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**GOVERNMENT OF INDIA MINISTRY OF RAILWAY**



सत्यमेव जयते

**RESEARCH DESIGNS & STANDARDS ORGANISATION**  
Manak Nagar, LUCKNOW-226011

**RDSO/SPN/TC/83/2020, Revision 2.1**

**SPECIFICATION**

**FOR**

**LAN SWITCH**

**ISSUED BY**  
**SIGNAL & TELECOM DIRECTORATE**

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## DOCUMENT DATA SHEET

Specification	RDSO/SPN/TC/83/2020
Revision	2.1
Title of Document	RDSO Specification For LAN Switch
Author	Executive Director/Telecom-I/RDSO
Approved by	Principle Executive Director/Signal & Telecom/RDSO

## Abstract

This document specifies technical specification of LAN Switch for IT applications in Indian Railways.

## DOCUMENT CONTROL SHEET

Designation	Organization	Function	Level	Signature
SSE/Telecom	RDSO	Member	Assist/Prepare	<i>Rani</i>
ADE/Telecom	RDSO	Member	Assist/Prepare, Check	<i>Ade</i>
ED/ Telecom-I	RDSO	Member Secretary	Prepare, Review, Issue	<i>ED</i>
PED/S&T	RDSO	Approving Authority	Approve	

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## Amendment History:

S.N.	Amendment Date	Version/Revision	Reason for Amendment
1.	August 2008	RDSO/SPN/TC/ 83/2008	First Issue
2.	March 2014	RDSO/SPN/TC/ 83/2014, Rev. 1.0	Revised
3.	February 2021	RDSO/SPN/TC/ 83/2020, Rev. 2.0	Revised
4.	25.10.2022	RDSO/SPN/TC/ 83/2020, Rev. 2.1	Correction of typographical error in Cl. No. 7.4. Approved by PED/S&T at Note#16 of Subject e-file.

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**I. SUMMARY:**

This document covers the technical requirements of LAN Switches for IT applications specifically for UTS & PRS applications for Indian Railways.

**II. SOURCE:**

1. Specification RDSO/ SPN/ TC/ 83 /2008, Rev 0.0 have been prepared by RDSO, Lucknow as per Railway Board letter No. 2006/Tele/TC/1 dated 28/07/2008.
2. Revision 1.0 of the specification RDSO/ SPN/ TC/ 83 /2014, Rev 1.0 have been prepared by RDSO, Lucknow as per Railway Board letter No. 2010/Tele/9(3)/1, dated 15.03.2012
3. Revision 2.0 of the specification RDSO/ SPN/TC/83/2020, Rev 2.0 have been prepared by RDSO, Lucknow as per DG/RDSO letter No. DG/Misc. dated 10.06.2020.
4. Revision 2.1 of the specification RDSO/ SPN/TC/83/2020 is issued for correction of typographical error in Cl. No. 7.4.

## RESEARCH DESIGNS & STANDARDS ORGANIZATION

MINISTRY OF RAILWAYS  
MANAK NAGAR, LUCKNOW

### Specification of LAN Switch

Specification No: RDSO/SPN/TC/83/2020 (Revision 2.1)

#### 1.0 INTRODUCTION:

- 1.1 This specification lays down the technical requirements for the Local Area Network (LAN) Switches used for LAN connection applications in the Indian Railways network. The LAN switch shall be used in Internet / Intranet as mechanism for allowing interconnection of servers, clients, RAS, Routers and other devices used in the Internet, Intranet, PRS, UTS, FOIS, COIS and other applications environments in Indian Railways.
- 1.2 A LAN switch is a local area networking device operating at Layer 1 through Layer 2 and Layer 3 of the seven layer ISO-OSI model. The basic function of a LAN switch is to forward packets from one port to another.
- 1.3 In the path determination function, a switch creates dynamic tables based on addresses learnt on the network. The creation and dynamic update of this switching table is part of the intelligence of the switch. Since the switching occurs in the hardware using Application Specific Integrated Circuits (ASICs), the latency of a switch shall be very low as compared to shared media repeaters.
- 1.4 LAN Switch shall be categorized in Two type based upon features and redundancy requirements as follows:

Type	Category	Network Application
Layer 3 Type	Core Switch Layer 3 (48 ports)	Suitable for Higher Density network
	Layer 3 Switch (24 ports)	Suitable for Normal network
Layer 2 Type	Layer 2 Switch 24 Ports	Suitable for Intermediate Connectivity
	Layer 2 Switch 8 Ports	Suitable for End Locations

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## 2.0 GENERAL REQUIREMENTS:

- 2.1 The LAN switch shall be fully solid state and adopt state of the art technology.
- 2.2 The LAN switch shall be compact, composite construction and lightweight. The actual dimension and weight of the equipment shall be furnished by the manufactures.
- 2.3 All connectors shall be reliable, low loss and standard type so as to ensure failure free operations over long operations.
- 2.4 All cables shall be of Gigabit Ethernet ready standards.
- 2.5 The LAN switch shall have adequate cooling arrangements.
- 2.6 Each sub-assembly shall be clearly marked with schematic reference to show its function, so that it is identifiable from the layout diagram in the handbook.
- 2.7 Each terminal block and individual tags shall be numbered suitably with clear identification code and shall correspond to the associated wiring their circuit diagrams and functions.
- 2.8 The LAN switch shall be designed for continuous operation. The manufacturer shall furnish the MTBF (Mean Time Between Failure) and MTRR (Mean Time to Restore) predicted and observed values along with calculations.
- 2.9 Suitable visual indications for healthy, unhealthy conditions and for non-urgent alarms shall be provided.
- 2.10 The design of the equipment shall not allow plugging of a module in a wrong slot or upside down.
- 2.11 The removal or addition of any interface cards shall not disrupt traffic on other cards.
- 2.12 In the event of a nig found in the software, the manufacturer shall provide patches and firmware replacement if involved, free of cost. Compatibility of the existing hardware shall be maintained with future software/firmware.
- 2.13 In the event of a full systems failure, a trace area shall be maintained in non-volatile memory for analysis and problem resolution.
- 2.14 Necessary alarms (indicators) for indication of faults at various levels of hardware shall be provided on the individual modules. Remote monitoring through NMS shall also be provided.
- 2.15 A power down condition shall not cause loss of connection configuration data storage.

- 2.16 The Hardware and software components shall not pose any problems in the normal functioning of all network elements wherever interfacing with Indian Railways network for voice, data and transmission systems, as the case shall be.
- 2.17 The system hardware / software shall not pose any problem, due to changes in date and time caused by events such as changeover of millennium / century, leap year etc., in the normal functioning of the system.
- 2.18 The LAN switch shall be protected in case of voltage variation beyond the range specified and also against input reverse polarity.

