

H3C S7500X-G Series High-End Multiservice Routing Switch

Performance Evaluation and Feature Validation

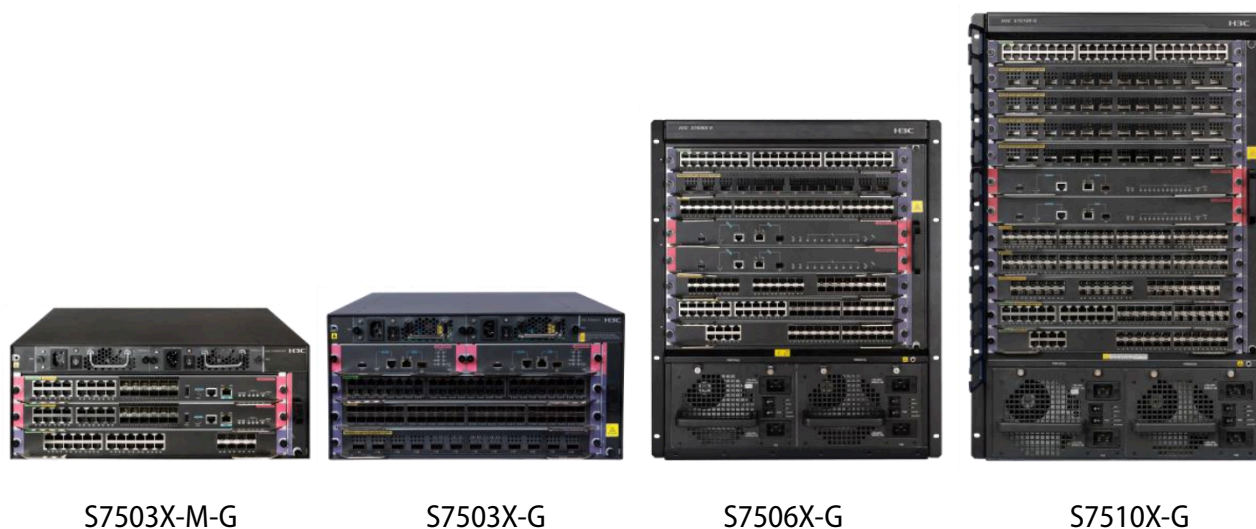
Executive Summary

With the development of cloud computing and campus networks, the gradually increasing scale accelerates requirements of high-performance and feature-rich switches. Core switches need to support comprehensive Ethernet protocols, high bandwidth, high availability features, SDN features, and provide easy-to-use O&M functions. The switches need to guarantee good network service and handle massive network traffic easily.

H3C S7500X-G series is a family of high-end multi service routing switches. They can be used in various network environments such as metropolitan area networks and campus network core and aggregation layers.

H3C commissioned Tolly to evaluate S7500X-G core switch's performance, capacity and features.

H3C S7500X-G Series High-End Multiservice Routing Switches



Source: Tolly, December 2023

Figure 1



Test Results

Tolly engineers tested functions and performance of the H3C S7500X-G series next generation multi service core switch (hereinafter referred to as the S7500X-G). The test data and results in this report are only applicable to products sold outside mainland China. H3C reserves the right to interpret the content. For a summary of the performance test cases, refer to Table 1 to Table 3 on Page 2 to Page 4. For a summary of the feature test cases, refer to Table 4 to Table 6 on Page 8 to Page 10. Test results are as follows.

Performance

Slot Bandwidth

Tolly engineers evaluated the slot bandwidth of each S7500X-G chassis using the RFC2544 test in Spirent TestCenter.

The S7503X-G and S7510X-G chassis each supports 263.4Gbps slot bandwidth for the 64-byte frame size and more than 500Gbps

slot bandwidth for frame sizes of 9216-byte. Please see Table 1 for detailed results.

Line Card Throughput

Tolly engineers evaluated throughput of multiple line cards on the H3C S7500X-G switch chassis using the RFC2544 test in Spirent TestCenter. Please see Table 2 on the next page for detailed results.

