**1. Data Center Overview**

This data center features a high-availability setup built on **two Cisco Catalyst 9500 switches** operating in HA mode, ensuring resilient core networking. The compute layer comprises **four Dell servers** with iDRAC remote management, all running **Ubuntu Server 24.04 LTS**. **OpenStack** is deployed with a **single controller node** and **three compute nodes** to provide a scalable and flexible cloud environment. Storage is handled by a **Ceph cluster** that leverages both SSDs and HDDs to deliver high-performance, distributed storage supporting block storage.

**2. Verification of Product Specifications:**

**Annexure I**

|  |  |  |
| --- | --- | --- |
| **Firewall** | |  |
| **Quantity: 01** | |  |
| Make/Model | Industry leading OEMs |  |
| Firewall Throughput | 500Mbps |  |
| UTM Throughput | 300Mbps |  |
| DPI-SSL Throughput | 150 Mbps |  |
| New connections/second | 5000 |  |
| Concurrent connections (SPI) | 75,000 |  |
| Concurrent connections (DPI) | 50,000 |  |
| Port Configuration | 8 x 1 GbE, Configurable |  |
| 1 x Console Port |  |
| VPN | Site-to-Site |  |
| SSL |  |
| Management/Monitoring | CLI, SSH, Web UI |  |
| Certifications | RoHS |  |
| Warranty | 5 years on-site |  |

**Annexure - II**

|  |  |  |
| --- | --- | --- |
| **Type - 1 Server** | | |
| **Quantity: 02** | | |
| Make/Model | Reputed OEM | Dell PowerEdge R760 |
| Processor | 1x Intel Xeon 65XX series or AMD EPYC 9xx4 series 32 core processor, and L3 cache at least 60MB, and Base frequency at least 2.2 GHz having SPECrate2017\_int\_base score at least 310 and SPECrate2017\_fp\_base score at least 400 | Intel Xeon Gold 6548y+ |
| Chipset | Should support 02 no of above specified processor , Should have 32 DIMMM slots, should support 8TB RAM, should support 120 CPU cores, Should have 8 PCIe slots | Verified through Dell iDRAC Hardware Inventory |
| RAM | 128 GB DDR5 5600 MHz ECC | Verified through Dell iDRAC Hardware Inventory (CPU supported frequency is 5200 MT/s) |
| Storage | SSD 6 TB (2 x 1 TB + 2 x 2 TB) | Verified through Dell iDRAC Hardware Inventory |
| SAS/SATA 12TB (4 x 3 TB/6 x 2 TB) | Verified through Dell iDRAC Hardware Inventory |
| Should be equipped with a 12Gbps RAID controller (from same OEM) with 8GB nonvolatile cache capable of building RAID using mixed type drives (HDD and SSD) simultaneously and supporting different RAID types simultaneously | Verified through Dell iDRAC Hardware Inventory |
| Power Supply | 80Plus Platinum rated 2200 W, Hot plug, Fully Redundant Power Supply | Wattage Verified through Dell iDRAC Hardware Inventory, Platinum rating verified through datasheet |
| Fan | Fully redundant hot swappable Fan systems | Verified through Dell iDRAC Hardware Inventory |
| Network  Interface | 2 x 10 G SFP+, 2 x 1/10 G Base-T with additional 1G base T dedicated management port | Verified through Dell iDRAC Hardware Inventory |
| Form Factor | 1/2U Rack mountable | 2U, Verified by physical inspection |
| Security | 1. Silicon-based Hardware Root of Trust.  2. Automatic BIOS recovery.  3. Firmware drift detection & alerting.  4. Cryptographically signed firmware updates.  5. Cryptographically verified trusted booting standards meeting NIST SP 800- 147B, protection standards meeting NIST SP 800-193 standards & secure media sanitization standards meeting NIST SP 800-88.  6. System lockdown support to lock down configuration and firmware, protecting the server from inadvertent or malicious changes.  7. Secure default passwords during transit. Persistent event logging including user activity.  8. Drive security, including secure system erase for HDD, SSD & NVMe. 9. Protection against compromised firmware execution.  10. UEFI secure boot with custom certificates.  11. Intrusion alert in case chassis being opened. | Verified through the OEM’s compliance sheet submitted in the bid process |
| OS  Compatibility | RHEL, Ubuntu, Windows Server, KVM, and VMware | Verified through datasheet |
| Management | 1. The system should provide comprehensive monitoring of critical components, including the fan, power supply, memory, CPU, RAID, and NIC, with proactive reporting for impending failures.  2. All updates must be carried out using the OEM's access controller and management software to ensure security.  3. The system management software should support at least (but not limited to) virtual media, virtual folders, remote file sharing, and virtual consoles.  4. The integrated remote access controller must enable advanced agent-free local and remote server administration, offering capabilities such as configuration management, firmware updates, OS deployment, health monitoring, diagnostics, and the automation of routine management tasks, all backed by a perpetual license.  5. The system management software should provide a RESTful interface for the management of appliances through implementing Redfish standards. | Features verified through iDRAC and the OEM’s compliance sheet submitted in the bid process |
| Certifications | ISO/IEC 27001, UL, RoHS | Verified through the OEM’s compliance sheet |
| Warranty | 5 years on-site | Verified through Dell Portal for Service Tag: 3HFVN24 & 8TSWN24 |