2.19 The switch shall be capable of working with AC Power Supply arrangement without any external adaptors with redundancy power supply: AC power supplies 110 - 240 V AC at 50Hz +/-2 Hz.

2.20 Core Switch should support Operation Temperature from 0°C to 40 °C and Rest all Switch should support Operation Temperature from 0°C to 50 °C.

The equipment's shall be able to work in the temperature range and humidity as specified in the corresponding clauses of the specification. Purchaser may specify any other temperature requirement and humidity as per site requirement.

2.21 Switch should be supplied with the all necessary hardware accessories like Power cord, Rack-mount bracket, Installation Guide, etc. and necessary software image file to fulfill all above mention feature set from day 1.

2.22 It should have safety certificates as per UL/IEC/EN 60950.

2.23 The supplier / manufacturer shall manufacture the equipment locally in India with international quality standards ISO 9001 for which the manufacturer shall be duly accredited. The quality plan describing the quality assurance system followed by the manufacturer shall be submitted.

**3.0 Core Switch Layer 3 (48 ports) suitable for Higher Density network:**

**3.1 Physical Specification:**

3.1.1 The Core Switch shall be rack mountable with the following ports:

48 Nos. 1G/10G SFP+, 4 Nos. 40G/100G QSFP 28 interfaces data center switch.

OR,

48-port 1G/10GBase-T, 4-port 40G/100G QSFP28 interfaces data center switch.



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### 3.2 General Specification:

- 3.2.1 The Core Switch shall be available with minimum 1.76 Tbps Switch Fabric.
  - 3.2.2 The Core Switch shall have minimum packet forwarding rate of 1309.44 million packets per second.
  - 3.2.3 The Core Switch shall support minimum 82K MAC address.
  - 3.2.4 The Core Switch shall support 16000 Unicast routes, 1000 static IP multicast route (IPv6/IPv4) and multicast groups.
  - 3.2.5 The switch should be stackable with physical stacking or Virtual Switching System (VSS) or Equivalent technology. For stacking the switches shall be either dedicated stack ports or Ethernet uplink ports.
  - 3.2.6 The switch shall have dual hot-pluggable redundant power supply (RPS) module. The Switch should have min 2 AC PSUs and support AC & DC modular power supply. The switch should not undergo reboot (no downtime) while adding/removing of redundant power supply.
  - 3.2.7 The switch shall be able to work on both IPv4 and IPv6 (dual stack) and OpenFlow or equivalent software defined networking (SDN) protocol (like Netconf etc) support from day one.
  - 3.2.8 All ports in the switch shall operate at wire-speed / line-rate.
  - 3.2.9 It shall have hot swappable fan tray.
  - 3.2.9 The Switch shall support 19 inch rack mounting.
- ### 3.3 Layer-2 Features:
- 3.3.1 The Core switch shall support IEEE 802.1Q Virtual Local Area Network (VLAN) (L2 and L3 level) up to 255 Active VLANs and 4094 VLAN ID.
  - 3.3.2 It shall support for Automatic Negotiation of link speed and duplex to help minimize the configuration & errors.
  - 3.3.3 It shall support centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the other switches automatically, thus reducing the overhead of creating / modifying / deleting VLANs in all the switches in turn eliminating the configuration errors & troubleshooting. It shall support Generic VLAN Registration

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Protocol (GVRP)/ VTP or any other industry standard protocol for VLAN pruning and management.

- 3.3.4 It shall support edge port in STP/RSTP/MSTP mode and Ethernet Ring Protection Switching (ERPS) (ITU-T G.8032) or Equivalent.
- 3.3.5 It shall support Port-spanning functionality for measurements using a network analyzer.
- 3.3.6 It shall support 802.1d, 802.1p, 802.1Q, 802.1s, 802.1w, 802.1x, 802.1ab, 802.3ad.
- 3.3.7 It shall support spanning-tree root guard to prevent other edge switches becoming the root bridge.
- 3.3.8 It shall support Internet Group Management Protocol (IGMP) v1, v2 & v3 as well as IGMP v1, v2 & v3 snooping.
- 3.3.9 It shall support Link Aggregation Protocol (LACP).
- 3.3.10 It shall support Detection of Unidirectional Links and to disable them to avoid problems such as spanning-tree loops and shall support Unidirectional Link Detection (UDLD) or any other industry equivalent protocol for unidirectional link detection.
- 3.3.11 It shall support configurable Maximum Transmission Unit (MTU) of up to 9K bytes, with a maximum Ethernet frame size of 9K bytes (Jumbo frames) for bridging on Gigabit Ethernet ports.
- 3.3.12 It shall be able to discover the neighboring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems. It shall support Link Layer Discovery Protocol (LLDP) or LLDP-MED for network discovery.
- 3.3.13 It shall support Multicast VLAN registration.
- 3.3.14 It shall Support Optical Transceiver Digital Diagnostic Monitoring and Support link layer remote loopback and discovery, Loopback Detection (LBD) and Switch should support layer remote loopback and discovery or any other industry equivalent protocol.
- 3.3.15 It shall support for Cross Stack Uplink Fast or equivalent technology to provide for sub second failover.
- 3.3.16 The switch shall support at least 64 Spanning Tree Protocol (STP) instances.

#### 3.4 Layer-3 Features:

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- 3.4.1 The Core Switch shall have Hot Standby Router Protocol (HSRP)/Virtual Router Redundancy Protocol (VRRP).
- 3.4.2 The Core Switch shall support IP unicast routing protocols (static, Routing Information Protocol (RIP) v1, and Open shortest path First (OSPF)). It shall support IP unicast routing for full layer3 routing between 2 or more VLANs.
- 3.4.3 It shall support for Border Gateway Protocol (BGP), Virtual Routing Forwarding (VRF), BGP L3 VPN, MP-BGP, BGP v4/v4, IS-IS, IS-ISv6.
- 3.4.4 It shall support Policy-Based Routing (PBR). Bidirectional Forwarding Detection (BFD), IP Directed Broadcast.
- 3.4.5 It shall support for IP unicast routing capability (static, RIPv1, RIPv2 and OSPFv3 protocols) to forward IP traffic through configured interfaces.
- 3.4.6 It shall support for Protocol Independent Multicast (PIM) for IP Multicast routing, including PIM sparse mode (PIM-SM), PIM dense mode (PIM-DM), and PIM sparse-dense mode.
- 3.4.7 It shall support for Multicast VLAN registration (MVR) to continuously send multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs for bandwidth and security reasons.
- 3.4.8 The switch should support IPv6 routing in hardware including RIPv6, and RFC2740 for OSPF for IPv6.
- 3.5 **Quality of Service (QoS) Features:**
- 3.5.1 The Core Switch shall support classification and scheduling as per IEEE 802.1P on all ports. It shall support classification and marking based on IP type of Service (TOS) and Differentiated Services Code Point (DSCP).
- 3.5.2 It shall have supports QoS Flow Actions, Remark 802.1p priority tag, TOS/DSCP tag, Bandwidth Control and Three Color Marker.
- 3.5.3 There shall be no performance penalty for highly granular QoS functions.
- 3.5.4 There shall be four egress queues per port to enable differentiated management of up to four traffic types across the stack.
- 3.5.5 There shall be Weighted Random Early Detection (WRED) to provide congestion avoidance or other industry standard protocol.

