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STANDARD FOR GENERIC REQUIREMENTS

TEC 48060:2024

(Supersedes No. TEC 48060:2023)

लैन स्विच

LAN Switch

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र
खुर्शीदलालभवन, जनपथ, नई दिल्ली–११०००१, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHID LAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This Standard for Generic Requirements for a LAN Switch pertains to a local area networking device operating at Layer 2 (and in some cases Layer 3) of the seven layer ISO OSI model. This document specifies the technical, operational and other Generic requirements of different kinds of LAN Switches that shall be required in service provider networks for Internet, Intranet and other applications environments.

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History Sheet

1	GR No. G/LSW-01/01.June 2000	1st issue.
2	GR No. GR/LSW-01/02. OCT 2003	2nd Issue after review.
3	GR No. GR/LSW-01/03. SEP 2007	3rd Issue after review.
4	GR No. TEC/GR/IT/LSW-01/04/MAR-11	4th Issue after review.
5	GR No. TEC/GR/IT/LSW-01/05/MAR-2014	5th Issue after incorporation of IPv6 requirements and other revisions.
6	Standard for Generic Requirements No TEC 48060:2023	6th issue after inclusion of category-V Industrial L2 Switch
7	Standard for Generic Requirements No TEC 48060:2024	7th issue

REFERENCES

QM 118, QM205, QM206, QM210, QM 301, QM 324, QM 333, QM 351	Quality Manual issued by the QA Circle
TEC/EMI/TEL-001/01/FEB-09	EMI/EMC Standards
RFC 8201	Path MTU Discovery for IP version 6
RFC 4330	Simple Network Time Protocol (SNTP) Version 4 for IPv4, IPv6 and OSI
RFC 2080	RIPng for IPv6
RFC 2119	Key words for use in RFCs to Indicate Requirement Levels
RFC 2236	IGMPv2
RFC 8200	Internet Protocol, Version 6 (IPv6) Specification
RFC 4861	Neighbor Discovery for IP Version 6 (IPv6)
RFC 2474	Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
RFC 2475	Architecture for Differentiated Services
RFC 2597	Assured Forwarding PHB Group
RFC 3246	An Expedited Forwarding PHB
RFC 2710	Multicast Listener Discovery (MLD) for IPv6
RFC 2711	IPv6 Router Alert Option
RFC 5340	OSPF for IPv6
RFC 8415	Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
RFC 3319	Dynamic Host Configuration Protocol (DHCPv6) Options for Session Initiation Protocol (SIP) Servers
RFC 3376	Internet Group Management Protocol, Version 3
RFC 3596	DNS Extensions to Support IP Version 6
RFC 3633	IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6
RFC 3646	DNS Configuration options for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)
RFC 3736	Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6
RFC 3810	Multicast Listener Discovery Version 2 (MLDv2) for IPv6
RFC 3956	Embedding the Rendezvous Point (RP) Address in an IPv6 Multicast Address
RFC 4007	IPv6 Scoped Address Architecture
RFC 4193	Procedures for Renumbering an IPv6 Network without a Flag Day
RFC 4292	IP Forwarding Table MIB
RFC 4293	Management Information Base for the Internet Protocol (IP)

RFC 4443	Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification
RFC 5798	Virtual Router Redundancy Protocol (VRRP) Version 3 for IPv4 and IPv6
IEEE 802.1d	IEEE Standard for Spanning tree protocol
IEEE 802.1p	IEEE Standards for LAN Layer 2 QoS/CoS Protocol for Traffic Prioritization
IEEE 802.1q	IEEE Standards for Local and metropolitan area networks Virtual Bridged Local Area Networks
IEEE 802.1s	IEEE Standards for Multiple Spanning Tree Protocol
IEEE 802.1w	IEEE Standards for Rapid Reconfiguration of Spanning Tree
IEEE 802.1ab	IEEE Standards for Station and Media Access Control Connectivity Discovery
IEEE 802.2	IEEE Standards for Logical Link Control (LLC)
IEEE 802.3u	IEEE Standards for Isolation requirements for Power over Ethernet
IEEE 802.3x	IEEE Standards for flow control
IEEE 802.3z	IEEE Standards for 1000BASE-X Gbit/s Ethernet over Fiber-Optic at 1 Gbit/s
IEEE 802.3ad	IEEE Standards for link aggregation
IEEE 802.3ae	IEEE Standards for 10 Gbit/s (1,250 MB/s) Ethernet over fiber
ITU-T G.8031	ITU-T Recommendations on Ethernet linear protection switching
ITU-T G.8032	ITU-T Recommendations on Ethernet ring protection switching
ISO 9000:2008	Series of standards, developed and published by the International Organization for Standardization (ISO), that define, establish, and maintain an effective quality assurance system for manufacturing and service industries
MEF-9	Abstract Test Suite for Ethernet Services at the UNI
CISPR 11	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific & medical (ISM) radiofrequency equipment
CISPR 32	Electromagnetic compatibility of multimedia equipment – Emission requirements
EN 55011	Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement
EN 55032	Information Technology Equipment - Radio disturbance characteristics - Limits and methods of measurement
IEC/EN 61000-4-2	Testing and measurement techniques – Electrostatic discharge immunity test
IEC/EN 61000-4-3	Testing and measurement techniques – Radiated, radio-frequency,

	electromagnetic field immunity test
IEC/EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
IEC/EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
IEC/EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
IEC/EN 61000-4-11	Electromagnetic compatibility (EMC) Part 4-11: Testing and measurement techniques Voltage dips, short interruptions and voltage variations immunity tests
IEC 60479-1	Effects of current on human beings and livestock - Part 1: General aspects
IEC 13252	Information Technology Equipment -- Safety, Part 1: General Requirements
IS 10437	Safety requirements for radio transmitting equipment

1.0   INTRODUCTION

1.1   The basic function of a LAN switch is to forward Ethernet frames from one port to another. 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 is very low as compared to shared media repeaters.

1.2   **Scope:** A LAN switch is a local area networking device operating at Layer 2 (and in some cases Layer 3) of the seven layer ISO-OSI model. This document specifies the technical, operational and other Generic requirements of different kinds of LAN Switches that shall be required in service provider networks for Internet, Intranet and other applications environments.

1.3   The RFC documents of the IETF are subject to periodic revision. Hence where ever RFC's are mentioned in this document, the offered product shall meet either the referred RFC or its previous version or its previous draft or its updated version. Wherever a feature of the RFC is mentioned, product shall comply with the part of the RFC specifying the feature.

1.4   The interpretation of the clauses of the RFC's shall be as per RFC 2119.

2.0   DESCRIPTION

LAN Switch to be used in service provider network can be categorised in five type based upon features and redundancy requirements as follows:

i. High functionality & high redundancy – suitable for aggregation network. This is described in Category I.

ii. High functionality & low redundancy – suitable for Metro Ethernet Edge Node (Metro Ethernet Switches). This is described in Category II.

iii. Low functionality & high redundancy – suitable for Data Centre application. This is described in Category III.

iv. Low functionality & low redundancy – suitable for Intranet etc. This is described in Category IV.

v. Low functionality & low redundancy Industrial Grade switches- Suitable for the outdoor. This is described in Category V.

Category	Type		Network Application
I	A	High Range	Aggregation
	B	Low Range	… do …
II	A	High Range	Metro Ethernet Aggregation / Distribution
	B	Medium Range	… do …
	C	Low Range	… do …
	D	High Range	Metro Ethernet Access
	E	Low Range	… do …
III	A	High Range	Data Centre Aggregation
IV	A	High Range	Intranet Application / CPE
	B	Low Range	… do …
V	A	Field Switches	Outdoor applications etc

3.0 FUNCTIONAL REQUIREMENTS

PART-1 CAPACITY REQUIREMENTS

3.1 Capacity Metrics Requirements:-

Category		Type	Minimum Backplane Capacity (Full Duplex)	Packets forwarding rate (Million PPS)	Min MAC address support	Min. VLANs
I (Aggregation)	A	High Range	960Gb	1500	125k	
	B	low Range	160 Gb	250	50K	
II (Metro Ethernet Aggregation)	A	High Range	960Gb	1000	512K	
	B	Medium Range	240Gb	300	64K	
	C	Low Range	40 Gb	60	16K	
II (Metro Ethernet Access)	D	High Range	30 Gb	40	16K	
	E	Low Range	15 Gb	20	8K	
III	A	High Range	3 Tb	4400	1,00,000	
IV	A	High end	52 Gb	77	16k	1000
	B	Low	28 Gb	44	8000	255
V Industrial Grade L2 Switches	A	Field Switch	12GB	17	16K	4K

Note: The packet forwarding rate for the High Range of Category I and III Switches is at 128 bytes per Ethernet frame and for Category II, IV , V and low range of Category I is at 64 bytes per Ethernet frame

PART-2 REQUIREMENTS FOR CATEGORY-I LAN SWITCHES

3.2 Functional Requirements of LAN Switch for Aggregation Network (Category I):-

i. The LAN switch shall support non-disruptive software upgrades.

ii. The LAN switch shall support a console port or auxiliary port for the purpose of local and remote configuration and diagnostics.

iii. The LAN switch shall support extensive debugging capabilities to assist in hardware and software problem resolution.

iv. The LAN switch shall support the adequate memory to meet the full configuration requirement.

v. The switching fabric /backplane shall be non-blocking supporting wire speed interface. The chassis shall be fully configured for concerned Category. The switch shall support a wire speed L2 switching and wire speed L3 routing capabilities under full load conditions.

vi. The individual interface on LAN Switch shall support 1,488,100 packets per second (pps) on Gigabit Ethernet in Full Duplex; 148,810 pps on 100 Mbps Full Duplex Ethernet; 14,881 pps on 10 Mbps Full Duplex Ethernet at Minimum Frame size of 64 Bytes on Ethernet.

vii. The LAN switch shall support built in power diagnostics system to detect hardware failures.

viii. The LAN Switch shall be capable of working with -44 V to 57 V DC (High Range). The exact power requirement shall be indicated by Tendering authority. The switch should also be capable of working with 220 V AC with a variance of +/- 20% as the supply is always through UPS.

ix. High range Switch shall be modular in design (chassis based) while medium and low range switches can be chassis based or stackable switches. It shall be able to interconnect networks which support different media and topology. It shall be scalable to take care of future expansion.

x. The performance of device shall not be degraded upon enabling of one or more features.

xi. All the interfaces on the devices shall be supported as integrated interfaces and shall not require any external converters/ adapters.

xii. The line interface slots in the devices shall be universal.

xiii. Core LAN Switch shall support IPv4 Routing, IPv6 Routing & L2 Bridging in hardware for optimal performance.