**Annexure -III**

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| --- | --- | --- |
| **Type - 2 Server** | | |
| **Quantity: 02** | | |
| Make/Model | Reputed OEM | Dell PowerEdge R760 |
| Processor | 2x Intel Xeon 65XX series or AMD EPYC 9xx4 series 32 core processor, and L3 cache at least 60MB, and Base frequency at least 2.2 GHz having SPECrate2017\_int\_base score at least 310 and SPECrate2017\_fp\_base score at least 400 | 2xIntel Xeon Gold 6548y+ |
| Chipset | Should support 02 no of above specified processor , Should have 32 DIMMM slots, should support 8TB RAM, should support 120 CPU cores, Should have 8 PCIe slots | Verified through Dell iDRAC Hardware Inventory |
| RAM | 256 GB DDR5 5600 MHz ECC | Verified through Dell iDRAC Hardware Inventory (CPU supported frequency is 5200 MT/s) |
| Storage | SSD 6 TB (2 x 1 TB + 2 x 2 TB) | Verified through Dell iDRAC Hardware Inventory |
| SAS/SATA 12TB (4 x 3 TB/6 x 2 TB) | Verified through Dell iDRAC Hardware Inventory |
| Should be equipped with a 12Gbps RAID controller (from same OEM) with 8GB nonvolatile cache capable of building RAID using mixed type drives (HDD and SSD) simultaneously and supporting different RAID types simultaneously | Verified through Dell iDRAC Hardware Inventory |
| Power Supply | 80Plus Platinum rated 2200 W, Hot plug, Fully Redundant Power Supply | Wattage Verified through Dell iDRAC Hardware Inventory, Platinum rating verified through datasheet |
| Fan | Fully redundant hot swappable Fan systems | Verified through Dell iDRAC Hardware Inventory |
| Network  Interface | 2 x 10 G SFP+, 2 x 1/10 G Base-T with additional 1G base T dedicated management port | Verified through Dell iDRAC Hardware Inventory |
| Form Factor | 1U Rack mountable | 2U, Verified by physical inspection |
| Security | 1. Silicon-based Hardware Root of Trust.  2. Automatic BIOS recovery.  3. Firmware drift detection & alerting.  4. Cryptographically signed firmware updates.  5. Cryptographically verified trusted booting standards meeting NIST SP 800- 147B, protection standards meeting NIST SP 800-193 standards & secure media sanitization standards meeting NIST SP 800-88.  6. System lockdown support to lock down configuration and firmware, protecting the server from inadvertent or malicious changes.  7. Secure default passwords during transit. Persistent event logging including user activity.  8. Drive security, including secure system erase for HDD, SSD & NVMe. 9. Protection against compromised firmware execution.  10. UEFI secure boot with custom certificates.  11. Intrusion alert in case chassis being opened. | Verified through the OEM’s compliance sheet submitted in the bid process |
| OS  Compatibility | RHEL, Ubuntu, Windows Server, KVM, and VMware | Verified through datasheet |
| Management | 1. The system should provide comprehensive monitoring of critical components, including the fan, power supply, memory, CPU, RAID, and NIC, with proactive reporting for impending failures.  2. All updates must be carried out using the OEM's access controller and management software to ensure security.  3. The system management software should support at least (but not limited to) virtual media, virtual folders, remote file sharing, and virtual consoles. 4. The integrated remote access controller must enable advanced agent-free local and remote server administration, offering capabilities such as configuration management, firmware updates, OS deployment, health monitoring, diagnostics, and the automation of routine management tasks, all backed by a perpetual license.  5. The system management software should provide a RESTful interface for the management of appliances through implementing Redfish standards. | Features verified through iDRAC and the OEM’s compliance sheet submitted in the bid process |
| Certifications | ISO/IEC 27001, UL, RoHS | Verified through datasheet |
| Warranty | 5 years on-site | Verified through Dell Portal for Service Tag: 1C2WN24 & 7HFVN24 |