Line Card Latency

Tolly engineers evaluated latency between two ports on different line cards of the S7500X-G switch chassis. Please see Table 3 on Page 4 for detailed results.

IRF2

Intelligent Resilient Framework 2.0 (IRF2) is H3C's stacking technology to stack multiple switches into one for management and forwarding with high availability. With link aggregation from the IRF2 members to the uplink or downlink device, traffic is load balanced between the IRF2 members. H3C S7500X-G supports IRF2.

New H3C
Technologies Co.,
Ltd.

S7500X-G Series
Next Generation
Multiservice
Core Switch

Performance
Evaluation and
Feature Validation



Tested
December
2023

The S7500X-G IRF2 stack supports In-Service Software Upgrade (ISSU) with no packet loss to upgrade IRF2 members. ISSU upgrades IRF2 members in sequence. The system automatically switch traffic on one member to the other member before upgrading it.

H3C S7500X-G Series Switch - Slot Bandwidth (Gbps)
(as reported by Spirent TestCenter)

Model	Frame Size 64-Byte	128-Byte	256-Byte	512-Byte	1024-Byte	1280-Byte	1518-Byte	9216-Byte
S7503X-G	263.4	280.1	324.6	458.3	508.4	508.4	514.0	519.5
S7506X-G	246.7	280.1	307.9	330.2	341.3	341.3	341.3	346.9
S7510X-G	263.4	280.1	324.6	458.3	491.7	497.3	497.3	508.4

Note: On each model, two line cards (each has 8*40GE ports + 4*100GE ports) are used to forward traffic with all ports in two cross-board snake topology (40GE ports are in one snake topology and 100GE ports are in another snake topology. For the 40GE snake topology: TestCenter port 1—> slot A port 1 —> slot B port 1 —> slot A port 2 —> slot B port 2 —> slot A port 3 ... slot A port 8—> slot B port 8 —> TestCenter port 2. The 100GE snake topology is in a similar way) with bidirectional traffic. 519.5Gbps slot bandwidth means the slot can support 519.5Gbps throughput on each direction with 1.039Tbps aggregated throughput. Each model was fully loaded with main processing units (MPUs) and switch fabric units.

Source: Tolly, December 2023

Table 1



H3C S7500X-G Series Switch - Line Card Throughput (Percentage of Line-rate)

Two line cards, bidirectional cross-board traffic
(as reported by Spirent TestCenter)

Line Card	Frame Size	64-Byte	128-Byte	256-Byte	512-Byte	1024-Byte	1280-Byte	1518-Byte	9216-Byte
LSCM2GT48SD0 48*GE		100%	100%	100%	100%	100%	100%	100%	100%
LSCM2GV48SD0 48*GE		100%	100%	100%	100%	100%	100%	100%	100%
LSCM2GP48SD0 48*GE		100%	100%	100%	100%	100%	100%	100%	100%
LSCM2GT24GPTSSD0 44*GE + 4*10GE		73.7%	84.5%	93.0%	98.5%	100.0%	100.0%	100.0%	100.0%
LSCM3QGS8CSSE0 8*40GE + 4*100GE		36.6%	38.9%	45.1%	63.6%	68.3%	69.1%	69.1%	70.6%

Note: Line card performance was tested in the highest pressure scenario with bidirectional cross-board traffic using all ports (for the snake topology of each type of port, TestCenter port 1—> DUT slot A port 1 —> DUT slot B port 1 —> slot A port 2 —> slot B port 2 —> slotA port3 ... slot A port X —> slot B port X —> TestCenter port 2. X is the last port on the line-card.) Traffic was forwarded by both the on-board processor(s) and the switch fabric units.