3.2.1 Availability / Redundancy: LAN Switch shall have the following features to ensure high availability and redundancy.

i.   All mission critical modules must be identified and provided in full redundant configuration for high reliability.

ii.   A single point failure on the equipment shall not result in equipment or network management system downtime.

iii.   The LAN switch shall support hot standby dual operating software image and dual configuration files for redundancy.

iv.   Comprehensive hardware and software fault isolation and recovery features shall be supported.

v.   The LAN Switch shall support dynamic online configuration.

vi.   The LAN Switch shall support non-disruptive hot-swap of modules.

vii.   The LAN switch shall support hot-Pluggable redundant, hot-standby power supplies.

viii.   ll type of interfaces shall be supplied on at least two cards mounted in different physical slots of chassis.

ix.   Wherever the redundant interface(s) have been asked, the same shall be provided using interface(s) on different cards mounted in different physical slots of chassis.

x.   The interface modules shall support Online Insertion and Removal capability.

xi.   The LAN switch shall support fast convergence on the backbone links and uplinks.

xii.   Switch should have redundant controller for working in hot standby configuration.

xiii.   The fans provided shall be in redundant configuration.

xiv.   The CPU shall support non-stop forwarding and stateful switchover in case of active CPU failure in hot standby mode with subsequent redundancy.

xv.   The switch shall support Ethernet protection based on ITU-T G.8031,/G.8032.

3.2.2 Protocols:- It shall support the following protocols:-

i.   Spanning Tree Protocol (IEEE 802.1d):-

    a.   The Switching Module shall possess redundant load balancing capability to support fault-tolerant connections to other switches or shared media segments to protect against a primary link failure. If the primary link fails, the backup path shall be automatically activated to maintain network connectivity and throughput.

    b.   An LAN Switch shall be able to prioritize BPDUs in the data plane (by providing

dedicated queues) and in the control plane (by providing dedicated CPU queues for BPDUs).

      c.   An LAN Switch shall be able to drop BPDUs if those BPDUs have a root bridge identifier which is lower (better) than the current Spanning Tree root. This function shall be configurable on a per port basis.

      d.   An LAN Switch shall be able to drop BPDUs regardless of the BPDU content. This function shall be configurable on a per port basis.

   ii.   Link-layer discovery protocol (LLDP) (802.1ab) or similar protocol.

   iii.   Logical Link Control (LLC) (IEEE 802.2).

   iv.   Flow Control (IEEE 802.3x).

   v.   SNMP v3

   vi.   TFTP

   vii.   Telnet

   viii.   SSH

   ix.   It shall support Port trunking capability at Layer 2.

   x.   Link Aggregation as per IEEE802.3ad to allow link resilience. Load balancing over IEEE 802.3ad Aggregated Links shall also be supported

   xi.   IEEE 802.1q tagging and stacking support.

   xii.   IEEE 802.1w VLAN RST (Rapid Spanning Tree) and IEEE 802.1s VLAN MST (Multiple Spanning Tree). Minimum two instances of Multiple Spanning Tree shall be supported.

3.2.3 **Layer-3 Features:** The LAN switch shall support the following layer 3 capabilities. Requirement of the same shall be indicated by the tendering authority.

   i.   Multicast Multi-layer switching.

   ii.   IP routing protocols: – RIP, RIPv2, OSPF, BGP

   iii.   Intelligent Queuing based on IP ToS bits for scalability.

   iv.   IP precedence classification.

   v.   Diffserv support.

   vi.   Multicast features such as PIM-Sparse / dense.

   vii.   QoS classification of packets.

   viii.   Support for standby routing protocol to ensure L2 and L3 redundancy per VLAN.

   ix.   For supporting the Web cache redirection, the LAN Switch shall support L4

Switching (optional).

x.   Shall support at least 2,50,000 IPv4 Routes & 64,000 IPv6 Routes for High range & 64K IPv4 Routes, 16K IPv6 Routes for Low Range Switches.

xi.   LAN switch should support multi-VRFs and ability to route them across the entire network.

xii.   LAN switch should support Layer-2 & Layer-3 MPLS and all major related TE features.

3.2.4   VLAN features:-The LAN switch shall support the following VLAN features:-

i.   VLAN shall be possible to be created among ports of different types as well as ports on the interface cards.

ii.   The LAN Switch shall support VLAN Bridge (for outer tag only) as per 802.1ad.

iii.   The LAN Switch shall support user isolation per outer VLAN tag. This behavior shall be configurable on a per VLAN basis.

iv.   VLAN shall be possible to be created among ports of different types as well as ports on the interface cards.

v.   4000 VLANs (as per IEEE 802.1q) shall be supported.

vi.   VLAN ingress filtering to Prevent VLAN leakage

vii.   VLAN Tag overlapping

viii.   VLAN CoS preservation

ix.   VLAN CoS differentiation

x.   It shall support 802.1q Tagging Support in the following manner:

   a.   Tagged only, which is an 802.1q trunk.

   b.   Untagged.

   c.   Hybrid, tagged and untagged frames.

   d.   Tag insertion, removal and swapping.

xi.   LAN Switch shall support the disabling of MAC learning on a per VLAN basis.

xii.   An LAN Switch shall be able to rely on IGMP Snooping to install bridge table entries for multicast entries while MAC learning is disabled in the Multicast VLAN.

3.2.5   Multicast capabilities: The LAN Switch shall support Internet Group Management Protocol (IGMP) v2 and v3 as described in RFC 2236 and RFC 3376. The following IGMP capabilities shall be supported:

A. Multicast capabilities in IPv4:-

i. Fast leave – terminates the multicast session immediately, rather than using the standard group-specific query to check if other group members are present on the network.

ii. The IGMP Query Engine shall handle functions like Query Generation, Processing of Membership Reports, Join and Leave Messages.

iii. Proxy summarization of IGMP messages, reducing the number of IGMP messages processed by upstream devices in the network.

iv. IGMP filtering: filter group membership reports from a particular host or range of hosts, filter to prevent a host from transmitting multicast streams into the network.

v. It shall provide static join Function is to reduce the latency of the channel zapping by bringing the Multicast streams further down in the network, closer to the video service termination point.

vi. IGMP Message Shaping

vii. IGMP Message Filtering

viii. IGMP Fast Leave processing to ensure removal of a multicast group as soon as an IGMP leave message is received on that interface.

ix. IGMP Snooping dynamic mode to support any multicast address.

x. IGMP snooping static mode support to specify a range of multicast addresses.

xi. IGMP Snooping with Port Replication to ensure multicast flooding suppression and ensure multicast flooding only to those ports which IGMP join messages have been received.

xii. Multicast Security:-

Unknown Multicast Filtering (UMF): Filtering of multicast packets with an unknown destination address.

xiii. The LAN Switch shall support IGMP snooping. Snooping function on per port and per VLAN basis with the following capabilities:-

a. The LAN Switch shall have the capability to learn on a per VLAN basis the location of multicast routers through listening and updating their forwarding tables based on IGMP general queries.

b. The LAN Switch shall support IGMP snooping with the capability to learn both the multicast source IP address and the destination group address

and the destination group address based on the multicast group IP address.

    c.   The LAN Switch shall provide statistics on all active group and sources and per a VLAN and port basis.

    d.   The LAN Switch shall provide statistics on the multicast routers.

xiv.   The LAN Switch shall support an IGMP v3 transparent snooping function on a per VLAN basis.

xv.   Create and delete MAC-level Group Filter entries, enabling in turn and selective multicast forwarding from network-facing VLANs to user-facing ports.

xvi.   Upon detecting topology changes, the LAN Switch shall be able to issue an IGMP proxy query solicitation, i.e. an IGMP Group Leave with group address '0.0.0.0'. (This will indicate to the IGMP router) it immediately needs to send Group Specific queries, which will populate the L2 multicast filters in the LAN Switch, in order to speed up network convergence).

B.   LAN switch shall support anycast capabilities.

3.2.6 QoS:- The LAN switch shall support the following QoS features per port and for each VLAN:-

a)   Filtering

b)   Broadcast suppression

c)   Link load balancing

d)   Rate limiting of bandwidth on the switch ports

e)   Traffic prioritization

f)   Traffic Shaping

g)   Rate limiting of bandwidth: shall support User bandwidth from 1Mb/s to 1Gbps in 1Mb/s increment.

h)   The LAN Switch shall support at least 4 traffic classes scalable to 6 for Ethernet frames, and shall support configurable mapping to these classes from the 8 possible values of the Ethernet priority field.

i)   The LAN Switch shall support drop precedence within at least 2 traffic classes and shall support configurable mapping to both the classes as well as drop precedence from the 8 possible values of the Ethernet priority field.

j)   The LAN Switch(s) shall support scheduling of the interface queues according to their assigned priority and weight. The number of priorities shall be at least 2;

however multiple queues shall be assigned to the same priority. Queues assigned to the same priority shall be scheduled according to a weighted algorithm (like WFQ or equivalent) with weights assigned through provisioning. This mechanism provides support for mapping diffserv PHBs (e.g. EF, AF, BE, LE) to the Ethernet queues.

k) The LAN Switch shall support at least 4 queues scalable to 6 per interface, one per traffic class.

l) The LAN Switch shall support scheduling of queues according to strict priority with the number of priority levels being 2 or more.

m) The LAN Switch shall support setting the maximum size/depth of all queues.

n) Policy based bandwidth classification

o) Bandwidth management reports and statistics

p) Bandwidth management policies

q) Policy based QoS

r) Congestion avoidance mechanism WRED and WFQ.

s) IEEE 802.1p priority marking. All 8 values shall be supported.

3.2.7   Management and Security:-

The switch shall support the following management and security features:-

i. **SNMP Manageability:** Shall support SNMP v3. RMON (Remote Monitoring) MIB I, II shall also be supported. The public and private MIB shall be provided to service provider.

ii. **Access Security:** The switches shall have password protection features on Telnet access to the box. The LAN Switch shall support Secure Shell Access.

iii. **Console and Out-of-band management:** The switch shall have console management access along with provision for remote out-of-band management. Switch CLI access control shall be on the basis of user name and password for separate users.

iv. **FTP / TFTP:** The switch shall support FTP / TFTP access to its configuration/boot files.

v. **LAN** switch should support TACACS+ and RADIUS authentication for centralized AAA and control.

vi. **Configuration Software:** The switch shall support configuration management through a GUI based software configuration utility. Configuration management through the console is also required. Support of configuration on web interface shall be available.

vii. The LAN switch shall be manageable from a standards based NMS platform. The LAN switch NMS application shall be capable of running on a standards based NMS platform.

Network management software shall be standards based and shall support protocols like SNMP V3 and RMON. Support for standard MIBs is mandatory.

viii. The LAN switch shall support Network Time Protocol (NTP) / SNTP as per RFC 4330for synchronizing with a centralised NTP server.

ix. LAN Switch should support Layer 2 traceroute.

x. The LAN switch shall support DHCP server agent and relay functionalities.

3.2.8 Other parameters:- LAN switch shall provide the following features:-

i. LAN Switch shall not allow port to port traffic to prevent the by passing of network policy enforcement point by the users.

ii. Per VLAN MAC Learning to ensure MAC addresses are learnt only from a VLAN perspective and automatic / manual disabling of MAC addresses learning for the VLAN where there are less than two ports in that VLAN.

iii. Shall support L2 Learning parameters: source learning per Port / VLAN / Source address.

iv. It shall be possible to enabled L2 Aging on every port.

v. It shall be possible to set per port dynamic MAC learning limit.

vi. It shall be possible to set per port static MAC configuration.

vii. Shall support standard MTU Frame Sizes from 64 bytes to 1500 and Jumbo frames of at least 9000 bytes on all ports.