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- 3.5.6 It shall support strict priority queuing mechanisms.
- 3.5.7 The Core Switch shall provide traffic shaping and rate limiting features (for egress as well as ingress traffic) for specified Host, network, applications etc.
- 3.5.8 Rate limiting support based on source and destination IP address, source and destination MAC address, Layer 4 TCP and UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps shall be available.
- 3.5.9 There shall be support for Asynchronous data flows upstream and downstream from the end station or on the uplink using ingress policing and egress shaping.
- 3.5.10 Up to link aggregate or individual policers or QoS Access Control list (ACL) or parent and child policers or any other industry equivalent protocol for per Fast Ethernet or Gigabit Ethernet port shall be available.
- 3.5.11 It shall have supports L2/L3/L4 QoS/CoS solutions help ensure that critical network services such as VoIP, ERP, Intranet, and video conferencing are served with proper priority.
- 3.5.12 It shall support QoS configuration on per switch port basis.
- 3.6 **Network Security Features:**
- 3.6.1 The Core Switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
- 3.6.2 The Core Switch shall support for Admission Control features to improve the network's ability to automatically identify, prevent, and respond to security threats and also to enable the switches to collaborate with third-party solutions for security-policy compliance and enforcement before a host is permitted to access the network.
- 3.6.3 It shall support VLAN ACLs (VACLs) on all VLANs to prevent unauthorized data flows from being bridged within VLANs. It shall also support port-based ACLs (PACLs) for Layer 2 interfaces to allow application of security policies on individual switch ports.
- 3.6.4 It shall support MAC Address based filters / Access Control Lists (ACLs) on all switch ports. Shall support Filters/ACLs based on Network Address, Mask, Protocol Type & Socket Type on all switch ports.

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- 3.6.5 It shall support unicast MAC filtering to prevent the forwarding of any type of packet with a matching MAC address. Switch shall support per port broadcast, multicast & unicast storm control to prevent degradation of overall system performance occurred due to faulty end equipment.
- 3.6.6 It shall support unknown unicast and multicast port blocking to allow tight control by filtering packets that the switch has not already learned how to forward.
- 3.6.7 It shall have support for SSHv2 and Simple Management Network Protocol (SNMP) v3 to provide network security by encrypting administrator traffic during Telnet, SSH and SNMP sessions.
- 3.6.8 It shall support private VLAN to provide security and isolation between switch ports to ensure that users cannot snoop on other users' traffic.
- 3.6.9 It shall support Port Mirroring based on port basis / VLAN basis to support intrusion prevention system deployment in different VLANs.
- 3.6.10 It shall support dynamic Arp and Dynamic Host Control Protocol (DHCP) snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.
- 3.6.11 IP source guard shall be available to prevent a malicious user from spoofing or taking over another user's IP address by creating a binding table between client's IP and MAC address, port, and VLAN.
- 3.6.12 It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
- 3.6.13 It shall support MAC address notification to allow administrators to be notified of users added to or removed from the network.
- 3.6.14 It shall support DHCP Interface Tracker (Option 82) to augment a host IP address request with the switch port ID.
- 3.6.15 It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port.

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- 3.6.16 It shall support multilevel security on console access to prevent unauthorized users from altering the switch configuration.
- 3.6.17 It shall support Bridge Protocol data Unit (BPDU) Guard feature, to shut down Spanning Tree Protocol Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.
- 3.6.18 It shall support spanning-Tree Root Guard (STRG) to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes or any other industry standard method/protocol.
- 3.6.19 It shall have support for min. 4000 access control entries (ACEs).
- 3.7 Management:
- 3.7.1 The Core Switch shall have CLI support to provide a common user interface and command set with all routers and switches of the same vendor.
- 3.7.2 It shall have Remote Monitoring (RMON) software agent to support four RMON groups (history, statistics, alarms, and events) or Flexible Netflow (FNF)/ equivalent, Telemetry/SNMP Polling of data for enhanced traffic management, monitoring, and analysis.
- 3.7.3 It shall have Layer 2 trace route to ease troubleshooting by identifying the physical path that a packet takes from source to destination and All ports should support IP-MAC-Port Binding (IMPB)
- 3.7.4 It shall have Domain Name System (DNS) client, relay support for IPv4/IPv6.
- 3.7.5 It shall support Trivial File Transfer Protocol (TFTP) / File Transfers Protocol (FTP) to reduce the cost of administering software upgrades by downloading from a centralized location.
- 3.7.6 It shall support Simple Network Timing Protocol (SNTP) / Network Timing Protocol (NTP) to provide an accurate and consistent time stamp to all intranet switches.
- 3.7.7 It shall support RMON v1 and v2 standards.
- 3.7.8 It shall support SNMPv1, SNMPv2, and SNMPv3 and Telnet interface to deliver comprehensive in-band management, and a CLI-based management console to provide

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detailed out-of-band management. It shall support NETCONF / YANG / Sflow modelling for software defined networking.

- 3.7.9 It shall have a console port with RS-232/RJ-45 interface for configuration & diagnostic purpose.
- 3.7.10 It shall support all the standard Management Information Base (MIBs) (MIB-I & II).
- 3.7.11 It shall support Telnet & SSH V-2 for command line management.
- 3.7.12 It shall support System & Event logging function as well as forwarding these logs onto a separate server for log management.
- 3.7.13 The Core Switch shall support online software reconfiguration to implement changes without rebooting. For any changes in configuration of switches related to L-2 & 3 functions, VLAN, STP, Security, QoS or firmware, rebooting the switch may be allowed.
- 3.7.14 It shall have comprehensive debugging features required for software & hardware fault diagnosis. Switch should support Dying Gasp for quick trouble shooting during power failures or system shut downs.
- 3.7.15 It shall support multiple privilege levels to provide different levels of access on console port & telnet sessions.
- 3.7.16 It shall support following user level access, i.e. the user with minimum privileges: PING, TELNET, L3 TRACEROUTE, L2 Traceroute Display of preconfigured description/label on each interface, Display of Input & output error statistics on all interfaces, Display of Dynamic ARP table, Display of MAC Address table & Display of Routing Table.