Source: Tolly, December 2023

Table 2



H3C S7500X-G Series Switch - Line Card Latency (μs)

Port-to-port, LIFO (last-in-first-out) latency type
(as reported by Spirent TestCenter)

Line Card		Frame Size	64-Byte	128-Byte	256-Byte	512-Byte	1024-Byte	1280-Byte	1518-Byte	9216-Byte
LSCM2GT48SD0 48*GE	GE ports		1.333	1.335	1.144	1.148	1.147	1.136	1.167	1.142
LSCM2GV48SD0 48*GE	GE ports		1.410	1.409	1.216	1.216	1.215	1.211	1.242	1.215
LSCM2GP48SD0 48*GE	GE ports		1.209	1.208	0.992	0.999	0.997	0.984	0.995	0.988
LSCM2GT24GPTSSD0 44*GE + 4*10GE	GE ports		1.222	1.226	1.013	1.007	1.006	1.003	1.005	1.004
	10GE ports		0.85	0.847	0.765	0.646	0.67	0.662	0.675	0.668
LSCM2TGS16GP32SD0 32*GE + 16*10GE	GE ports		1.224	1.222	1.028	1.033	1.038	1.021	1.029	1.023
	10GE ports		0.806	0.806	0.722	0.625	0.649	0.64	0.651	0.647
LSCM3TGS48SF0 48*10GE	10GE ports		0.996	1.022	1.011	0.975	0.878	0.894	0.882	0.875
LSCM2YGS32TS16SF0 16*10GE + 32*25GE	10GE ports		0.961	0.986	0.967	0.935	0.836	0.854	0.823	0.832
	25GE ports		0.883	0.898	0.897	0.879	0.736	0.746	0.744	0.74
LSCM3QGS8CSSE0 8*40GE + 4*100GE	40GE ports		0.795	0.794	0.778	0.73	0.67	0.672	0.68	0.7
	100GE ports		0.966	0.93	0.93	0.938	0.961	0.964	0.972	0.999
LSCM3CGS8QS8SF0 8*40GE + 8*100GE	40GE ports		0.827	0.831	0.831	0.822	0.726	0.679	0.677	0.675
	100GE ports		0.867	0.871	0.872	0.868	0.835	0.817	0.799	0.72

Note: 100% line-rate traffic between two ports were used as the test traffic to evaluate the latency between the two ports.

Source: Tolly, December 2023

Table 3

M-LAG

M-LAG virtualizes two switches into an M-LAG system, which connects to the uplink or downlink device through a multi-chassis link aggregation group (M-LAG). It provides high availability as the IRF2 feature. However, it's more suitable for the current VXLAN overlay network. H3C S7500X-G supports DRNI.

The S7500X-G M-LAG supports Graceful Insertion and Removal (GIR) with no packet loss to upgrade M-LAG members. GIR upgrades M-LAG members in sequence. GIR maintenance mode automatically switch traffic on one member to the other member before upgrading it.

MDC

The Multitenant Device Context (MDC) technology can virtualize a physical switch device into multiple logical switches called MDCs. The MDCs work independently. The H3C S7500X-G switch can be virtualized into up to 5 MDCs.

Link Aggregation

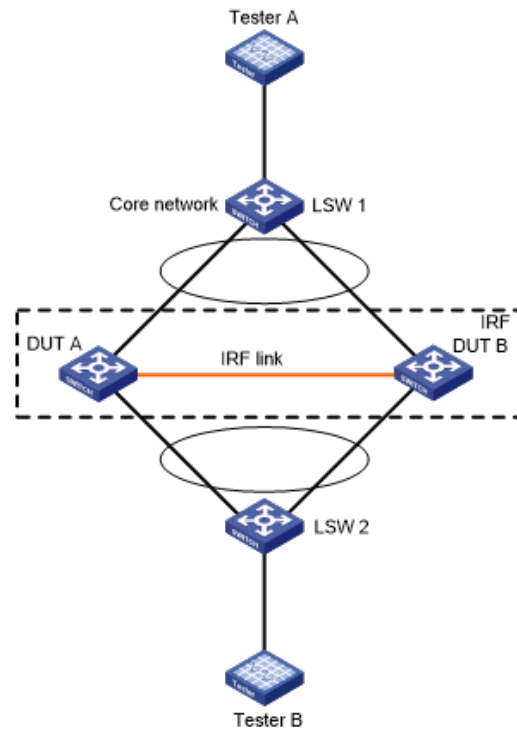
LAG with Load Balancing

H3C S7500X-G supports static link aggregation group (LAG) or dynamic LAG using LACP. The LAG supports load balancing between member links for unicast, multicast and broadcast traffic.