PART-3 REQUIREMENTS FOR CATEGORY-II LAN SWITCHES

3.3 Functional Requirements of LAN Switch for Metro Ethernet Aggregation / Distribution Network (Category II):-

i. The LAN switch shall support a console port or auxiliary port for the purpose of local and remote configuration and diagnostics.

ii. The LAN switch shall support extensive debugging capabilities to assist in hardware and software problem resolution.

iii. The LAN switch shall support the adequate memory to meet the full configuration requirement.

iv. The individual port on LAN Switch shall support 1,488,100 packets per second (pps) on Gigabit Ethernet in Full Duplex; 148,810 pps on 100 Mbps Full Duplex Ethernet; 14,881 pps on 10 Mbps Full Duplex Ethernet at Minimum Frame size of 64 Bytes on Ethernet.

v. The LAN switch shall support built in power diagnostics system to detect hardware failures.

vi. The LAN Switch shall be capable of working with 220V AC with variance of +/- 20% as the supply is always through UPS. LAN Switch shall also be capable of working with -44 V to -57 V DC.

vii. The performance of device shall not be degraded upon enabling of one or more features.

viii. All the interfaces on the devices shall be supported as integrated interfaces and shall not require any external converters/ adapters.

ix. The line interface slots in the devices shall be universal.

x. High Range shall be chassis based and Medium/Low range shall be Chassis based or stackable or standalone.

xi. The switch shall support ITU-T standard for Phy level distribution of precision frequency.

xii. The switch shall support E-Line, E-LAN and E-Tree Services as specified in the MEF standards.

xiii. The switch should support multilevel priority scheduling for voice and video applications with minimal jitter, latency and packet loss.

xiv. The performance of device shall not be degraded upon enabling of one or more features.

3.3.1 Availability / Redundancy: -LAN Switch shall have the following features to ensure high availability and redundancy.

i.   Comprehensive hardware and software fault isolation and recovery features shall be supported.

ii.   The LAN Switch shall support dynamic online configuration.

iii. The High chassis based LAN Metro Switch shall support non-disruptive hot-swap of interface modules.

iv.   The fans used shall be in redundant configuration.

v.   For High range chassis switches, all type of interfaces shall be supplied on at least two cards mounted in different physical slots of chassis.

vi.   For High range chassis based switches the removal or addition of any cards shall not disrupt traffic on other cards.

vii. A single point failure on the high/medium range chassis based switches shall not result in network or network management system downtime.

viii. High / Medium Range chassis based switches shall support redundant control and fabric modules such that failure of any one module should not degrade the services.

ix.   The switch shall support PW Redundancy with MAC withdrawal (Optional)

x.   The High / Medium Range switches shall support transmission of a multicast join message from a receiver toward a source on a primary path, while also transmitting a secondary multicast join message from the receiver toward the source on a backup path to minimize convergence times in the event of node or link failures on the primary path.

xi.   The switch shall support Ethernet protection based on ITU-T G.8031,/G.8032.

3.3.2   Protocols: - It shall support the following protocols:-

i.   Spanning Tree Protocol (IEEE 802.1d):-

a. The Switching Module shall support fault-tolerant connections to other switches or shared media segments to protect against a primary link failure. If the primary link fails, the backup path shall be automatically activated to maintain network connectivity and throughput.
b. An LAN Switch shall be able to prioritize BPDUs in the data plane (by providing dedicated queues) and in the control plane (by providing dedicated CPU queues for BPDUs).
c. An LAN Switch shall be able to drop BPDUs if those BPDUs have a root bridge identifier which is lower (better) than the current Spanning Tree root. This function shall be configurable on a per port basis.
d. An LAN Switch shall be able to drop BPDUs regardless of the BPDU content. This function shall be configurable on a per port basis.

ii.   Link-layer discovery protocol (802.1ab) or similar protocol.

iii. Logical Link Control (IEEE 802.2)

iv.   Flow Control (IEEE 802.3x)

v.   SNMP v3

vi.   TFTP

vii. Telnet

viii. SSH

ix.   It shall support Port trunking capability at Layer 2.

x.   Link Aggregation as per IEEE 802.3ad to allow link resilience. load balancing over IEEE 802.3ad Aggregated Links shall also be supported

xi.   IEEE 802.1q tagging and stacking support

xii.   IEEE 802.1w VLAN RST (Rapid Spanning Tree) and IEEE 802.1s VLAN MST (Multiple Spanning Tree). Minimum two instances of Multiple Spanning Tree shall be supported.

xiii.   The switch shall support both IPv4 and IPv6 routing protocols.

xiv.   LAN Switch shall support VRRP (Virtual Router Redundancy Protocol) as described in RFC 5798 for both IPv4 and IPv6 networks.

3.3.3   VLAN features: The Metro Aggregation Switch shall support the following VLAN features:

i.   VLAN shall be possible to be created among ports of different types as well as ports on the interface cards.

ii.   The LAN Switch shall support VLAN Bridge (for outer tag only) as per 802.1ad.

iii.   The LAN Switch shall support user isolation per outer VLAN tag. This behaviour shall be configurable on a per VLAN basis.

iv.   4000 VLANs (as per IEEE 802.1q) shall be supported.

v.   VLAN ingress filtering to Prevent VLAN leakage.

vi.   VLAN Tag overlapping

vii.   VLAN CoS preservation

viii.   VLAN CoS differentiation

ix.   It shall support 802.1Q Tagging Support in the following manner:

      a.   Tagged Only, which is an 802.1Q trunk

      b.   Untagged

      c.   Hybrid, tagged and untagged frames.

      d.   tag insertion, removal and swapping.

      e.   capability of insertion and removal of second tag.

      f.   The switch shall support Encapsulation translation and rewrites: Push, pop and translate for 802.1Q /IEEE 802.1ad tags.

      g.   The switch shall support local VLAN and ports cross-connect and multipoint or point-to-multipoint with Hierarchical Virtual Private LAN service (H-VPLS: VPLS bridged topologies with pseudowires) or locally defined bridge domains. (Optional)

x.   Virtual Private LAN Services (VPLS), Hierarchical VPLS (H-VPLS), Virtual Private Wire Service (VPWS), Ethernet over MPLS (EoMPLS), and multisegment pseudowire stitching.(Optional)

3.3.4   Multicast capabilities:

The LAN Switch shall support Internet Group Management Protocol (IGMP) v2 and v3 as

described in RFC 2236 and RFC 3376.

The following IGMP capabilities shall be supported:-

i. Multicast capabilities in IPv4:-

    a. The LAN Switch shall provide statistics on all active group and sources and per a VLAN and port basis.

    b. The LAN Switch shall support an IGMP v3 transparent snooping function.

    c. Source-based and shared distribution trees, Protocol Independent Multicast sparse mode (PIM-SM), PIM Source Specific Multicast (PIM SSM), Automatic route processing (AutoRP). Multiprotocol BGP (MBGP) and Multicast Source Discovery Protocol (MSDP) shall be applicable for category I and III high range chassis based L3 switches only.

    d. The High/Medium Range switches shall support transmission of a multicast join message from a receiver toward a source on a primary path, while also transmitting a secondary multicast join message from the receiver toward the source on a backup path to minimize convergence times in the event of node or link failures on the primary path.

ii. LAN switch shall also support anycast capabilities.

3.3.5 QoS:- The switch shall support the following QoS features per port and per VLAN:-

i. Filtering

ii. Broadcast suppression

iii. Link load balancing

iv. Rate limiting of bandwidth on the switch ports

v. Traffic prioritization

vi. Traffic Shaping

vii. Rate limiting of bandwidth: shall support User bandwidth from 1Mb/s to 1Gbps in 1Mb/s increment.

viii. Tendering authority shall indicate the actual no of queues. No of queues are required for per flow treatment of traffic, which is required in case there is no other device (e.g. BRAS) is doing the same.

ix. The LAN Switch shall support scheduling of queues according to strict priority with the number of priority levels being 2 or more.

x. The LAN Switch shall support setting the maximum size / depth of all queues.

xi. Policy based bandwidth classification.

xii. Bandwidth management reports and statistics.

xiii. Bandwidth management policies.

xiv. Policy based QoS.

xv. Congestion avoidance mechanism WRED, WFQ.

xvi. IEEE 802.1p priority marking. All 8 values shall be supported.

3.3.6 xviii. The switch shall optionally support tiered QoS (Hierarchical Quality of Service)**Management and Security**

The switch shall support the following management and security features.

i. IEEE 802.3ah: Ethernet Link OAM (EFM OAM) (Optional)MEF E-LMI: Ethernet Local Management Interface

ii. IEEE 802.1ag: Connectivity Fault Management (CFM)

iii. ITU-T Y.1731: OAM functions and mechanisms for Ethernet based networks.

iv. Ethernet SLA monitoring: Performance Management using CFM and Y.1731 Mechanisms.

v. MPLS/MPLS-TP OAM (label switched path [LSP] ping, LSP traceroute and Virtual Circuit Connectivity Verification [VCCV]) (Optional)

vi. **SNMP Manageability:** Shall support SNMP version 3. RMON (Remote Monitoring) MIB I, II shall also be supported. The public and private MIB shall be provided to service provider.

vii. Access Security: The switches shall have password protection features on Telnet access to the box. The LAN Switch shall support Secure Shell Access.

viii. Console and Out-of-band management: The switch shall have console management access along with provision for remote out-of-band management. Switch CLI access control shall be on the basis of user name and password for separate users.

ix. FTP / TFTP: The switch shall support FTP / TFTP access to its configuration/boot files.

x. Configuration Software: The switch shall support configuration management through a GUI based software configuration utility. Configuration management through the console is also required. Support of configuration on web interface shall be available.

xi. The LAN switch shall be manageable from a standards based NMS platform. The LAN switch NMS application shall be capable of running on a standards based NMS platform. Network management software shall be standards based and shall support protocols like SNMP V3 and RMON. Support for standard MIBs is mandatory

xi. The LAN switch shall support Network Time Protocol (NTP) / SNTP as per RFC 4330for synchronizing with a centralised NTP server.

3.3.7 **Other parameters:** LAN switch shall provide the following features:

i. LAN Switch shall not allow port to port traffic to prevent the by passing of network policy enforcement point by the users.

ii. Per VLAN MAC Learning to ensure MAC addresses are learnt only from a VLAN perspective and automatic/ manual disabling of MAC addresses learning for the VLAN where there are less than two ports in that VLAN.

iii. shall support L2 Learning parameters as below:

Source learning per Port / VLAN / Source address.

iv. It shall be possible to enabled L2 Aging on every port.

v. It shall be possible to set per port dynamic MAC learning limit.

vi. It shall be possible to set per port static MAC configuration.

vii. Shall support Frame Sizes from 64 byte to 1600 and to 9200(not on FE) byte on all ports.

viii. LAN Switch shall work as simple DHCP relay

ix. LAN Switch shall support IP SLA

x. It shall support Policy Based Routing (PBR)

xi. It shall support Captive Portal redirection, per port downloadable ACL, CoA (Optional)

PART-4 REQUIREMENTS FOR CATEGORY-III LAN SWITCHES

3.4 Functional Requirements of LAN Switch for Data Centre Aggregation (Category III):-

i. The LAN switch shall support non-disruptive software upgrades.

ii. The LAN switch shall support a console port or auxiliary port for the purpose of local and remote configuration and diagnostics.

iii. The LAN switch shall support extensive debugging capabilities to assist in hardware and software problem resolution.

iv. The LAN switch shall support the adequate memory to meet the full configuration requirement.

v. The switching fabric /backplane shall be non-blocking supporting wire speed interface. The chassis shall be fully configured for concerned Category. The switch shall support a wire speed L2 switching and wire speed L3 routing capabilities under full load conditions.

vi. The individual interface on LAN Switch shall support 1,488,100 packets per second (pps) on Gigabit Ethernet in Full Duplex; 148,810 pps on 100 Mbps Full Duplex Ethernet; 14,881 pps on 10 Mbps Full Duplex Ethernet at Minimum Frame size of 64 Bytes on Ethernet.

vii. The LAN switch shall support built in power diagnostics system to detect hardware failures.

viii. The LAN Switch shall be capable of working with 220 V AC with variance of +/- 20% as the supply is always through UPS.