#### 4.0 LAYER 3 SWITCH (24 Ports) SUITABLE FOR NORMAL NETWORK:

##### 4.1 Physical Specification:

- 4.1.1 The LAN switch shall be rack mountable with the following ports:

24 Nos. 10/100/1000 Base-T ports and 4 Nos. SFP+ ports.

OR,

24 Nos. SFP ports with and 4 Nos. SFP+ ports.

OR,

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24 Nos. 10/100/1000BASE-T PoE+ ports and 4 Nos. SFP+ ports. 370W PoE Budget from Day 1 and potential to be expanded to 740 watts.

#### 4.2 General Specification:

- 4.2.1 The LAN switch shall be available with minimum 128 Gbps Switch Fabric.
- 4.2.2 The LAN switch shall have minimum packet forwarding rate of 95.24 million packets per second at 64-byte packet length.
- 4.2.3 The LAN switch shall support minimum 32K MAC address.
- 4.2.4 The LAN switch shall support 11000 Unicast routes, 1000 IGMP and multicast groups.
- 4.2.5 The switch should be stackable with a minimum stacking bandwidth of atleast 80 Gbps. It should support stacking of atleast 4 units or higher or Virtual Switching System (VSS) or Equivalent technology. For stacking the switches shall be either dedicated stack ports or Ethernet uplink ports.
- 4.2.6 The switch shall have dual redundant power supply (RPS) module. The Switch should have min 2 AC PSUs and support AC & DC modular power supply
- 4.2.7 The switch shall be able to work on both IPv4 and IPv6 (dual stack) from day one.
- 4.2.8 All ports in the switch shall operate at wire-speed / line-rate.
- 4.2.9 The switch shall support 19 inch rack mounting.
- 4.2.10 The LAN Switch should support IEEE 802.1ag/ITU-T Y.1731 Service Operations Administration and Maintenance (OAM).
- #### 4.3 Layer-2 Features:
- 4.3.1 The LAN switch shall support IEEE 802.1Q VLAN (L2 and L3 level) up to 255 Active VLANs and 4094 VLAN ID.
- 4.3.2 It shall support for Automatic Negotiation of link speed and duplex to help minimize the configuration & errors.
- 4.3.3 It shall support centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the other switches automatically, thus reducing the overhead of creating / modifying / deleting VLANs in all the switches in turn eliminating the configuration errors & troubleshooting. It shall support GVRP or any other industry standard protocol for VLAN pruning and management.



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- 4.3.4 It shall support edge port in STP/RSTP/MSTP mode and Ethernet Ring Protection Switching (ERPS) (ITU-T G.8032) or Equivalent.
- 4.3.5 It shall support Port-spanning functionality for measurements using a network analyzer.
- 4.3.6 It shall support 802.1d, 802.1p, 802.1Q, 802.1s, 802.1w, 802.1x, 802.1ab, 802.3ad.
- 4.3.7 It shall support spanning-tree root guard to prevent other edge switches becoming the root bridge.
- 4.3.8 It shall support IGMP v1, v2 & v3 as well as IGMP v1, v2 & v3 snooping.
- 4.3.9 It shall support Link Aggregation Protocol (LACP).
- 4.3.10 It shall support Detection of Unidirectional Links and to disable them to avoid problems such as spanning-tree loops and shall support UDLD or any other industry equivalent protocol for unidirectional link detection.
- 4.3.11 It shall support configurable Maximum Transmission Unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames) for bridging on Gigabit Ethernet ports
- 4.3.12 It shall be able to discover the neighboring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems. It shall support LLDP or LLDP-MED for network discovery.
- 4.3.13 It shall support Multicast VLAN registration.
- 4.3.14 It shall Support Optical Transceiver Digital Diagnostic Monitoring and link layer remote loopback and discovery, Loopback Detection (LBD) and Switch should link layer remote loopback and discovery.
- 4.3.15 The switch shall support at least 64 STP instances.
- 4.4 Layer-3 Features:**
- 4.4.1 The LAN switch shall have HSRP/VRRP.
- 4.4.2 The LAN switch shall support IP unicast routing protocols (static, RIPv1, and OSPF). It shall support IP unicast routing for full layer3 routing between 2 or more VLANs.
- 4.4.3 It shall support for advanced routing protocol Border Gateway Protocol Version 4 [BGPv4]) for load balancing and constructing scalable LANs. It shall support BGP+, BGP (support multi-address family).

- 4.4.4 It shall support Policy-Based Routing (PBR), Bidirectional Forwarding Detection (BFD), IP Directed Broadcast.
- 4.4.5 It shall support for IP unicast routing capability (static, RIPv1, RIPv2 and OSPFv3 protocols) to forward IP traffic through configured interfaces.
- 4.4.6 It shall support for Protocol Independent Multicast (PIM) for IP Multicast routing, including PIM sparse mode (PIM-SM), PIM dense mode (PIM-DM), and PIM sparse-dense mode and VRF support.
- 4.4.7 It shall support for Multicast VLAN registration (MVR) to continuously send multicast streams in a multicast VLAN while isolating the streams from subscriber VLANs or Port for bandwidth and security reasons.
- 4.4.8 The switch should support IPv6 routing in hardware including RIPng, and RFC2740 for OSPF for IPv6.
- 4.5 **Quality of Service (QoS) Features:**
  - 4.5.1 The LAN switch shall support classification and scheduling as per IEEE 802.1P on all ports. It shall support classification and marking based on IP type of Service (TOS) and DSCP.
  - 4.5.2 It shall have supports QoS Flow Actions, Remark 802.1p priority tag, TOS/DSCP tag, Bandwidth Control and Three Color Marker.
  - 4.5.3 There shall be no performance penalty for highly granular QoS functions.
  - 4.5.4 There shall be four egress queues per port to enable differentiated management of up to four traffic types across the stack.
  - 4.5.5 There shall be Random Early Detection (WRED) or Shaped Round Robin (SRR) to provide congestion avoidance or other industry standard protocol.
  - 4.5.6 It shall support strict priority queuing mechanisms.
  - 4.5.7 The LAN switch shall provide traffic shaping and rate limiting features (for egress as well as ingress traffic) for specified Host, network, applications etc.
  - 4.5.8 Rate limiting support based on source and destination IP address, source and destination MAC address, Layer 4 TCP and UDP information, or any combination of these fields, using QoS ACLs (IP ACLs or MAC ACLs), class maps, and policy maps shall be available.