Capacity

H3C S7500X-G supports up to 255 links in a dynamic LAG. Each H3C S7500X-G supports up to 256 link aggregation groups.

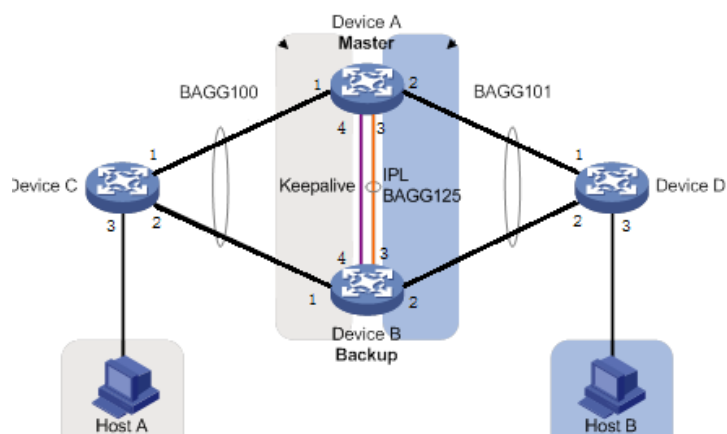
H3C Intelligent Resilient Framework 2.0 (IRF2)



Source: Tolly, December 2023

Figure 2

H3C M-LAG



Source: Tolly, December 2023

Figure 3



VXLAN

Basic VXLAN Functions

H3C S7500X-G supports the VXLAN overlay network which is widely used to build modern campus networks and data center networks.

Tolly engineers verified that H3C S7500X-G can provide Layer 2 and Layer 3 endpoint connectivity over the VXLAN overlay network. It can also provide endpoint connectivity between VXLAN and traditional VLAN (non-VXLAN) networks.

EVPN VXLAN with Distributed Gateways

VXLAN with the BGP-EVPN control plane and distributed gateways is the most popular VXLAN implementation with many advantages including high scalability and easy deployment. H3C S7500X-G supports EVPN VXLAN with distributed gateways.

S7500X-G also supports centralized L3 gateway for traditional VXLAN deployment.

VXLAN Capacity

H3C S7500X-G supports 8,188 virtual switch instances (VSI). Each VSI has one unique VXLAN network identifier (VNI) which works like the VLAN ID in VLAN network.

H3C S7500X-G supports 4,094 IPv4 VXLAN tunnels. It supports 2,048 IPv6 VXLAN tunnels.

VXLAN OAM

H3C S7500X-G supports VXLAN Ping and VXLAN Tracer to VXLAN tunnel destination (loopback interface) address for VXLAN operations, administration, and maintenance (OAM).

MPLS

MPLS VPN

H3C S7500X-G supports MPLS L2VPN (point-to-point), MPLS VPLS (point-to-multipoint L2VPN), and MPLS L3VPN.

MPLS MCE

MPLS Multi-VPN-Instance Customer Edge (MPLS MCE) enables a switch to function as the CE of multiple VPN instances in a BGP/MPLS VPN network to reduce equipment investment. H3C S7500X-G supports MPLS MCE.

BFD

H3C S7500X-G supports hardware-based IPv4/IPv6 bidirectional forwarding detection (BFD) with 3ms minimum sending interval.

In the BFD for OSPF/OSPFv3 fast re-route (FRR) test, the traffic failover time was less than 15ms.