LAN Switch shall also be capable of working with -44 V to -57 V DC.

ix. LAN Switch shall be modular in design (chassis based) and shall be able to interconnect networks which support different media and topology.

x. The performance of device shall not be degraded upon enabling of one or more features.

xi. The removal or addition of any cards shall not disrupt traffic on other cards.

xii. All the interfaces on the devices shall be supported as integrated interfaces and shall not require any external converters / adapters.

xiii. No data interfaces shall be provided in the Control Card / module.

xiv. The line interface slots in the devices shall be universal.

xv. Data Center Switch should have capability to support creation of 3 or more separate logical devices within the switch. Each such logical device/logical switch should be able to maintain its own unique set of running software, processes, VLANs, VRFs, having its own configuration, and being managed by a separate administrator.

xvi. Stateful Switchover and Nonstop Forwarding to ensure that in case of failure of active CPU module the redundant CPU should start switching L2 / L3 traffic in less than 1 sec.

xvii. The switch should support roll back to earlier configurations (checkpointing / mile stoning of multiple configurations) for ease of restoration in case of problems. Each logical device context should be able to maintain its own set of configuration

checkpoints.

xviii. The DC switch shall support multiple chassis's architecture. It should support link aggregation across 2 physical switches.

xix. The Data Center Core Switch should support converged traffic through standards based Fibre Channel over Ethernet protocol (INCITS FC-BB-5). Interoperability issues, if any, shall be resolved by the vendor for the tendering authority will specify the interoperability requirements for the FCOE.

3.4.1 Availability / Redundancy:-

LAN Switch shall have the following features to ensure high availability and redundancy:-

i. All mission critical modules must be identified and provided in full redundant

ii. Configuration for high reliability.

iii. A single point failure on the equipment shall not result in equipment or network management system downtime.

iv. Comprehensive hardware and software fault isolation and recovery features shall be supported.

v. The LAN Switch shall support dynamic online configuration.

vi. The LAN Switch shall support non-disruptive hot-swap of modules.

vii. The LAN switch shall support hot standby dual operating software image and dual configuration files for redundancy.

viii. All type of interfaces shall be supplied on at least two cards mounted in different physical slots of chassis.

ix. A single point failure on the equipment shall not result in network or network management system downtime.

x. Wherever the redundant interface(s) have been asked, the same shall be provided using interface(s) on different cards mounted in different physical slots of chassis.

xi. The LAN switch shall support hot-Pluggable redundant, load sharing power supplies (in load sharing modes).

xii. The interface modules shall support Online Insertion and Removal capability.

xiii. The LAN switch shall support fast convergence on the backbone links and uplinks.

xiv. The fans used shall be in redundant configuration.

xv. The Switch should support key Layer 2 data center interconnect technologies - MAC-in-MAC or MPLS.

3.4.2 Protocols:- It shall support the following protocols:

i. Spanning Tree Protocol (IEEE 802.1d):-

a) The Switching Module shall possess redundant load balancing capability to support fault-tolerant connections to other switches or shared media segments to protect against a primary link failure. If the primary link fails, the backup path shall be automatically activated to maintain network connectivity and throughput.

b) An LAN Switch shall be able to prioritize BPDUs in the data plane (by providing dedicated queues) and in the control plane (by providing dedicated CPU queues for BPDUs).

c) An LAN Switch shall be able to drop BPDUs if those BPDUs have a root bridge identifier which is lower (better) than the current Spanning Tree root. This function shall be configurable on a per port basis.

d) An LAN Switch shall be able to drop BPDUs regardless of the BPDU content. This function shall be configurable on a per port basis.

ii. Logical Link Control (IEEE 802.2)

iii. Flow Control (IEEE 802.3x)

iv. SNMP v3

v. TFTP

vi. Telnet

vii. SSH

viii. It shall support Port trunking capability at Layer 2.

ix. Link Aggregation as per IEEE802.3ad to allow link resilience load balancing over IEEE 802.3ad Aggregated Links shall also be supported.

x. IEEE 802.1Q tagging support

xi. IEEE 802.1w VLAN RST (Rapid Spanning Tree) and IEEE 802.1s VLAN MST (Multiple Spanning Tree). Minimum two instances of Multiple Spanning Tree shall be supported.

3.4.3 **Layer-3 Features:** The LAN switch shall support the following layer 3 capabilities. Requirement of the same shall be indicated by the tendering authority.

i. IP routing protocols – RIP2 & OSPF and shall be supported for both IPv4 and IPv6.

ii. Intelligent Queuing based on IP ToS bits for scalability.

iii. IP precedence classification

iv. Diffserv support.

v. QoS classification of packets.

vi. Above protocols shall also be supported for IPv6.

vii. VRRP for IPv6 interfaces shall be supported for instant failover.

viii. The LAN Switch shall support a minimum of 1,25,000 Layer 3 IPv4 and IPv6 Routes together.

3.4.4 **VLAN features:** The LAN switch shall support the following VLAN features:

i. VLAN shall be possible to be created among ports of different types as well as ports on the interface cards.

ii. The LAN Switch shall support VLAN Bridge (for outer tag only) as per 802.1ad.

iii. The LAN Switch shall support user isolation per outer VLAN tag. This behaviour shall be configurable on a per VLAN basis.

iv.   VLAN shall be possible to be created among ports of different types as well as ports on the interface cards.

v.   4000 VLANs (as per IEEE 802.1Q) shall be supported.

vi.   Private VLAN on layer-2.

3.4.5 Multicast capabilities: The LAN switch shall support the following multicast capabilities

i.   IGMP v2 and v3 as described in RFC 2236 and RFC 3376.

ii.   PIM-SM and PIM-SSM

iii.   Support for Multicast capabilities in IPv4

iv.   LAN switch shall support anycast capabilities.

3.4.6 QoS:- The LAN switch shall support the following QoS features per port and for each VLAN:-

i.   Filtering

ii.   Broadcast/Multicast suppression.

iii.   Link Load balancing in IPv4 and IPv6 (using Anycast).

iv.   Rate limiting of bandwidth on the switch ports

v.   Traffic prioritization

vi.   Traffic Shaping

vii.   Rate limiting of bandwidth: shall support User bandwidth from 1Mb/s to 1Gbps in 1Mb/s increment.

viii.   Bandwidth management reports and statistics

ix.   Bandwidth management policies

x.   Policy based QoS

xi.   IEEE 802.1p priority marking. All 8 values shall be supported.

3.4.7 Management and Security: The switch shall support the following management and security features.

i.   **SNMP Manageability:** Shall support SNMP ver 3. RMON (Remote Monitoring) MIB I, II shall also be supported. The public and private MIB shall be provided to service provider.

ii.   **Access Security:** The switches shall have password protection features on Telnet access to the box. The LAN Switch shall support Secure Shell Access.

iii.   **Console and Out-of-band management:** The switch shall have console management access along with provision for remote out-of-band management. Switch CLI access control shall be on the basis of user name and password for separate users.

iv.   **FTP / TFTP:** The switch shall support FTP / TFTP access to its configuration/boot files.

v.   **Configuration Software:** The switch shall support configuration management through a GUI based software configuration utility. Configuration management

through the console is also required. Support of configuration on web interface shall be available.

vi. The LAN switch shall be manageable from a standards based NMS platform. The LAN switch NMS application shall be capable of running on a standards based NMS platform. Network management software shall be standards based and shall support protocols like SNMP V3 and RMON. Support for standard MIBs is mandatory.

vii. The LAN switch shall support Network Time Protocol (NTP) / SNTP as per RFC 4330 for synchronizing with a centralised NTP server.

viii. Trace Route feature (MAC Trace in layer-2 and IP trace in Layer-3 as optional features).

ix. Should support port mirroring over L2 / L3 networks – both local and remote

x. Should support integrated security features like DHCP snooping, Dynamic ARP Inspection (IPv4 only), IP Source Guard and uRPF (unicast Reverse Path Forwarding), Neighbour Spoofing in IPv6.

xi. Should support layer 2 traceroute.

xii. DC Switch should support Private VLAN.

xiii. DC Switch should support MAC Address Filtering based on source and destination address.

PART-5 REQUIREMENTS FOR CATEGORY-IV LAN SWITCHES

3.5 Functional Requirements of LAN Switch for Intranet Application / CPE (Category IV):-

i. The LAN switch shall support a console port or auxiliary port for the purpose of local and remote configuration and diagnostics.

ii. The LAN switch shall support extensive debugging capabilities to assist in hardware and software problem resolution.

iii. The LAN switch shall support the adequate memory to meet the full configuration requirement.

iv. The individual interface on LAN Switch shall support 1,488,100 packets per second (pps) on Gigabit Ethernet in Full Duplex; 148,810 pps on 100 Mbps Full Duplex Ethernet; 14,881 pps on 10 Mbps Full Duplex Ethernet at Minimum Frame size of 84 Bytes on Ethernet.

v. The LAN switch shall support built in power diagnostics system to detect hardware failures.

vi. The LAN Switch shall be capable of working with 180 – 250V, 50 Hz AC power supply. It shall have over voltage protection. The exact power requirement shall be indicated by Tendering authority.

vii. The performance of device shall not be degraded upon enabling of one or more features.

viii. Switch shall support   optionally PoE/POE+ as per standard IEEE 802.3af/802.2at with following Power Budget Requirements

   a. 24 Port Switch (PoE) _- 370W, 8-Port Switch (PoE) – 120 W

   b. 24 port Switch(PoE+) – 740W

   c. 48 Port (PoE/PoE+) – 740W

ix. Each Port on PoE/PoE+ Switch should be flexibly configurable as PoE or PoE+ or Non POE. .

x. PoE based switches should support persistent PoE on each port which ensures the Power supply to be made available to PoE connected device in case of switch undergoing reboot

In Chassis based Switches, the removal or addition of any cards shall not disrupt traffic on other cards.

xi. All the interfaces on the devices shall be supported as integrated interfaces and shall not require any external converters / adapters.

xii. Shall support Redundant Power Supplies. (Optional)

xiii. LAN Switch shall be standalone fixed configuration or stackable.