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- 4.5.9 There shall be support for Asynchronous data flows upstream and downstream from the end station or on the uplink using ingress policing and egress shaping.
- 4.5.10 Up to link aggregate or individual policers or QoS ACL or parent and child policers or any other industry equivalent protocol for per Fast Ethernet or Gigabit Ethernet port shall be available.
- 4.5.11 It shall have supports L2/L3/L4 QoS/CoS solutions help ensure that critical network services such as VoIP, ERP, Intranet, and video conferencing are served with proper priority.
- 4.5.12 It shall support QoS configuration on per switch port basis.
- 4.6 **Network Security Features:**
- 4.6.1 The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
- 4.6.2 The LAN switch shall support for Admission Control features to improve the network's ability to automatically identify, prevent, and respond to security threats and also to enable the switches to collaborate with third-party solutions for security-policy compliance and enforcement before a host is permitted to access the network.
- 4.6.3 It shall support VLAN ACLs (VACLs) on all VLANs to prevent unauthorized data flows from being bridged within VLANs. It shall also support port-based ACLs (PACLs) for Layer 2 interfaces to allow application of security policies on individual switch ports.
- 4.6.4 It shall support MAC Address based filters / Access Control Lists (ACLs) on all switch ports. Shall support Filters/ACLs based on Network Address, Mask, Protocol Type on all switch ports.
- 4.6.5 It shall support unicast MAC filtering to prevent the forwarding of any type of packet with a matching MAC address. Switch shall support per port broadcast, multicast & unicast storm control to prevent degradation of overall system performance occurred due to faulty end equipment.
- 4.6.6 It shall support unknown unicast and multicast port blocking to allow tight control by filtering packets that the switch has not already learned how to forward.
- 4.6.7 It shall have support for SSHv2 and SNMPv3 to provide network security by encrypting administrator traffic during Telnet, SSH and SNMP sessions.
- 4.6.8 It shall support private VLAN to provide security and isolation between switch ports to ensure that users cannot snoop on other users' traffic.

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- 4.6.9 It shall support Port Mirroring based on port basis / VLAN basis to support intrusion prevention system deployment in different VLANs.
- 4.6.10 It shall support dynamic Arp and DHCP snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.
- 4.6.11 IP source guard shall be available to prevent a malicious user from spoofing or taking over another user's IP address by creating a binding table between client's IP and MAC address, port, and VLAN.
- 4.6.12 It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
- 4.6.13 It shall support MAC address notification to allow administrators to be notified of users added to or removed from the network.
- 4.6.14 It shall support DHCP snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.
- 4.6.15 It shall support DHCP Interface Tracker (Option 82) to augment a host IP address request with the switch port ID.
- 4.6.16 It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port.
- 4.6.17 It shall support multilevel security on console access to prevent unauthorized users from altering the switch configuration.
- 4.6.18 It shall support BPDU Guard feature, to shut down Spanning Tree Protocol Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.
- 4.6.19 It shall support spanning-Tree Root Guard (STRG) to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes or any other industry standard method/protocol.
- 4.6.20 It shall have support for min. 4000 access control entries (ACEs).
- 4.7 Management:

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- 4.7.1 The LAN switch shall have CLI support to provide a common user interface and command set with all routers and switches of the same vendor.
- 4.7.2 It shall have Remote Monitoring (RMON) software agent to support four RMON groups (history, statistics, alarms, and events) or Flexible Netflow (FNF) /equivalent , Telemetry/SNMP Polling of data for enhanced traffic management, monitoring, and analysis.
- 4.7.3 It shall have Layer 2 trace route to ease troubleshooting by identifying the physical path that a packet takes from source to destination.
- 4.7.4 It shall have Domain Name System (DNS) client, relay support for IPv4/IPv6.
- 4.7.5 It shall support Trivial File Transfer Protocol (TFTP) and File Transfers Protocol (FTP) to reduce the cost of administering software upgrades by downloading from a centralized location.
- 4.7.6 It shall support Simple Network Timing Protocol (SNTP) / Network Timing Protocol (NTP) to provide an accurate and consistent time stamp to all intranet switches.
- 4.7.7 It shall support RMON v1 and v2 standards.
- 4.7.8 It shall support SNMPv1, SNMPv2, and SNMPv3 and Telnet interface to deliver comprehensive in-band management, and a CLI-based management console to provide detailed out-of-band management. It shall support NETCONF / YANG / Sflow modelling for software defined networking.
- 4.7.9 It shall have a console port with RS-232/RJ-45 interface for configuration & diagnostic purpose.
- 4.7.10 It shall support all the standard MIBs (MIB-I & II).
- 4.7.11 It shall support Telnet & SSH V-2 for command line management.
- 4.7.12 It shall support System & Event logging function as well as forwarding these logs onto a separate server for log management.
- 4.7.13 The LAN switch shall support online software reconfiguration to implement changes without rebooting. For any changes in configuration of switches related to L-2 & 3 functions, VLAN, STP, Security, QoS or firmware, rebooting the switch may be allowed.
- 4.7.14 It shall have comprehensive debugging features required for software & hardware fault diagnosis.

- 4.7.15 It shall support multiple privilege levels to provide different levels of access on console port & telnet sessions.
- 4.7.16 It shall support following user level access, i.e. the user with minimum privileges: PING, TELNET, L3 TRACEROUTE, L2 Traceroute Display of preconfigured description/label on each interface, Display of Input & output error statistics on all interfaces, Display of Dynamic ARP table, Display of MAC Address table & Display of Routing Table.
- 4.7.17 All Gigabit Ethernet ports support IEC 61000-4-5 surge protection (6kV). (External/Internal)
- 4.7.18 Loopback Detection (LBD) and Switch should support link layer remote loopback and discovery or any other industry equivalent protocol.
- 5.0 LAYER 2 SWITCH (24 Ports) SUITABLE FOR INTERMEDIATE CONNECTIVITY:**
- 5.1 Physical Specification:**
- 5.1.1 The LAN switch shall be rack mountable with the following ports:
- 24 Nos. 10/100/1000 Base-T, 2 Nos. 10GBase-T ports and 2 Nos. 10G SFP+ ports Stackable Managed Switch.
- OR,
- 24 Nos. 10/100/1000Base-T PoE+ ports, 2 Nos. 10GBase-T ports and 2 Nos. 10G SFP+ ports Stackable Managed Switch. 370W PoE Budget from Day 1 and potential to be expanded to 740 watts.
- 5.2 General Specification:**
- 5.2.1 The LAN switch shall be available with minimum 128 Gbps Switching Fabric.
- 5.2.2 The LAN switch shall have minimum packet forwarding rate of 95.24 million packets per second at 64 byte packet length.
- 5.2.3 The LAN switch shall support minimum 16000MAC addresses.
- 5.2.4 There shall be 1K IGMP groups.
- 5.2.5 The switch should be stackable with a minimum stacking bandwidth of atleast 80 Gbps. It should support stacking of atleast 4 units or higher or Virtual Switching System (VSS) or Equivalent technology. For stacking the switches shall be either dedicated stack ports or Ethernet uplink ports.

