	ICMPv6
5798	VRRPv3 for IPv6

#### IPv6 Routing Protocols

2080	RIPng
2545	BGP-4 extensions for IPv6
5308	IS-IS for IPv6
5340	OSPFv3
4601	PIM-SM for IPv4/IPv6

#### RIP

1058	RIPv1
2453	RIPv2

#### OSPF

1587	NSSA
1745	OSPF/BGP interaction
1765	OSPF Database overflow
2154	MD5

Consistent functionality, a stable code base and a common management interface and tool set all help reduce operational expenses (OPEX), thus lowering total cost of ownership (TCO). By supporting FTOS across all its switch/router products, Force10 extends the reliability and scalability benefits to all tiers of the network for optimal uptime.

### Dell FTOS Command Line Interface (CLI)

The CLI is a primary method of administering, configuring, and monitoring FTOS applications and Dell Force10 switches/routers. The CLI is a significant asset in protecting training investments: It is fully compliant with the predominant, de-facto industry standard CLI. Certified engineers will be immediately familiar with the Dell Force10 CLI and productive from day one.

The CLI has many powerful features which make it very convenient for usage on a daily basis. It includes on-line help, auto-completion, plain text or XML front-ends, Unix-like tools, such as grep, and non-interactive mode for scripting, to mention some.

2328	OSPFv2
2370	Opaque LSA
2740	OSPFv3
3101	OSPF NSSA
3623	Graceful Restart
4222	Prioritization and Congestion Avoidance OSPF Link-State Advertisement (LSA) Throttling

#### IS-IS

1142	IS-IS
1195	IPv4 Routing
2763	Dynamic Hostname
2966	Domain-wide Prefixes
3373	Three-way Handshake
3567	MD5
3784	Wide Metrics
5120	Multi-topology
5301	Dynamic Hostname Exchange.
5302	Dynamic Wide Prefixes
5303	Three-way Handshake
5304	MD5
5305	TE Extensions to ISIS
5306	Restart Signaling for IS-IS
draft-ietf-isis-igp-p2p-over-lan-06	Point-to-Point Operation
draft-ietf-isis-ipv6-06	IPv6 Routing
draft-kaplan-isis-ext-eth-02	Extended Frame Size

#### BGP

1997	Communities
2385	MD5
2439	Route Flap Damping
2545	Multiprotocol Extensions for IPv6
2796	Route Reflection
2842	Capabilities
2858	Multiprotocol Extensions
2918	Route Refresh
3065	Confederations
4271	BGP-4
4360	Extended Communities
4893	4-byte ASN
4724	BGP Graceful Restart
4760	Multiprotocol Extensions
5396	4-byte ASN Representation
5492	Capabilities Advertisement
draft-ietf-idr-bgp4-20	BGPv4
draft-ietf-idr-restart-06	Graceful Restart
draft-michaelson-4byte-as-representation-05	4-byte ASN Representation (partial)

## Multicast

1112	IGMPv1
2236	IGMPv2
2710	MLDv1
3376	IGMPv3
3569	SSM for IPv4/IPv6
3618	MSDP
3810	MLDv2
3973	PIM-DM
4541	IGMPv1/v2/v3, MLDv1 Snooping, MLDv2 Snooping

draft-ietf-pim-sm-v2-new-05 PIM-SM for IPv4/IPv6

## MPLS

2702	Requirements for TE Over MPLS
3031	MPLS Architecture
3032	MPLS Label Stack Encoding
3209	RSVP-TE: Extensions to RSVP for LSP Tunnels
3630	TE Extensions to OSPF Version 2
3784	IS-IS Extensions for TE
3812	MPLS-TE MIB
3813	MPLS LSR MIB
4090	Fast Reroute Extensions to RSVP-TE for LSP Tunnels
4379	Detecting MPLS Data Plane Failures (TE/LDP) Ping & Traceroute
5036	LDP Specification
5063	Extensions to GMPLS RSVP Graceful Restart

## Network Management

1155	SMIv1
1156	Internet MIB
1157	SNMPv1
1212	Concise MIB Definitions
1215	SNMP Traps
1493	Bridges MIB
1657	BGP-4
1724	RIPv2 MIB
1850	OSPFv2 MIB
1901	Community-based SNMPv2
1905	SNMPv2
1907	SNMP MIB
2011	IP MIB
2012	TCP MIB
2013	UDP MIB
2024	DLsw MIB
2096	IP Forwarding Table MIB

2233	Interfaces MIB
2558	SONET/SDH MIB
2570	SNMPv3
2571	Management Frameworks
2572	Message Processing and Dispatching
2574	SNMPv3 USM
2575	SNMPv3 VACM
2576	Coexistence Between SNMPv1/v2/v3
2578	SMIv2
2579	Textual Conventions for SMIv2
2580	Conformance Statements for SMIv2
2618	RADIUS Authentication MIB
2665	Ethernet-like Interfaces MIB
2674	Extended Bridge MIB
2787	VRRP MIB
2819	RMON MIB (groups 1, 2, 3, 9)
2863	Interfaces MIB
2865	RADIUS
2933	IGMP MIB
3273	RMON High Capacity MIB
3416	SNMPv2
3418	SNMP MIB
3434	RMON High Capacity Alarm MIB
3580	802.1X with RADIUS
3815	LDP MIB
4292	IPv6 Forwarding Table MIB
4293	IPv6 MIB
5060	PIM MIB

ANSI/TIA-1057 LLDP-MED MIB

draft-grant-tacacs-02 TACACS+

draft-ietf-idr-bgp4-mib-06 BGP MIBv1

draft-ietf-isis-wg-mib-16 IS-IS MIB

IEEE 802.1AB LLDP MIB

IEEE 802.1AB LLDP DOT1 MIB

IEEE 802.1AB LLDP DOT3 MIB

IPv4 Multicast MIB

ISIS MIB

ruzin-mstp-mib-02 MSTP MIB (traps)

sFlow.org sFlowv5

sFlow.org sFlowv5 MIB (version 1.3)

## MIBs

FORCE10-BGP4-V2-MIB

FORCE10-CHASSIS-MIB

FORCE10-COPY-CONFIG-MIB

FORCE10-CS-CHASSIS-MIB

FORCE10-FIB-MIB  
FORCE10-FORWARDINGPLANE-STATS-MIB  
FORCE10-IF-EXTENSION-MIB  
FORCE10-LINKAGG-MIB  
FORCE10-MON-MIB  
FORCE10-PRODUCTS-MIB  
FORCE10-SMI  
FORCE10-SS-CHASSIS-MIB  
FORCE10-SYSTEM-COMPONENT-MIB  
FORCE10-TC-MIB  
FORCE10-TRAP-ALARM-MIB

## Management and Security

HP OpenView support  
Industry-standard CLI  
Interface access control  
Layer 2 and 3 ACLs  
NTPv3  
Port mirroring  
Port monitoring  
RADIUS/TACACS+ authentication  
RMON (groups 1, 2, 3, 9)  
Secure copy (scp)  
sFlow traffic accounting  
SNMPv1/v2/v3  
XML configuration and command output

## Automation

Hyperlink  
JumpStart  
SmartScripts  
SwitchLink

## Quality of Service and Rate Policing

Weighted Fair Queuing (WFQ)

## Virtualization

VRF-Lite

## Other

ACL-based accounting  
Destination-based MAC accounting  
DNS Client  
Ping & Traceroute

Feature capabilities vary between the Z-Series, E-Series, C-Series, and S-Series due to hardware differences. Consult the data sheets and product manuals for specific details on supported software features for each platform.

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