3.5.1 Availability / Redundancy

i. Comprehensive hardware and software fault isolation and recovery features shall be supported.

ii. The LAN Switch shall support dynamic online configuration.

iii. Switches can be of fanless design or in case of design with fans it shall be in

redundant configuration,

3.5.2 Protocols:- It shall support the following protocols:

    i.   Spanning Tree Protocol (IEEE 802.1d)

        a.   The Switching Module shall possess redundant load balancing capability to support fault-tolerant connections to other switches or shared media segments to protect against a primary link failure. If the primary link fails, the backup path shall be automatically activated to maintain network connectivity and throughput.

        b.   An LAN Switch shall be able to prioritize BPDUs in the data plane (by providing dedicated queues) and in the control plane (by providing dedicated CPU queues for BPDUs).

        c.   An LAN Switch shall be able to drop BPDUs if those BPDUs have a root bridge identifier which is lower (better) than the current Spanning Tree root. This function shall be configurable on a per port basis.

        d.   An LAN Switch shall be able to drop BPDUs regardless of the BPDU content. This function shall be configurable on a per port basis.

    ii.   Flow Control (IEEE 802.3x)

    iii.   SNMP v3

    iv.   TFTP

    v.   Telnet

    vi.   SSH

    vii.   It shall support Port trunking capability at Layer 2.

    viii. Link Aggregation as per IEEE 802.3ad to allow link resilience. Load balancing over IEEE 802.3ad Aggregated Links shall also be supported.

    ix.   IEEE 802.1Q tagging support.

    x.   IEEE 802.1w VLAN RST (Rapid Spanning Tree) and IEEE 802.1s VLAN MST (Multiple Spanning Tree). Minimum two instances of Multiple Spanning Tree shall be supported.

3.5.3 VLAN features: VLAN shall be possible to be created among ports of different types. as well as ports on the interface cards.(In case of Chassis based Switch)

3.5.4 Layer-3 Features: (Optional)

The LAN switch shall support the following layer 3 capabilities. Requirement of the same shall be indicated by the tendering authority.

i   IP routing protocols – Static Routing and OSPF shall be supported for both IPv4 and IPv6.

ii   PIM (Protocol Independent Multicast)-Sparse Mode (PIM-SM), and Source Specific Multicast (PIM-SSM).

3.5.5 Multicast capabilities: The LAN switch shall support Internet Group Management

Protocol (IGMP) v2 and v3 as described in RFC 2236 & RFC 3376.

3.5.6 QoS:- The LAN switch shall support the following QoS features per port and for each VLAN:-

    i.   Filtering

    ii.   Broadcast suppression

    iii.   Link load balancing

    iv.   Rate limiting of bandwidth on the switch ports

    v.   Traffic prioritization

    vi.   Traffic Shaping

    vii.   Rate limiting of bandwidth: shall support User bandwidth from 1Mb/s to 1Gbps in 1Mb/s increment.

    viii.   Policy based bandwidth classification

    ix.   Bandwidth management reports and statistics

    x.   Bandwidth management policies

    xi.   IEEE 802.1p priority marking. All 8 values shall be supported.

    xii.   IPv6 ACL or QoS.

3.5.7 Management and Security

The switch shall support the following management and security features.

    i.   **SNMP Manageability:** Shall support SNMP ver 3. RMON (Remote Monitoring) MIB I, II shall also be supported. The public and private MIB shall be provided to service provider.

    ii.   **Access Security:** The switches shall have password protection features on Telnet access to the box. The LAN Switch shall support Secure Shell Access.

    iii.   **Console and Out-of-band management:** The switch shall have console management access along with provision for remote out-of-band management. Switch CLI access control shall be on the basis of user name and password for separate users.

    iv.   **FTP / TFTP:** The switch shall support FTP / TFTP access to its configuration/boot files.

    v.   **Configuration Software:** The switch shall support configuration management through a GUI based software configuration utility. Configuration management through the console is also required. Support of configuration on web interface shall be available.

    vi.   The LAN switch shall be manageable from a standards based NMS platform. The LAN switch NMS application shall be capable of running on a standards based NMS platform. Network management software shall be standards based and shall support protocols like SNMP V3 and RMON. Support for standard MIBs is mandatory.

    vii.   The LAN switch shall support Network Time Protocol (NTP) / SNTP as per RFC

4330for synchronizing with a centralised NTP server.

viii.   The LAN switch shall support both IPv4 and IPv6 host and management.

Other feature-sets

1. The LAN switch shall support Port Based 802.1x Security
2. It shall support Captive Portal redirection, per port downloadable ACL, CoA (Optional)

PART-6 REQUIREMENTS FOR CATEGORY-V Industrial Grade SWITCHES

3.6   Functional Requirements of Industrial Grade switches (Category V):-

I.   The Industrial Grade switch shall support a console port or auxiliary port for the purpose of local and remote configuration and diagnostics.

II.   The Industrial Grade switch shall support extensive debugging capabilities to assist in hardware and software problem resolution.

III. The Industrial Grade switch shall support the adequate memory to meet the full configuration requirement.

IV.   The individual interface on LAN Switch shall support 1,488,100 packets per second (pps) on Gigabit Ethernet in Full Duplex; 148,810 pps on 100 Mbps Full Duplex Ethernet; 14,881 pps on 10 Mbps Full Duplex Ethernet at Minimum Frame size of 84 Bytes on Ethernet.

V.   The Industrial Grade DIN Rail switch shall be -48v DC operating. It shall have over voltage protection. For AC feed industrial grade AC to DC compatible adapter shall be used.

VI.   Operating temperature -40Deg C to +70Deg C.

VII. The performance of device shall not be degraded upon enabling of one or more features.

VIII. All the interfaces on the devices shall be supported as integrated interfaces and shall not require any external converters / adapters.

IX.   Shall support dual feed Power Supply.

X.   Shall support Fan less design & low power consumption.

XI.   Industrial Grade switch shall be standalone fixed configuration.

XII. Switch shall support Non-PoE or PoE/POE+ as per standard IEEE 802.3af/802.2at respectively.

XIII. For the PoE/PoE+ switches PoE budget must sufficient to provide per port as per PoE/PoE+ standard.

XIV. PoE based switches should support persistent PoE on each port.

3.6.1   Protocols:- It shall support the following protocols:

i.   Spanning Tree Protocol (IEEE 802.1d)

ii.   Flow Control (IEEE 802.3x)

iii. SNMP v3

iv.   TFTP

v.   Telnet

vi.   SSH

vii. It shall support Port trunking capability at Layer 2.

viii. Link Aggregation as per IEEE 802.3ad to allow link resilience. Load balancing over IEEE 802.3ad Aggregated Links shall also be supported.

ix.   IEEE 802.1Q tagging support.

x.   IEEE 802.1w VLAN RST (Rapid Spanning Tree) and IEEE 802.1s VLAN MST (Multiple

Spanning Tree). Minimum two instances of Multiple Spanning Tree shall be supported.

3.6.2 VLAN features: VLAN shall be possible to be created among ports of different types.

3.6.3 Switch should support minimum of 128 Layer 3 IPv4 and IPv6 Routes together

3.6.4 Multicast capabilities: The LAN switch shall support Internet Group Management Protocol (IGMP) v2 and v3 as described in RFC 2236 & RFC 3376.

3.6.5 QoS:- The Industrial Grade switch shall support the following QoS features per port and for each VLAN:-

i   Filtering

ii   Broadcast suppression

iii Link load balancing

iv   Rate limiting of bandwidth on the switch ports

v   Traffic prioritization

vi   Traffic Shaping

vii Rate limiting of bandwidth: shall support User bandwidth from 1Mb/s to 1Gbps in 1Mb/s increment.

viii Policy based bandwidth classification

ix   Bandwidth management policies

x   IEEE 802.1p priority marking. All 8 values shall be supported.

xi   IPv6 ACL or QoS.

3.6.6 Management and Security

The switch shall support the following management and security features.

xiii.   **SNMP Manageability:** Shall support SNMP ver 3. RMON (Remote Monitoring) MIB I, II shall also be supported. The public and private MIB shall be provided to service provider.

xiv.   **Access Security:** The switches shall have password protection features on Telnet access to the box. The Industrial Grade switch shall support Secure Shell Access.

xv.   **Console and Out-of-band management:** The switch shall have console management access along with provision for remote out-of-band management. Switch CLI access control shall be on the basis of user name and password for separate users.

xvi.   **FTP / TFTP:** The switch shall support FTP / TFTP access to its configuration/boot files.

xvii.   **Configuration Software:** The switch shall support configuration management through a GUI based software configuration utility. Configuration management through the console is also required. Support of configuration on web interface

shall be available.

xviii. The LAN switch shall be manageable from a standards based NMS platform. The LAN switch NMS application shall be capable of running on a standards based NMS platform. Network management software shall be standards based and shall support protocols like SNMP V3 and RMON.

xix. The LAN switch shall support Network Time Protocol (NTP) / SNTP as per RFC 4330 for synchronizing with a centralised NTP server.

xx. The LAN switch shall support both IPv4 and IPv6 host and management.

3.6.7 Other features

i. The LAN Switches shall support dying gasp as per IEEE802.3ah

ii. It should support 6KV surge on each Ethernet port

iii. It shall be IPv6 ready Logo certified

iv. It shall support Port Security based on 802.1x

v. The switch should have max (No PoE Load) Power Consumption of 15 W.

PART-7 IPv6 REQUIREMENTS FOR ALL CATEGORY OF LAN SWITCHESs

3.7 **IPv6 Protocol Requirements:** The following IPv6 protocols shall be met by all category of LAN switches

3.7.1 **IP Routing Protocols [Applicable to LAN Switches with Layer-3 capabilities]:-**

  i.   RIPng for IPv6 as per RFC 2080

 ii.   OSPFv3 for IPv6 as per RFC 5340

iii.   IPv6 Static Routing

 iv.   IPv6 Route Redistribution

3.7.2 **General IPv6 support:-**

  i.   IPv6 Address types: Unicast (Unique Local IPv6 address as per RFC 4193), Anycast and Multicast.

 ii.   ICMPv6 as per RFC 2463

iii.   IPv6 Neighbor Discovery as per RFC 2461

 iv.   IPv6 stateless auto configuration as per RFC 4862

  v.   IPv6 MTU path discovery as per RFC 8201

 vi.   IPv6 ping

vii.   ICMPv6 redirect

viii.   ICMPv6 rate limiting

 ix.   IPv6 neighbor discovery duplicate address detection

  x.   IPv6 default router preference as per RFC 2711

 xi.   IPv6 access control

xii.   Syslog over IPv6

xiii.   IP SLAs for IPv6

xiv.   IPv6 Specification as per RFC 8200

 xv.   IPv6 Scoped Address Architecture as per RFC 4007

xvi.   ICMPv6 for IPv6 Specification as per RFC 4443

3.7.3 **IPv6 QoS:-**

  i.   Packet classification as per RFC 2474

 ii.   Traffic shaping

iii.   Traffic policing

 iv.   Packet marking/re-marking as per RFC 2475

v. IPv6 QoS queuing

vi. Weighted random early detection (WRED)- based drop

vii. Assured Forwarding PHB Group shall be as per RFC 2597

viii. LAN switch shall support An Expedited Forwarding PHB as per RFC 3246

3.7.4 IPv6 Services:-

i. Standard access control lists for IPv6

ii. Secure Shell (SSH) support over IPv6

iii. IPv6 MIB support

iv. SNMP over IPv6

v. Stateless DHCPv6

vi. DHCPv6 prefix delegation

vii. DHCP for IPv6 relay agent

viii. DHCPv6 prefix delegation via AAA

ix. DHCPv6 Server Stateless Auto Configuration

x. DHCPv6 Client Information Refresh Option.

xi. DHCPv6 relay agent notification for prefix delegation

xii. DHCPv6 relay- reload persistent interface ID option

xiii. DHCP - DHCPv6 Individual Address Assignment

xiv. LAN switch shall support Dynamic Host Configuration Protocol for IPv6 (DHCPv6) as per RFC 8415

xv. DNS Extensions to Support IP Version 6 as per RFC 3596

xvi. LAN switch shall support DHCP IPv6 Prefix Delegation RFC 3633

xvii. LAN switch shall support DNS Configuration options for DHCPv6 as per RFC 3646

xviii. LAN switch shall support Stateless DHCP Service for IPv6 as per RFC 3736

xix. IP Forwarding Table MIB as per RFC 4292

xx. Management Information Base for the Internet Protocol as per RFC 4293

xxi. Dynamic Host Configuration Protocol version 6 (DHCPv6) options as per RFC 3319.