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- 5.2.6 The switch should support external redundant power supply (RPS). The Switch should have min 2 AC PSUs and support AC & DC modular power supply.
- 5.2.7 The switch shall be able to work on both IPv4 and IPv6 (dual stack) from day one.
- 5.2.8 All ports in the switch shall operate at wire-speed / line-rate.
- 5.2.9 The switch shall support 19 inch rack mounting.
- 5.3 Layer - 2 Features:
- 5.3.1 The LAN switch shall support IEEE 802.1Q VLAN encapsulation. Minimum 255 VLANs per switch and up to 4094 VLAN IDs.
- 5.3.2 It shall support for Automatic Negotiation of link speed and duplex to help minimize the configuration & errors.
- 5.3.3 It shall support centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the other switches automatically, thus reducing the overhead of creating / modifying / deleting VLANs in all the switches in turn eliminating the configuration errors & troubleshooting.
- 5.3.4 It shall support edge port in STP/RSTP/MSTP mode and Ethernet Ring Protection Switching (ERPS) (ITU-T G.8032)
- 5.3.5 It shall support 802.1d, 802.1p, 802.1Q, 802.1s, 802.1w, 802.1x, 802.1ab, 802.3ad.
- 5.3.6 It shall support spanning-tree root guard or any other industry standard protocol to prevent other edge switches becoming the root bridge.
- 5.3.7 It shall support IGMP snooping v1, v2 and v3.
- 5.3.8 It shall support Link Aggregation Protocol (LACP).
- 5.3.9 It shall Support for Detection of Unidirectional links and to disable them to avoid problems such as spanning tree loops and support Unidirectional Link Detection (UDLD) or equivalent.
- 5.3.10 It shall be able to discover the neighboring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems.

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- 5.3.11 It shall support Optical Transceiver Digital Diagnostic Monitoring and Support 802.3ah link layer remote loopback and discovery, Loopback Detection (LBD) and Switch should support 802.3ah link layer remote loopback and discovery.
- 5.3.12 It shall support Multicast VLAN registration.
- 5.3.13 It shall support Local Proxy Address Resolution Protocol (ARP) works in conjunction with Private VLAN Edge to minimize broadcasts and maximize available bandwidth.
- 5.3.14 It shall support LLDP / LLDP-MED including client location information. It shall exchange link and device information in multi vendor networks.
- 5.3.15 It shall support configuration replacement and rollback to replace current configuration with any saved configuration file.
- 5.3.16 It shall support link state tracking which provides layer 2 redundancy in the network when used in conjunction with server teaming or any other industry equivalent protocol.
- 5.3.17 It shall support configurable maximum transmission unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames) for bridging on Gigabit Ethernet ports.
- 5.3.18 It shall support auto sensing speed on 10/100/1000 ports, auto negotiating half/full-duplex on all ports and Auto-Medium Dependent Interface Crossover (MDIX).
- 5.4 QoS Features:
- 5.4.1 The LAN switch shall have per-port broadcast, multicast, and unicast storm control.
- 5.4.2 It shall have standard 802.1p CoS and DSCP classification using marking and reclassification on a per-packet basis by source and destination IP address, source and destination MAC address, or Layer 4 TCP or User Datagram Protocol (UDP) port number.
- 5.4.3 It shall have supports QoS Flow Actions, Remark 802.1p priority tag, TOS/DSCP tag, Bandwidth Control and Three Color Marker.
- 5.4.4 It shall have no performance penalty for highly granular QoS functions.
- 5.4.5 There shall be four egress queues per port to enable differentiated management of up to four traffic types.
- 5.4.6 There shall be weighted Random Early Detection (WRED) to provide congestion avoidance.



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- 5.4.7 There shall be strict priority queuing mechanisms.
- 5.4.8 Rate limiting will be based on rate of traffic per second.
- 5.4.9 There shall be support for Asynchronous data flows upstream and downstream from the end station or on the uplink using ingress policing and egress shaping.
- 5.4.10 It shall have supports L2/L3/L4 QoS/CoS solutions help ensure that critical network services such as VoIP, ERP, Intranet, and video conferencing are served with proper priority.
- 5.5 Network Security Features:**
- 5.5.1 The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
- 5.5.2 The LAN switch shall support for Admission Control features to improve the network's ability to automatically identify, prevent, and respond to security threats and also to enable the switches to collaborate with third-party solutions for security-policy compliance and enforcement before a host is permitted to access the network.
- 5.5.3 It shall support port-based ACLs (PACLs) for Layer 2 interfaces to allow application of security policies on individual switch ports. It shall also support VLAN based filters.
- 5.5.4 It shall support unicast MAC filtering to prevent the forwarding of any type of packet with a matching MAC address. It shall support Unicast and Multicast MAC addresses and associated VLANs.
- 5.5.5 It shall support unknown unicast and multicast port blocking to allow tight control by filtering packets that the switch has not already learned how to forward.
- 5.5.6 It shall support IGMP filtering which shall provide multicast authentication by filtering out no subscribers and limits the number of concurrent multicast streams available per port.
- 5.5.7 It shall support for SSHv2, SNMPv3 to provide network security by encrypting administrator traffic during Telnet, SSH and SNMP sessions.
- 5.5.8 The switch shall support 2 session of Port Mirroring based on port basis / VLAN basis to support intrusion prevention system deployment in different VLANs. It shall support bidirectional data on mirror port which allows IDS to take action when an intruder is detected.
- 5.5.9 It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.

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- 5.5.10 It shall support MAC address notification to allow administrators to be notified of users added to or removed from the network / It shall support SNMP Trap for new MAC notification.
- 5.5.11 It shall support DHCP snooping to allow administrators to ensure consistent mapping of IP to MAC addresses. This can be used to prevent attacks that attempt to poison the DHCP binding database, and to rate limit the amount of DHCP traffic that enters a switch port.
- 5.5.12 It shall support DHCP Interface Tracker (Option 82) to augment a host IP address request with the switch port ID.
- 5.5.13 It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port.
- 5.5.14 It shall support multilevel security on console access to prevent unauthorized users from altering the switch configuration.
- 5.5.15 It shall support BPDU filtering feature, to shut down Spanning Tree Protocol Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.
- 5.5.16 It shall support Spanning-Tree Root Guard (STRG) to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.
- 5.5.17 It shall support for up to 1500 access control entries (ACEs) or any industry standard features.
- 5.6 Management:**
- 5.6.1 The LAN switch shall have CLI support to provide a common user interface and command set with all routers and switches of the same vendor.
- 5.6.2 It shall have Remote Monitoring (RMON v1 and v2) software agent to support for enhanced traffic management, monitoring, and analysis.
- 5.6.3 It shall have support for RMON groups through the use of a mirrored port, which permits traffic monitoring of a single port, a group of ports, or the entire switch from a single network analyzer or RMON probe.
- 5.6.4 It shall have Time-Domain Reflectometer (TDR) or equivalent technology to diagnose and resolve cabling problems on copper ports.