**Annexure IV**

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| **Technical Specification of Layer-3 Switch** | |
| **Quantity: 01 (with high availability)** | |
| **Physical Requirements** | |
| 1. The switch should be 1/2U 19" Rack Mountable. | 1U, Cisco C9500-48-Y4C |
| 2. The switch should have dual, redundant, field-replaceable, hot-swappable power supplies and fans with front-to-back airflow. Should have at-least 4 Fan modules and 2 power supplies installed from day 1. | Verified through datasheet and product web console |
| 3. The switch should have 48 ports of 10GbE/25GbE (SFP+/SFP28). The switch should be populated with atleast 6 Single Mode and 24 Multi Mode enterprise grade transceivers from same OEM from day 1. | Verified through Physical inspection and device web console |
| 4. The switch should have minimum 4 ports of 40GbE/100GbE (QSFP+/QSFP28). | Verified through Physical inspection and device web console |
| 5. The switch should provide console access through RJ45 and USB connector. Separate RJ45 Ethernet management port should be present for out-of-band management. | Verified through datasheet and product web console |

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| **High Availability** | |
| The switch should be configured with standby systems (Active-Active) in order to achieve high availability. | Bidder needs to demonstrate this functionality and submit the report. |
| **Performance Requirements** | |
| 1. The switch should have minimum of 4 cores (64bit), 1.8 GHz processing unit. | Verified through datasheet and product web console |
| 2. The proposed switch should have minimum 16GB RAM, 16GB Flash Memory. | Verified through datasheet and product web console |
| 3. Should support unified packet buffer size of atleast 32MB. | Verified through datasheet and bidder’s compliance sheet |
| 4. Switch should have minimum 3.2 Tbps switching capacity. | Verified through datasheet and bidder’s compliance sheet |
| 5. Switch architecture should be able to achieve 1 Bpps forwarding rate. | Verified through datasheet and bidder’s compliance sheet |
| 6. The switch ports should support Jumbo Frames of size upto 9K bytes. | Verified through datasheet and bidder’s compliance sheet |
| 7. The switch should have minimum 50K MAC Address Table size. | Verified through datasheet and bidder’s compliance sheet |
| 8. The switch should support minimum 120K IPv4 routes, 80K IPv6 Routes and 4K IPv4/IPv6 Multicast Routes. | Verified through datasheet and bidder’s compliance sheet |
| 9. The switch should support minimum 25K IPv4 ACLs and 12K IPv6 ACLs. | Verified through datasheet and bidder’s compliance sheet |