3.7.5 IPv6 Multicast:-

i. IPv6 Multicast Listener Discovery (MLD) protocol versions 1 and 2

ii. IPv6 PIM sparse mode (PIM-SM)

iii. IPv6 PIM Source Specific Multicast (PIM-SSM)

iv. IPv6 multicast scope boundaries

v. IPv6 multicast MLD access group

vi. IPv6 multicast PIM accept register

vii. IPv6 multicast PIM embedded RP support

viii. IPv6 multicast RPF flooding of bootstrap router (BSR) packets

ix. IPv6 multicast routable address hello option

x. IPv6 multicast static multicast routing (mroute)

xi. IPv6 multicast SSM mapping for MLDv1 SSM

xii. IPv6 multicast IPv6 BSR—ability to configure RP mapping

xiii. IPv6 multicast MLD group limits

xiv. IPv6 Multicast Address Assignments as per RFC 2375

xv. IPv6 Multicast Listener Discovery (MLD) protocol, versions 1 and 2 as per RFC 2710

xvi. MLDv2 for IPv6 as per RFC 3810

xvii. Embedding the Rendezvous Point (RP) Address in an IPv6 Multicast Address as per RFC 3956

PART-8 Feature Mapping for various Category of LAN Switch

3.8.1 Category I & II

Features	I (Aggregation)		II (Metro Ethernet Aggregation)			II (Metro Ethernet Access)	
	A	B	A	B	C	D	E
	High Range	Low Range	High Range	Medium Range	Low Range	High Range	Low Range
Capacity (FD)	960 Gb	160 Gb	960 Gb	240 Gb	40 Gb	30 Gb	15 Gb
Type							
Chassis	Y	O	Y	O	N	N	N
Stackable	N	O	N	O	Y	O	N
Fixed / Standalone	N	O	N	O	Y	Y	Y
Layer-2							
Spanning Tree	Y	Y	Y	Y	Y	Y	Y
L2 Multicast (IGMP/MLD)	Y	Y	Y	Y	Y	Y	Y
Layer-3 Unicast (IPv4/v6)							
Static Routing	Y	Y	Y	Y	Y	Y	Y
VRRP	Y	Y	Y	Y	Y	Y	N
OSPF	Y	Y	O	O	O	O	N
RIP/RIPv2	Y	Y	O	O	O	O	N
BGP	Y	Y	O	O	O	O	N
MBGP	O	O	N	N	N	N	N
Layer-3 Multicast (IPv4/IPv6)							
PIM-SM	Y	Y	O	O	O	O	N
PIM-SSM	Y	Y	O	O	O	O	N
MPLS							
VPLS/H-VPLS	O	N	O	N	N	N	N
PW/VPWS	O	N	O	N	N	N	N
EoMPLS	O	N	O	N	N	N	N
MPLS-TE / FRR	O	N	O	N	N	N	N
QoS							
Classification/Filtering	Y	Y	Y	Y	Y	Y	Y

Traffic prioritization	Y	Y	Y	Y	Y	Y	Y
Traffic shaping	Y	Y	Y	Y	Y	Y	Y
Rate Limiting	Y	Y	Y	Y	Y	Y	Y
H-QoS	O	N	O	N	N	N	N
OAM							
MPLS OAM	O	N	O	N	N	N	N
802.3ah	N	N	O	O	O	O	O
802.1ag	N	N	Y	Y	O	O	O
Y.1731	N	N	Y	Y	O	O	O
PoE / PoE+ Capability	N	N	N	N	N	N	N

3.8.2 Category III, IV & V

Features	III	IV		V Industrial Grade L2 Switches
	A	A	B	A
	High Range	High end	Low end	Field Switch
Capacity (FD)	3 Tb	52 Gb	28 Gb	12 Gb
Type				
Chassis	Y	N	N	N
Stackable	O	Y	N	N
Fixed / Standalone	O	Y	Y	Y
Layer-2				
Spanning Tree	Y	Y	Y	Y
L2 Multicast (IGMP/MLD)	Y	Y	Y	Y
Layer-3 Unicast (IPv4/v6)				
Static Routing	Y	Y	Y	Y
VRRP	Y	Y	N	N
OSPF	Y	O	N	N
RIP/RIPv2	Y	O	N	N
BGP	Y	O	N	N
MBGP	O	N	N	N
Layer-3 Multicast (IPv4/IPv6)				
PIM-SM	Y	O	N	N
PIM-SSM	Y	O	N	N
MPLS				
VPLS/H-VPLS	N	N	N	N

PW/VPWS	N	N	N	N
EoMPLS	N	N	N	N
MPLS-TE / FRR	N	N	N	N
QoS				
Classification/Filtering	Y	Y	Y	Y
Traffic prioritization	Y	Y	Y	Y
Traffic shaping	Y	Y	Y	Y
Rate Limiting	Y	Y	Y	Y
H-QoS	N	N	N	N
OAM				
MPLS OAM	N	N	N	N
802.3ah	N	N	N	O
802.1ag	N	N	N	N
Y.1731	N	N	N	N
PoE / PoE+ Capability	N	O	O	O

Y – Yes, Required Feature
O – Optional Requirement
N – Not Required to be supported

4.0 INTERCONNECTIVITY & INTEROPERABILITY REQUIREMENTS

4.1 **Interface Requirements for Category I:-**The LAN switch shall support interfaces as indicated below:

i. 10/100/1000 Base-T Ethernet Electrical Interface (IEEE 802.3u).

ii. 1000 Base TX, SX, LX, Gigabit Ethernet Interfaces (IEEE 802.3z).

iii. 10 Gigabit Ethernet interface, IEEE 802.3au.

iv. 100 Gigabit Ethernet interface (for High range switches), IEEE802.ba/802.bj/802.bm/802.cd/802.ck/802.cu/802.ct/.

v. Full duplex capabilities on all ports.

4.2 **Interface Requirements for Category II:-** The LAN switch shall support interfaces as indicated below:

i. 10/100/1000 Base-T Ethernet Electrical Interface (IEEE 802.3u)

ii. 1000 Base TX, SX, LX, Gigabit Ethernet Interfaces (IEEE 802.3z)

iii. Full duplex capabilities on all ports.

iv. 10 Gigabit Base SX, LX, ZX on XFP/SFP/SFP+ interfaces (IEEE 802.3ae).

v. 100 Gigabit Ethernet interface (for High range switches), IEEE802.ba/802.bj/802.bm/802.cd/802.ck/802.cu/802.ct/.

4.3 **Interface Requirements for Category III:-** The LAN switch shall support interfaces as indicated below:

i. 10/100/1000 Base-T Ethernet Electrical Interface(IEEE 802.3u)

ii. 1000 Base TX, SX, LX, Gigabit Ethernet Interfaces (IEEE 802.3z)

iii. 10 Gigabit Ethernet interface, IEEE 802.3au (not on low range)

iv. Full duplex capabilities on all ports.

v. 100 Gigabit Ethernet interface, IEEE802.ba/802.bj/802.bm/802.cd/802.ck/802.cu/802.ct/.

4.4 **Interface Requirements for Category IV:-** The LAN switch shall support interfaces as indicated below:

i. 10/100/1000 Base-T Electrical Interface (IEEE 802.3u)

ii. 1000 Base TX, SX, LX, Gigabit Ethernet Interfaces (IEEE 802.3z)

iii. 10 Gigabit Base SX, LX, ZX on XFP/SFP/SFP+ interfaces (IEEE 802.3ae).

iv. Full duplex capabilities on all ports.

4.5   **Interface Requirements for Category V:-** Industrial Grade switch shall support interfaces as indicated below:

      <u>i</u>   10/100/1000 Base-T Electrical Interface (IEEE 802.3u)

      <u>ii</u>   1000 Base TX, SX, LX, Gigabit Ethernet Interfaces (IEEE 802.3z)

      <u>iii</u>   Full duplex capabilities on all ports.

As per requirement the type and number of ports and driving distance shall be specified by tendering authority.

4.6 All LAN Switches should optionally support SDN interfaces like SNMP/NETCONF/REST API via Domain Controller or equivalent.

5.0 QUALITATIVE REQUIREMENTS

5.1 The manufacturer shall furnish the MTBF value. Minimum value of MTBF   shall be 500,000 hours. The calculations shall be based on the guidelines given in either QA document No. QM-115 {January 1997} "Reliability Methods and Predictions" or any other international standards.

5.2 The equipment shall be manufactured in accordance with international quality management system ISO 9001:2015 or any other equivalent ISO certificate for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted.

5.3 The equipment shall conform to the requirements for Environment specified in TEC QA standards QM-333 {Issue- March, 2010} "Standard for Environmental testing of Telecommunication Equipments" or any other equivalent international standard, for operation, transportation and storage. The applicable tests shall be for environmental category "D" including vibration and corrosion (salt mist).

6.0 ELECTROMAGNETIC COMPATIBILITY (EMC) REQUIREMENTS

The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report from accredited test lab shall be furnished from a test agency.

a)   Conducted and radiated emission (applicable to telecom equipment):

Name of EMC Standard: "CISPR 32 (2015) with amendments - Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment".

Limits:-

i)   To comply with Class B of CISPR 32 (2015) with amendments for indoor deployments and Class A of CISPR 32 (2015) with amendments with amendments for outdoor deployments.

b)   Immunity to Electrostatic discharge:

Name of EMC Standard: IEC 61000-4-2 {2008} "Testing and measurement   techniques of Electrostatic discharge immunity test".

Limits:-

i)   Contact discharge level 2 {± 4 kV} or higher voltage;

ii)   Air discharge level 3 {± 8 kV} or higher voltage;

c)   Immunity to radiated RF:

Name of EMC Standard: IEC 61000-4-3 (2010) "Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test".

Limits:-

For Telecom Equipment and Telecom Terminal Equipment without Voice interface (s)

Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz and for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.

d)   Immunity to fast transients (burst):

Name of EMC Standard: IEC 61000-4-4 {2012}   "Testing and measurement techniques of electrical fast transients/burst immunity test".