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- 5.6.5 It shall have layer 2 trace route to ease troubleshooting by identifying the physical path that a packet takes from source to destination or any other industry equivalent protocol.
- 5.6.6 It shall support Web based or Trivial File Transfer Protocol (TFTP) or File Transfer Protocol (FTP) to reduce the cost of administering software upgrades by downloading from a centralized location.
- 5.6.7 It shall support Simple Network Time Protocol/Network Timing Protocol (SNTP/NTP) to provide an accurate and consistent timestamp to all intranet switches.
- 5.6.8 It shall support RMON v1 and v2 standards.
- 5.6.9 It shall support SNMPv1, SNMPv2, and SNMPv3 and Telnet interface to deliver comprehensive in-band management, and a CLI-based management console to provide detailed out-of-band management.
- 5.6.10 It shall support IPV6 management. ACL and QoS and IPV6 Neighbor Discovery.
- 5.6.11 All Gigabit Ethernet ports support IEC 61000-4-5 surge protection (6kV).  
(External/Internal)
- 5.6.12 Loopback Detection (LBD) and Switch should support 802.3ah link layer remote loopback and discovery.
- 5.6.13 Switch should support Dying Gasp for quick trouble shooting during power failures or system shut downs.
- 6.0 LAYER 2 SWITCH (8 PORTS) SUITABLE FOR END LOCATIONS:**
- 6.1 Physical Specification:**
- 6.1.1 The LAN switch shall be standalone / rack mountable with the following ports:  
8 Nos. 10/100/1000 Base-T port with 2 Nos SFP port.  
OR,  
8 Nos. 10/100/1000 Base-T PoE+ port with 2 Nos. SFP port. 70W PoE Budget from Day 1.
- 6.2 General Specification:**
- 6.2.1 The LAN switch shall be available with minimum 20Gbps Switching Fabric.
- 6.2.2 The LAN switch shall have minimum packet forwarding rate of 14.88 million packets per second at 64-byte packet length.
- 6.2.3 The LAN switch shall support minimum 8K MAC address.

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- 6.2.4 The LAN switch shall have 255 IGMP groups.
- 6.2.5 Switch should support Dying Gasp for quick trouble shooting during power failures or system shut downs.
- 6.3 **Layer-2 Features:**
  - 6.3.1 The LAN switch shall support IEEE 802.1Q VLAN up to 255 Active VLANs and 4094 VLAN ID.
  - 6.3.2 It shall support for Automatic Negotiation of link speed and duplex to help minimize the configuration & errors.
  - 6.3.3 It shall support centralized VLAN Management. VLANs created on the Core Switches shall be propagated to all the other switches automatically, thus reducing the overhead of creating / modifying / deleting VLANs in all the switches in turn eliminating the configuration errors & troubleshooting.
  - 6.3.4 It shall support edge port in STP/RSTP/MSTP mode.
  - 6.3.5 It shall support 802.1d, 802.1p, 802.1Q, 802.1s, 802.1w, 802.1x, 802.1ab, 802.3ad.
  - 6.3.6 It shall support spanning-tree root guard to prevent other edge switches becoming the root bridge.
  - 6.3.7 It shall support IGMP snooping v1, v2 and v3.
  - 6.3.8 It shall support Link Aggregation Protocol (LACP) as per IEEE 802.3ad.
  - 6.3.9 It shall Support for Detection of Unidirectional links and to disable them to avoid problems such as spanning tree loops and support Unidirectional Link Detection (UDLD) or any other industry equivalent protocol.
  - 6.3.10 It shall be able to discover the neighboring device of the same vendor giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems.
  - 6.3.11 It shall support Optical Transceiver Digital Diagnostic Monitoring and Support 802.3ah link layer remote loopback and discovery.
  - 6.3.12 It shall support LLDP / LLDP-MED exchange link and device information in multi vendor networks.

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- 6.3.13 It shall support configuration rollback to replace current configuration with any saved configuration file.
- 6.3.14 It shall support Auto sensing speed on 10/100/1000 ports, Auto negotiating half/full-duplex on all ports and Auto-MDIX.
- 6.4 Quality of Service (QoS) Features:**
- 6.4.1 The LAN switch shall have per-port broadcast, multicast, and unicast storm control.
- 6.4.2 There shall be four egress queues per port to enable differentiated management of up to four traffic types.
- 6.4.3 There shall be weighted Round Robin (WRR) to provide congestion avoidance or any other Industry standard protocol.
- 6.4.4 There shall be strict priority queuing mechanisms.
- 6.5 Network Security Features:**
- 6.5.1 The LAN switch shall support IEEE 802.1x to allow dynamic, port-based security, providing user authentication.
- 6.5.2 It shall support unicast MAC filtering to prevent the forwarding of any type of packet with a matching MAC address.
- 6.5.3 It shall support unknown unicast and multicast port blocking to allow tight control by filtering packets that the switch has not already learned how to forward.
- 6.5.4 It shall support IGMP filtering to provide multicast authentication by filtering out no subscribers and limits the number of concurrent multicast streams available per port.
- 6.5.5 It shall support for SSHv2, SNMPv3 to provide network security by encrypting administrator traffic during Telnet, SSH and SNMP sessions.
- 6.5.6 It shall support Port Mirroring based on port basis / VLAN basis to support intrusion prevention system deployment in different VLANs. It shall support bidirectional data on mirror port which allows IDS to take action when an intruder is detected.
- 6.5.7 It shall support RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.
- 6.5.8 It shall support MAC address notification to allow administrators to be notified of users added to or removed from the network.