Routing

Routing Protocols

H3C S7500X-G supports RIP, OSPF, IS-IS and BGP IPv4 routing protocols.

H3C S7500X-G also supports RIPng, OSPFv3, IS-IS for IPv6, and BGP4+ IPv6 routing protocols.

Graceful Restart (GR)

H3C S7500X-G supports graceful restart for IPv4 routing protocols including RIP, OSPF, IS-IS and BGP.

H3C S7500X-G also supports graceful restart for IPv6 routing protocols including RIPng, OSPFv3, IS-IS for IPv6, and BGP4+.

In a Layer 3 network with any of the routing protocols mentioned above, Tolly engineers verified that there was no packet loss when the active Main Processing Unit (MPU) on the S7500X-G switch failed.

Non-stop Routing (NSR)

H3C S7500X-G supports non-stop routing for IPv4 routing protocols including RIP, OSPF, IS-IS and BGP.

H3C S7500X-G also supports non-stop routing for IPv6 routing protocols including RIPng, OSPFv3, IS-IS for IPv6, and BGP4+.

In a Layer 3 network with any of the routing protocols mentioned above, Tolly engineers verified that there was no packet loss when the active Main Processing Unit (MPU) on the S7500X-G switch failed.

The difference between GR and NSR is that GR can only work properly when the device neighbors also support GR. NSR does not have this requirement.

O&M

Telemetry

H3C S7500X-G supports real-time and high performance gRPC-based Telemetry for network monitoring (e.g. device hardware and traffic statistics.)

INT

H3C S7500X-G supports Inband Network Telemetry (INT) which can be used to monitor device latency for each flow.

PTP

H3C S7500X-G can work as the Precision Time Protocol (PTP) server or client. It supports 1588v2, 802.1AS, SMPTE 2059, and AES67 standards.



iNQA

H3C S7500X-G supports Intelligent Network Quality Analyzer (iNQA) which uses the actual service packets to directly measure packet loss and latency in large-scale IP network.

OpenFlow

H3C S7500X-G supports OpenFlow to forward traffic according to the flow table.

High Availability

RRPP

H3C S7500X-G supports Rapid Ring Protection Protocol (RRPP) with less than 10ms failover time.

ERPS

H3C S7500X-G supports Ethernet Ring Protection Switching (ERPS) with less than 20ms failover time.

PVST

H3C S7500X-G supports Per VLAN Spanning Tree (PVST) with less than 10ms failover time.

DCB

DCBX, PFC and ETS

H3C S7500X-G supports Data Center Bridging Exchange (DCBX), Priority-based Flow Control (PFC) and Enhanced Transmission Selection (ETS) for a lossless data center network.

Security

Microsegmentation

The microsegmentation feature, also called group-based security segregation, controls traffic based on groups the traffic assigned to. For example, administrators can group endpoints based on specific criteria and apply traffic control policies such as policy-based routing, QoS, or packet filtering to different groups. H3C S7500X-G supports microsegmentation.

MACsec

H3C S7500X-G supports 256-bit MACsec to encrypt Layer 2 traffic for security.

Secure Boot

H3C S7500X-G supports secure boot to validate boot files including the btw file, the boot.bin file, the system.bin file and the ipe file. The device cannot boot with any illegal boot file.

When the device cannot boot from the main boot file, it automatically uses the backup boot file to boot.

Firewall Card

H3C S7500X-G supports the firewall card in the switch slot. The firewall card uses four 10GE ports to connect to the switch chassis backplane. It works as an independent firewall device.

Other Features

Integrated Wireless AC

H3C S7500X-G integrates wireless access controller functions. It can manage up to 1,024 wireless Access Points (APs) and configure the WLAN services. It supports 8K

(8,192) concurrent online wireless clients (STAs).

802.3az EEE Power Saving

H3C S7500X-G supports 802.3az EEE to save power consumption of the idle ports.