Limits:-

Test Level 2 i.e.

a) 1 kV for AC/DC power lines;

b) 0. 5 kV for signal / control / data / telecom lines;

e)   Immunity to surges:

Name of EMC Standard: IEC 61000-4-5 (2014) "Testing & Measurement techniques for Surge immunity test".

Limits:-

i)   For mains power input ports : (a) 2 kV peak open circuit voltage for line to ground coupling (b) 1 kV peak open circuit voltage for line to line coupling

ii)   For telecom ports : (a) 2kV peak open circuit voltage for line to ground (b) 2KV peak open circuit voltage for line to line coupling.

f)   Immunity to conducted disturbance induced by Radio frequency fields:

Name of EMC Standard: IEC 61000-4-6 (2013) with amendments) "Testing & measurement techniques- Immunity to conducted disturbances induced by radio- frequency fields".

Limits:-

Under the test level 2 {3 V r.m.s.} in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.

g)   Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any):

Name of EMC Standard: IEC 61000-4-11 (2004) "Testing & measurement techniques- voltage dips, short interruptions and voltage variations immunity tests".

Limits:-

i)   a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e. 70 % supply voltage for 500 ms)

ii)   a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e. 40% supply voltage for 200ms) and

iii)   a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s.

iv)   a voltage interruption corresponding to a reduction of supply voltage of >95% for 10s.

h)   Immunity to voltage dips & short interruptions (applicable to only DC power input ports, if any):

Name of EMC Standard: IEC 61000-4-29:2000: Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests.

Limits:-

i.   Voltage Interruption with 0% of supply for 10ms. Applicable Performance Criteria shall be B.

ii.   Voltage Interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms. Applicable Performance Criteria shall be C.

iii.   Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms. Applicable Performance Criteria shall be B.

iv.   Voltage dip corresponding to 40% & 70% of supply for 100ms, 300 ms and 1000ms. Applicable Performance Criteria shall be C.

v.   Voltage variations corresponding to 80% and 120%of supply for 100 ms to10s as per Table 1c of IEC 61000-4-29. Applicable Performance Criteria shall be B.

Note: - For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC/SD/DD/EMC-221/05/OCT-16 and the referenced base standards i.e. IEC and CISPR standards and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (h) and TEC Standard TEC/SD/DD/EMC-221/05/OCT-16. The details of IEC/CISPR and their corresponding Euro Norms are as follows:

IEC/CISPR	Euro Norm
CISPR 11	EN 55011
CISPR 32	EN55032

IEC 61000-4-2	EN 61000-4-2
IEC 61000-4-3	EN 61000-4-3
IEC 61000-4-4	EN 61000-4-4
IEC 61000-4-5	EN 61000-4-5
IEC 61000-4-6	EN 61000-4-6
IEC 61000-4-11	EN 61000-4-11
IEC 61000-4-29	EN 61000-4-29

7.0   SAFETY REQUIREMENTS

7.1 The equipment shall conform to relevant safety requirements as per IS/IEC 62368-1:2018 or Latest as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024. The manufacturer/supplier shall submit a certificate in respect of compliance to these requirements.

8.0   SECURITY REQUIREMENTS

8.1   Category I:-The LAN switch must support the following security features:-

a) IP Filtering.

b) Trap and syslog messaging on security violation.

c) Controlled SNMP Access through implementation of Access Lists on the LAN switch to ensure SNMP access only to the SNMP manager or the NMS workstation.

d) Port mirroring should support;-

    i.   At least 10 sessions.

    ii. Option to filter incoming / outgoing traffic.

    iii. At least concentration ratio of 1:5 and

    iv. Support for SPAN (Switch Port Analyser) / RSPAN (Remote Switch Port Analyser).

e) Security mechanism to prevent unauthorized users from accessing the console port.

f) Port level security mechanism to prevent unauthorized nodes from accessing the switch.

g) LAN Switch should support DHCP Snooping and IP Source Guard in IPv4 & IPv6. It should also support ARP Security in IPv4.

h) Should support MAC based filtering to allow or deny access to a host.

i) LAN Switch should support Private VLAN.

8.2   Category II:- The LAN switch must support the following security features:

i.   Security through ACL filters for Layer 2 and Layer 3 traffic, MAC address limits and storm control for broadcast, multicast and unknown unicast.

ii. Authentication, authorization and accounting (AAA); TACACS+; Secure Shell (SSH) Protocol; 802.1ad Layer 2 Control Protocol (L2CP); bridge-protocol-data-unit (BPDU) filtering; MAC limiting per Ethernet flow point (EFP) or bridge domain; unicast, multicast, and broadcast storm control blocking on any interface or port; Unknown Unicast Flood Blocking (UUFB); Dynamic Host Configuration Protocol (DHCP) snooping; and Unicast Reverse Path Forwarding (URPF).

iii. Trap and syslog messaging on security violation.

iv. Controlled SNMP Access through implementation of Access Lists on the LAN switch to ensure SNMP access only to the SNMP manager or the NMS workstation.

v.   Port mirroring should support:-

    a.   At least 10 sessions.

    b.   Option to filter incoming / outgoing traffic.

    c.   At least concentration ratio of 1:5.

    d.   Support for SPAN (Switch Port Analyser).

e. Security mechanism to prevent unauthorized users from accessing the console port.

f. Port level security mechanism to prevent unauthorized nodes from accessing the switch.

vi. Filtering: The LAN Switch shall be capable of filtering L2 / L3 traffic configurable on per PVC per Service and per Session basis atleast for the following parameters:-

a. Broadcast Traffic / broadcast storm control

b. Source MAC/IP address

c. IP address

d. Source and destination IP address range

e. Destination layer 4 port number

f. Maximum MAC address

g. Protection from ARP spoofing attacks

h. Ether type

vii. It shall be possible to create VLAN or Flow with TCP / IP parameters per service, for data, video and O&M traffic for service differentiation.

viii. LAN Switch shall implement MAC / IP address based control. It shall be possible to limit the number of MAC / IP addresses per port and to bind the MAC / IP addresses to a port.

ix. MAC Security Related Features

a. The LAN Switch shall be able to filter and discard all Ethernet frames received on bridged ports in the upstream direction with a MAC destination address (DA) different than the broadband network gateway MAC address. This feature shall be configurable.

b. The LAN Switch shall not learn MAC address from bridge port X if the same MAC address appears in the learning table pointing to bridge port Y (ports X and Y on the same LAN Switch and same VLAN), except in the case where the aggregation network forwards according to MAC Learning table. The LAN Switch shall prevent broadband network gateway MAC address spoofing.

<center>or</center>

c. The LAN Switch shall support unique MAC address per user to prevent spoofing and provide traceability. Solution shall prevent duplicate MAC addresses in the network and be traceable to the customer line. If a virtual / translated MAC address is used it shall be based on public Organizationally Unique Identifier (OUI) address space.

d. In order to prevent MAC address flooding DoS attack, the LAN Switch shall be able to limit the number of source MAC addresses learnt from a bridged port. This limit shall be configurable per bridged port.

e. LAN Switch shall allow the list of allowable MAC destination address.

f. Proxy ARP shall be implemented in the LAN Switch such that all ARP requests from subscribers shall be given the MAC address of the Router that provides L3 aggregation of that VLAN. The ARP address that the LAN Switch responds with should be unique per VLAN.

8.3 **Category III:-** The LAN switch must support the following security features:

i. IP Filtering

ii. Trap and syslog messaging on security violation

iii. Controlled SNMP Access through implementation of Access Lists on the LAN switch to ensure SNMP access only to the SNMP manager or the NMS workstation.

iv. Port mirroring

v. Security mechanism to prevent unauthorized users from accessing the console port.

vi. Port level security mechanism to prevent unauthorized nodes from accessing the switch.

8.3.1 FCOE support confirming to latest ANSI / INCITS 462-2010 FC-BB-5 standards.

8.3.2 Multiple Data Center: Extension of Ethernet should be supported by core switch MAC-in-MAC or MPLS encapsulation .

8.3.3 Support of secured and encrypted communication within the data center switches (desirable features).

8.4 **Category IV:-** The LAN switch must support the following security features:

i. Trap and syslog messaging on security violation.

ii. Controlled SNMP Access through implementation of Access Lists on the LAN switch to ensure SNMP access only to the SNMP manager or the NMS workstation.

iii. Port mirroring.

iv. Security mechanism to prevent unauthorized users from accessing the console port.

v. Port level security mechanism to prevent unauthorized nodes from accessing the switch.

8.5 **Category V:-** The LAN switch must support the following security features:

vi. Trap and syslog messaging on security violation.

vii. Controlled SNMP Access through implementation of Access Lists on the LAN switch to ensure SNMP access only to the SNMP manager or the NMS workstation.

viii. Port mirroring.

ix. Security mechanism to prevent unauthorized users from accessing the console port.

x. Port level security mechanism to prevent unauthorized nodes from accessing the

switch.

8.6   The LAN switches shall meet the latest security certification requirements mandated by DoT

9.0   OTHER MANDATORY REQUIREMENTS

9.1   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.

9.2   Wherever, the standardized documents like ITU-T, IEEE, QA and TEC documents are referred, the latest issue and number with the amendments shall be applicable.

9.3   LAN switch shall support the Lawful Interception as per the latest guidelines / document of DoT.

9.4   Power Supply: The equipment power supply requirements are given for each of the category. In addition, it shall meet the following requirements:
   i.   The equipment shall be able to function over the range specified in this GR without any degradation in performance.
   ii.   The equipment shall be protected in case of voltage variation beyond the range specified and also against input reverse polarity.
   iii. The derived DC voltages shall have protection against short circuit, over voltage and overload.

9.5   It should have the capacity of combining multiple physical switches into one logical switch.

9.6   **Engineering Requirements (ER):-**The system shall meet the following engineering requirements:

   a)   The equipment shall adopt state of the art technology.

   b)   The actual dimensions and weight of the equipment shall be furnished by the manufacturers.

   c)   All connectors shall be reliable, low loss and standard type so as to ensure failure free operations over long operations.

   d)   All cables shall be of Gigabit Ethernet ready standards.

   e)   The equipment shall have:

      i.   Proper earthing arrangement,

      ii.   Protection against short circuit / open circuit

      iii. Protection against accidental operations for all switches/ controls provided in the front panel.

      iv.   Protection against entry of dust, insects and lizards.

9.7   **Operational Requirements (OR):-**The system shall meet the following maintenance & operational requirements:

   a)   The equipment shall be designed for continuous operation.

   b)   The manufacturer shall ensure satisfactory performance without any degradation at an altitude upto 3000 meters above mean sea level. .

   c)   Suitable visual indications for healthy, unhealthy conditions and for non-urgent alarms shall be provided.

   d)   The design of the equipment shall not allow plugging of a module in the wrong slot or

upside down.

e) The removal or addition of any interface cards shall not disrupt traffic on other cards.

f) Special tools required for wiring shall be provided along with the equipment.

g) A single point failure on the chassis based LAN switch shall not result in network or network management system downtime.

h) In the event of a bug 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.

i) In the event of a full system failure, a trace area shall be maintained in non-volatile memory for analysis and problem resolution.

j) Necessary alarms (indicators) for indication of faults at various levels of hardware shall be provided on the individual modules.

k) A power down condition shall not cause loss of connection configuration data storage.

l) The Hardware and software components shall not pose any problems in the normal functioning of all network elements wherever interfacing with service provider network for voice, data and transmission systems, as the case shall be.

m) Live Insertion and hot swap of modules shall be possible to ensure maximum network availability and easy maintainability.