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- 6.5.9 It shall support port security to secure the access to an access or trunk port based on MAC address. After a specific timeframe, the aging feature should remove the MAC address from the switch to allow another device to connect to the same port.
- 6.5.10 It shall support multilevel security on console access to prevent unauthorized users from altering the switch configuration.
- 6.5.11 It shall support BPDU filtering feature, to shut down Spanning Tree Protocol Port Fast-enabled interfaces when BPDUs are received to avoid accidental topology loops.
- 6.5.12 It shall support Spanning-Tree Root Guard (STRG) to prevent edge devices not in the network administrator's control from becoming Spanning Tree Protocol root nodes.
- 6.6 **Management:**
- 6.6.1 It shall have Remote Monitoring software agent to support for enhanced traffic management, monitoring, and analysis or FNF (flexible netflow) or any industry standard.
- 6.6.2 It shall have Time-Domain Reflectometer (TDR) or Unidirectional Link Detection (UDLD) or equivalent technology to diagnose and resolve cabling problems on copper ports.
- 6.6.3 It shall have Layer 2 trace route to ease troubleshooting by identifying the physical path that a packet takes from source to destination.
- 6.6.4 It shall support Web based or Trivial File Transfer Protocol (TFTP) or File Transfer Protocol (FTP) to reduce the cost of administering software upgrades by downloading from a centralized location.
- 6.6.5 It shall support Simple Network Time Protocol/Network Timing Protocol (SNTP/NTP) to provide an accurate and consistent time stamp to all intranet switches
- 6.6.6 It shall support RMON v1 and v2 standards.
- 6.6.7 It shall support SNMPv1, SNMPv2c, and SNMPv3 and Telnet interface support to deliver comprehensive in-band management, and a CLI-based management console to provide detailed out-of-band management and Web Management for better manageability.
- 6.6.8 All Gigabit Ethernet ports support IEC 61000-4-5 surge protection (6kV). (External/Internal)
- 6.6.9 Ethernet Ring Protection Switching (ERPS) for single ring topologies (ITU-T G.8032).
- 6.6.10 Loopback Detection (LBD) and Switch should support 802.3ah link layer remote loopback and discovery.

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## 7.0 REGULATORY COMPLIANCE OF LAN SWITCHES:

- 7.1 The LAN switch shall conform to UL 60950 or IEC 60950 or CSA 60950 or EN 60950 Standards.
- 7.2 The LAN switch shall conform to EN 55022 Class A/B or CISPR22 Class A/B or CE Class A/B or FCC Class A/B Standards for EMC.
- 7.3 The LAN switch shall conform to the Electromagnetic Compatibility (EMC) requirement as per the following standards and limits indicated therein:  
EN55022 class A, FCC class A, VCCI class A Immunity: EN55024, EN61000-3- levels 2.
- 7.4 The operating personnel shall be protected against shock hazards as per IS/IEC 60479 – Effects of current on human beings and livestock.
- 7.5 The switch shall be manufactured in accordance with international quality standards ISO9001:2008 for which manufacturer should be duly accredited.

## 8.0 TEST REQUIREMENT

### 8.1 Condition of Test

- 8.1.1 Unless otherwise specified all tests shall be carried out at ambient atmospheric conditions.
- 8.1.2 Inspection and testing shall be carried out to the effect that all requirements of this specification are complied with.
- 8.1.3 Inspection shall be carried out for one complete system of LAN Switch.

### 8.2 ACCEPTANCE TEST:

- 8.2.1 The following shall constitute the acceptance tests which shall be carried out by the inspecting authority for the purpose of acceptance on randomly selected 20% of items offered from the lot (minimum 1 each type of item) offered for inspection by the supplier:
- (i) Visual inspection (Clause 9.1)
  - (ii) Performance test (Clause 9.2)
  - (iii) Regulatory Compliance (Clause 7.0)
  - (iv) Endurance Test(Clause 9.3)

8.2.2 Any other tests shall be carried out as considered necessary by the inspecting authority.

**8.3 ROUTINE TESTS:**

8.3.1 The following shall comprise the routine tests and shall be conducted by manufacturer on every equipment and the test results will be submitted to the inspection authority before inspection.

(i) Visual Inspection of complete system (Clause 9.1)

(ii) Performance test (Clause 9.2)

**9.0 TEST PROCEDURE:**

The test procedure shall be based on the system design. The methodologies to be adopted for various tests shall be decided taking into account the system design/configuration.

9.1 **VISUAL INSPECTION:** Each equipment of the system shall be visually inspected to ensure compliance with the requirement of clause 2, 3, 4, 5, 6, 8 & 9 of this specification.

**9.2 PERFORMANCE TEST:**

9.2.1 The equipment shall comply with the requirements as specified in clauses 2, 3, 4, 5 & 6.

**9.3 ENDURANCE TEST:**

9.3.1 During acceptance test, endurance test shall be conducted on complete system for continuous operation which shall be 48 hrs at ambient room temperature without giving any deterioration.

**10.0 QUALITY ASSURANCE:**

10.1 All materials & workmanship shall be of good quality.

10.2 Since the quality of the equipment bears a direct relationship to the manufacturing process and the environment under which it is manufactured, the manufacturer shall ensure Quality Assurance Program of adequate standard.

**11.0 REJECTION:**

11.1 Any of the materials which do not comply with the requirements of this specification may be rejected.



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## 12.0 MARKING & PACKING:

12.1 The following information shall be clearly marked at a suitable place on each equipment:

- i) Name and Address of the manufacturer.
- ii) Month & Year of the manufacturing.
- iii) Serial number of Equipment.

12.2 The equipment and its sub-assemblies shall be packed in Florafoam boxes and the empty spaces shall be filled with suitable filling material. Before keeping in the Florafoam box, the equipment shall be wrapped with bubble sheet. The equipment shall be finally packed in a wooden case of sufficient strength so that it can withstand bumps and jerks encountered in a road/rail journey.

## 13.0 DOCUMENTATION:

The supplier shall provide the complete operation, maintenance and installation manuals in English for the product under procurement. The manufacturer/ supplier should also mention about year upto which continuity of their sale/service support for the product under procurement may be ensured.

## 14.0 INFORMATION TO BE FURNISHED BY THE PURCHASER:

14.1	Type of LAN Switch as per clause no. 1.4	To be specified by the purchaser
14.2	Requirement of ports/interfaces as per clause no. 3.1.1, 4.1.1, 5.1.1 & 6.1.1	To be specified by the purchaser

### ABBREVIATIONS

GVRP: Generic VLAN Registration Protocol

IGMP: Internet Group Management Protocol

LACP: Link Aggregation Control Protocol

UDLD: Unidirectional Link Detection

LLDP: Link Layer Discovery Protocol

STP: Spanning Tree Protocol

HSRP: Hot Standby Router Protocol

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- VRRP: Virtual Router Redundancy Protocol
- RIP: Routing Information Protocol
- OSPF: Open shortest path First
- DSCP: Differentiated Services Code Point
- ACL: Access Control list
- PACL: Port Access list
- SNMP: Simple Management Network Protocol
- DHCP: Dynamic Host Control Protocol
- BPDU: Bridge Protocol data Unit
- TFTP: Trivial File Transfer protocol
- SNTP: Simple Network Timing Potocol
- MIB: Management Information Base
- OAM: Operations Administration and Maintenance
- MDIX: Medium Dependent Interface Crossover
- UDP: User Datagram Protocol

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