Capacity

MAC Table

H3C S7500X-G supports up to 720,896 MAC addresses in the MAC table. Tolly engineers verified that the switch forwarded traffic matching all entries in the MAC table, without frame loss or broadcasts occurring.

MAC Learning Rate

H3C S7500X-G supports learning up to 7,700 MAC addresses per second to the MAC table.

ARP Table

H3C S7500X-G supports up to 96,230 ARP entries in the ARP table. Tolly engineers verified that the switch forwarded traffic matching all entries in its ARP table, without any packet loss.

ND Table

H3C S7500X-G supports up to 81,350 ND entries in the ND table. Tolly engineers verified that the switch forwarded traffic matching all entries in its ND table, without any packet loss.

FIBv4

H3C S7500X-G supports up to 780,288 IPv4 routes in the FIB. Tolly engineers verified that the switch forwarded traffic matching all routing entries in the FIBv4 table, without any packet loss.

**H3C S7500X-G Series Next Generation Multiservice Core Switch****Tolly Verified Features - Part 1 of 3**

IRF2		VXLAN	
✓	Intelligent Resilient Framework 2.0 (IRF2) IRF2 is H3C's stacking technology to stack multiple switches into one for management and forwarding	✓	Layer 2 connectivity over the VXLAN overlay network with the same VXLAN Network Identifier (VNI)
✓	Load balancing between IRF2 members With link aggregation from the IRF2 members to the uplink or downlink device, traffic is load balanced between the IRF2 members	✓	Layer 3 connectivity over the VXLAN overlay network with different VNIs
✓	In-Service Software Upgrade (ISSU) No packet loss to upgrade IRF2 members. ISSU upgrades IRF2 members in sequence. The system automatically switch traffic on one member to the other member before upgrading it	✓	Connectivity between VXLAN and traditional VLAN (non-VXLAN) networks
M-LAG		✓	Distributed VXLAN L3 gateway with an IPv4 or IPv6 underlay network
✓	M-LAG Multi-chassis Link Aggregation Group (M-LAG) virtualizes two switches into an M-LAG system, which connects to the uplink or downlink device through a multichassis aggregate link group	✓	Centralized VXLAN L3 gateway with an IPv4 or IPv6 underlay network
✓	Graceful Insertion and Removal (GIR) No packet loss to upgrade DRNI members. GIR upgrades DRNI members in sequence. GIR maintenance mode automatically switch traffic on one member to the other member before upgrading it	✓	EVPN VXLAN Widely used modern network architecture. VXLAN with the BGP EVPN control plane
MDC		✓	VXLAN instance capacity: 8,188 Virtual Switch Instances (VSI) Each VSI has one unique VXLAN Network Identifier (VNI)
✓	Multitenant Device Context (MDC) - up to 5 MDCs		
Link Aggregation		✓	VXLAN tunnel capacity: 4,094 IPv4 VXLAN tunnels 2,048 IPv6 VXLAN tunnels
✓	Static Link Aggregation Group (LAG)		
✓	Dynamic Link Aggregation Group (LAG) with LACP	✓	VXLAN OAM VXLAN Ping and VXLAN Tracert to VXLAN tunnel destination (loopback interface) address for VXLAN operations, administration, and maintenance (OAM)
✓	Load Balancing for unicast, multicast and broadcast traffic with either the static LAG or dynamic LAG		
✓	LAG member capacity: 255 links in a LAG		
✓	LAG capacity: 256 link aggregation groups		