10.0   DESIRABLE / OPTIONAL REQUIREMENTS

This chapter describes the desirable/optional requirements for the LAN switches. The exact requirement shall be specified by the purchaser at the time of tendering

10.1   DOCUMENTATION:-

This section describes the general requirements for documentation to be provided. This shall be applicable to all categories and categories of routers.

All technical documents shall be in English language both in CD-ROM and in hard copy.

The documents shall comprise of:-

1. System description documents
2. Installation, Operation and Maintenance documents
3. Training documents
4. Repair manual

10.1.1 System description documents: The following system description documents shall be supplied along with the system.

a) Over-all system specification and description of hardware and software.

b) Equipment layout drawings.

c) Cabling and wiring diagrams.

d) Schematic drawings of all circuits in the system with timing diagrams wherever necessary.

e) Detailed specification and description of all Input / Output devices

f) Adjustment procedures, if there are any field adjustable units.

g) Spare parts catalogue - including information on individual component values, tolerances, etc. enabling procurement from alternative sources.

h) Detailed description of software describing the principles, functions and interactions with hardware, structure of the program and data.

i) Detailed description of each individual software package indicating its functions and its linkage with the other packages, hardware, and data.

j) Program and data listings.

k) Graphical description of the system. In addition to the narrative description a functional description of the system using the functional Specification.

10.1.2 System operation documents: The following system operation documents shall be available.

a) Installation manuals and testing procedures.

b) Precautions for installation, operations and maintenance

c) Operating and Maintenance manual of the system.

d) Safety measures to be observed in handling the equipment

e) Man-machine language manual.

f) Fault location and trouble shooting instructions including fault dictionary.

g) Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance and unit / card / sub-assembly replacement.

h) Emergency action procedures and alarm dictionary.

10.1.3 Training Documents:-

a) Training manuals and documents necessary for organizing training in installation, operation and maintenance and repair of the system shall be made available.

b) Any provisional document, if supplied, shall be clearly indicated. The updates of all provisional documents shall be provided immediately following the issue of such updates.

c) The structure and scope of each document shall be clearly described.

d) The documents shall be well structured with detailed cross-referencing and indexing enabling easy identification of necessary information.

e) All diagrams, illustrations and tables shall be consistent with the relevant text.

10.1.4 Repair Manual:-

a) List of replaceable parts used

b) Detailed ordering information for all the replaceable parts

c) Procedure for trouble shooting and sub-assembly replacement

d) Test fixtures and accessories for repair

e) Systematic trouble shooting charts (fault tree) for all the probable faults with their remedial actions.

10.2 INSTALLATION:-

a) All necessary interfaces, connectors, connecting cables and accessories required for satisfactory installation and convenient operations shall be supplied. Type of connectors, adopters to be used shall be in conformity with the interfaces defined in this GR.

b) It shall be ensured that all testers, tools and support required for carrying out the stage by stage testing of the equipment before final commissioning of the network shall be supplied along with the equipment.

c) All installation materials, consumables and spare parts to be supplied.

d) All literature and instructions required for installation of the equipment, testing and bringing it to service shall be made available in English language.

e) For the installations to be carried out by the supplier, the time frames shall be furnished by the supplier including the important milestones of the installation process well before commencing the installations.

10.3 SOFTWARE MAINTENANCE:-

a) All the software updates shall be provided on continuous basis. These updates shall include new features and services and other maintenance updates.

b) The software for the support of all protocols and interfaces mentioned in this GR shall be ensured in the devices.

10.4 ADDITIONAL FUNCTIONAL REQUIREMENTS FOR CATEGORY I:-

i. The high & medium End LAN switch shall support the ability for multiple chassis's to behave as a single virtual chassis using virtual technology. It should support link aggregation across 2 physical switches.

ii Switch shall support Service modules like IPS, firewall and wireless control – either internally or externally.

iii. The LAN Switch shall support Stateful Switchover of user traffic and Non-stop Forwarding to ensure that in case of failure of active CPU module the redundant CPU should start forwarding L2/L3 traffic in less than 1 sec.

iv The LAN switch shall support the IP routing protocols BGP & ISIS layer 3 capabilities.

v. The High and Medium End LAN Switches shall have a modular OS or network structure for high availability, fault tolerance and fault isolation.

10.5 ADDITIONAL FUNCTIONAL REQUIREMENTS FOR CATEGORY II:-

i. The switch should support Layer 2 transport: EoMPLS pseudo wire aggregation and switching, H-VPLS (VPLS mesh in the core with access facing attachment circuit pseudowires) and point-to-multipoint multicast distribution with H-VPLS (VPLS bridged topologies with pseudo- wire split horizon enabled or disabled).

a. The switch should support Layer 3 transport: IP, MPLS (IP over MPLS and IP Multicast over VPLS pseudo-wires) and MPLS or IP Multicast VPN transport support for retail and wholesale triple play (data, voice and video) services.

b. The switch shall support flexible service mapping with dot1q trunk, dot1q tunnel, EoMPLSxconnect, attachment circuit functionality under same physical port simultaneously.

c. The switch should support multiplexing of multiple service instances from different physical ports into same bridge-domain, which could be associated to same EoMPLS pseudo wire.

ii. The switch shall support MPLS TE / FRR and IPFRR to ensure high availability and redundancy.

iii. Protocols:-

    a. MPLS and MPLS TE (including TE-FRR).

    b. Label Distribution Protocol (LDP), Targeted LDP (T-LDP), Resource Reservation Protocol (RSVP), Differentiated Services (DiffServ)-aware traffic engineering, MPLS L3VPN.

    c. Virtual Private LAN Services (VPLS), Hierarchical VPLS (H-VPLS), Virtual Private Wire Service (VPWS), Ethernet over MPLS (EoMPLS), and multi segment pseudowire stitching.

iv. VLAN Features: It shall support 802.1Q Tagging Support in the following manner: The switch shall support Point-to-point Ethernet transport based on Ethernet over MPLS (EoMPLS) pseudowire (with backup pseudowire support for redundancy).

10.6 ADDITIONAL FUNCTIONAL REQUIREMENT FOR CATEGORY III:-

    i. The LAN switch shall support the IP routing protocols BGP & ISIS layer 3 capabilities.

10.7 ADDITIONAL FUNCTIONAL REQUIREMENT FOR CATEGORY IV: High range LAN Switch shall support the following optional layer 3 capabilities.

    ii. IP routing protocols – Static Routing.

    iii. Intelligent Queuing based on IP ToS bits for scalability.

    iv. IP precedence classification

    v. Diffserv support.

    vi. QoS classification of packets.

    vii. VRRP IPv6 interfaces shall be supported for instant failover.

    viii. The LAN Switch shall support a minimum of 1000 Layer 3 IPv4 and IPv6 Routes together.

10.8   Guidelines for tendering authority

Clause	Description
3.2.ix, 3.3.vi, 3.4.ix, 3.5.vi	The exact power requirement should be indicated.
4.1.v, 4.2.iii, 4.3.iv, 4.4.iii	As per requirement the type and number of ports and driving distance should be specified.
3.2.3, 3.4.2.xii, 3.4.3	Support of layer 3 capabilities in LAN switch should be indicated if required.
10.1	Requirement of documentation
10.2	Installation Requirements
10.3	Software Requirements
10.4 to 10.7	Additional Functional Requirements

10.9   Minimum Equipments Required for Type approval

While offering the LAN Switches for Type Approval Certificate, the following shall be the minimum requirements and the same shall be mentioned in the Type Approval Certificate. The Type Approval certificate shall be issued for the offered category and Type.

10.9.1 Any Category and Type of the Switch

10.9.2 Minimum 8 Number of Interfaces

10.9.3 Atleast 2 Numbers of interface shall be available for an offered type of interface

GLOSSARY

ACL	-	Access Control List
ASIC	-	Application Specific Integrated Circuits
BGP	-	Border Gateway Protocol
BPDU	-	Bridge Protocol Data Unit
BOOTP	-	Boot Protocol
CD ROM	-	Compact Disc Read Only Memory
CIDR	-	Classless Inter Domain Routing
CLI	-	Called Party Identification
CPU	-	Central Processor Unit
DHCP	-	Dynamic Host Configuration Protocol
DSP	-	Digital Signalling Processor
DVMRP	-	Distance Vector Multicast Routing Protocol
EAPS	-	Ethernet Automatic Protection Switching
FTP	-	File Transfer Protocol
GVRP	-	GARP VLAN Registration Protocol
HTTP	-	Hyper Text Transfer Protocol
ICMP	-	Internet Control Message Control
IAP	-	Internet Access Point
IEEE	-	International Electrical and Electronics Engineering
IETF	-	Internet Engineering Task Force
IG	-	International Gateway
IGMP	-	Internet Group Management Protocol
IP	-	Internet Protocol
ISO	-	International Standard Organization.
ISP	-	Internet Service Provider
ITU-T	-	International Telecommunication Union - Telecom
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
LLDP	-	Link Layer Discovery Protocol
LQM	-	Link Quality Monitoring
MIB	-	Management Information Base
MTNL	-	Mahanagar Telephone Nigam Limited
MPLS	-	Multi Protocol Label Switching
MTU	-	Maximum Transmission Unit
MQC	-	Modular QoS Command-line interface
NAT	-	Network Address Translation

NMS	-	Network Management System
NTP	-	Network Time Protocol
PCB	-	Printed Card Board
PIM	-	Protocol Independent Multicast
PNNI	-	Private Network-Network Interface
POP	-	Point of Presence/ Post Office Protocol
OSI	-	Open System Interconnection
OSPF	-	Open Short Path First
PPP	-	Point to Point Protocol
QA	-	Quality Assurance
QoS	-	Quality of Service
RADIUS	-	Remote Authentication Dial In User Service
RAS	-	Remote Access Server
RFC	-	Request For Comments
RIP	-	Routing Information Protocol
RIPng	-	Routing Information Protocol Next Generation
RMON	-	Remote Monitoring
RTPS	-	Real-Time Publish Subscribe
RSVP	-	Resource Reservation Protocol
SDH	-	Synchronous Digital Hierarchy
SFTP	-	Secure File Transfer Protocol
SLIP	-	Serial Line Internet Protocol
SNMP	-	Simple Network Management Protocol
SMTP	-	Simple Mail Transfer Protocol
SSL	-	Secure Socket Layer
TCP	-	Transmission Control Protocol
TEC	-	Telecom Engineering Center
TFTP	-	Trivial File Transfer Protocol
TLS	-	Transport Layer Security
ToS	-	Type of Service
UDP	-	User Datagram Protocol
VLAN	-	Virtual Local Area Network (VLAN)
WAN	-	Wide Area Network
WRED	-	Weighted Random Entry Detection

- End of Document -