Source: Tolly, December 2023

Table 4



H3C S7500X-G Series Next Generation Multiservice Core Switch

Tolly Verified Features - Part 2 of 3

MPLS		O&M	
✓	MPLS L2VPN Point-to-point L2VPN	✓	Telemetry Real-time and high performance gRPC-based Telemetry for network monitoring (e.g. device hardware and traffic statistics)
✓	MPLS VPLS Point-to-multipoint L2VPN	✓	Inband Network Telemetry (INT) Can be used to monitor device latency for each flow
✓	MPLS L3VPN	✓	Precision Time Protocol (PTP) server and client 1588v2, 802.1AS, SMPTE 2059, and AES67 standards
✓	MPLS MCE MPLS Multi-VPN-Instance Customer Edge (MPLS MCE) enables a switch to function as the CE of multiple VPN instances in a BGP/MPLS VPN network to reduce equipment investment	✓	iNQA Intelligent Network Quality Analyzer (iNQA) uses the actual service packets to directly measure packet loss and latency in large-scale IP network
BFD		OpenFlow	
✓	Hardware-based IPv4/IPv6 BFD with 3ms BFD sending interval Less than 15ms BFD for OSPF/OSPFv3 FRR traffic failover	✓	OpenFlow Forwarding traffic with the flow table
Routing		High Availability	
✓	IPv4 routing protocols: RIP, OSPF, IS-IS, BGP	✓	Rapid Ring Protection Protocol (RRPP) Less than 10ms failover time
✓	IPv6 routing protocols: RIPng, OSPFv3, IS-IS for IPv6, BGP4+	✓	Ethernet Ring Protection Switching (ERPS) Less than 20ms failover time
✓	Graceful Restart (GR) IPv4: RIP GR, OSPF GR, IS-IS GR, BGP GR IPv6: RIPng GR, OSPFv3 GR, IS-IS for IPv6 GR, BGP4+ GR 0 packet loss when the active Main Processing Unit (MPU) failed on the H3C S7500X-G switch chassis	✓	Per VLAN Spanning Tree (PVST) Less than 10ms failover time
✓	Non-stop Routing (NSR) IPv4: RIP NSR, OSPF NSR, IS-IS NSR, BGP NSR IPv6: RIPng NSR, OSPFv3 NSR, IS-IS for IPv6 NSR, BGP4+ NSR 0 packet loss when the active Main Processing Unit (MPU) failed on the H3C S7500X-G switch chassis		

Source: Tolly, December 2023

Table 5



FIBv4 Learning Rate

H3C S7500X-G supports learning up to 69,800 IPv4 routes per second to the FIB.

FIBv6

H3C S7500X-G supports up to 278,528 (272K) IPv6 routes in the FIB. Tolly engineers verified that the switch forwarded traffic matching all routing entries in the FIBv6 table, without any packet loss.

FIBv6 Learning Rate

H3C S7500X-G supports learning up to 4,500 IPv6 routes per second to the FIB.

H3C S7500X-G Series Next Generation Multiservice Core Switch Tolly Verified Features - Part 3 of 3

DCB		Capacity	
✓	DCBX, PFC and ETS Data Center Bridging Exchange (DCBX), Priority-based Flow Control (PFC) and Enhanced Transmission Selection (ETS)	✓	MAC table: 720,896 MAC addresses
Security		✓	MAC learning rate: 7,700 MAC addresses per second
✓	Microsegmentation	✓	ARP table: 96,230 ARP entries
✓	256-bit MACsec	✓	ND table: 81,350 ND entries
✓	Secure boot	✓	IPv4 FIB: 780,288 routes
✓	Firewall card	✓	IPv4 FIB learning rate: 69,800 routes per second
Other Features		✓	IPv6 FIB: 278,528 (272K) routes
✓	Integrated Wireless Access Controller Manages 1,024 wireless Access Points (APs); supports 8K (8,192) concurrent online wireless clients (STAs)	✓	IPv6 FIB learning rate: 4,500 routes per second
✓	802.3az (EEE) power saving		

Note: Different line-cards may have different capacities and the switch supports multiple modes. Please contact H3C for detailed capacity of any specific line card in different modes.

Source: Tolly, December 2023

Table 6



About Tolly

The Tolly Group companies have been delivering world-class ICT services for over 30 years. Tolly is a leading global provider of third-party validation services for vendors of ICT products, components and services.

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Learn More About H3C

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