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| **Functional Requirements** | |
| 1. The switch should support Spanning Tree Protocol (STP/RSTP/MSTP) with Root Guard. | Verified through datasheet and bidder’s compliance sheet |
| 2. The switch should support Ethernet Ring Protection Switching (ERPS) and Unidirectional Link Detection (UDLD) | Verified through datasheet and bidder’s compliance sheet |
| 3. The switch should support eight egress queues per port for different types of traffic | Verified through datasheet and bidder’s compliance sheet |
| 4. The switch should support switch virtualization feature that allows links, physically connected to two different switches, to appear as a single port channel | Verified through datasheet and bidder’s compliance sheet |
| 5. The switch should support layer 2 QoS mechanism like 802.1p or equivalent | Verified through datasheet and bidder’s compliance sheet |
| 6. The switch should support Link Aggregation Control Protocol (LACP). | Verified through datasheet and bidder’s compliance sheet |
| 7. The switch should support Precision Time Protocol or equivalent to synchronize clocks with sub-microsecond accuracy across devices in a network. | Verified through datasheet and bidder’s compliance sheet |
| 8. The switch should support atleast 4000 IEEE 802.1Q VLANs. | Verified through datasheet and bidder’s compliance sheet |
| 9. The switch should support Private VLAN for traffic isolation within a particular VLAN. | Verified through datasheet and bidder’s compliance sheet |
| 10. The switch should provide storm protection to limit unknown broadcast, multicast, or unicast storms with user-defined thresholds. | Verified through datasheet and bidder’s compliance sheet |

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| 11. The switch should support Strict Priority (SP) queuing, explicit congestion avoidance features and Access Control Lists (ACLs) for both IPv4 and IPv6 traffic. | Verified through datasheet and bidder’s compliance sheet |
| 12. The switch should support Internet Group Management Protocol (IGMPv1, v2, and v3) and Multicast Listener Discovery (MLDv1 and v2). | Verified through datasheet and bidder’s compliance sheet |
| 13. Should support hardware accelerated MACSEC-256 encryption algorithm with static key provisioning enabling secure communication. | Verified through datasheet and bidder’s compliance sheet |
| 14. The switch should support static VXLAN as well dynamic VXLAN with BGP EVPN(Should also support multicasting) | Verified through datasheet and bidder’s compliance sheet |
| 15. The switch should support IPv4 and IPv6 Static Routing. | Verified through datasheet and bidder’s compliance sheet |
| 16. The switch should support Open shortest path first (OSPF) for IPv4 and IPv6. | Verified through datasheet and bidder’s compliance sheet |
| 17. It should support VRRP or equivalent , enabling switches to work together for dynamic backup and ensuring a highly available routing environment. | Verified through datasheet and bidder’s compliance sheet |
| 18. Should support Virtual routing and forwarding (VRF) to allow multiple instances of a routing table to co-exist within the same router | Verified through datasheet and bidder’s compliance sheet |
| 19. The switch should support Border Gateway Protocol 4 (BGP) for IPv4 and IPv6. | Verified through datasheet and bidder’s compliance sheet |
| 20. The switch should support Policy Based Routing (PBR). | Verified through datasheet and bidder’s compliance sheet |
| 21. The switch should support Multicast Routing using PIM-SM/SSM | Verified through datasheet and bidder’s compliance sheet |
| 22. The switch should support DHCP Server providing DHCP services (for IPv4 and IPv6). | Verified through datasheet and bidder’s compliance sheet |
| 23. The switch should support Equal-Cost Multipath (ECMP). | Verified through datasheet and bidder’s compliance sheet |
| 24. Switch should support secure boot feature e.g. during system boots, the system’s software signatures should be checked for integrity. System should capable to understand that system OS are authentic and unmodified, it should have cryptographically signed images to provide assurance that the firmware & BIOS are authentic. | Verified through datasheet and bidder’s compliance sheet |
| **Switch Management Requirements** | |
| 1. The switch should support SSH, SNMP and Remote monitoring (RMON). | Verified through datasheet and bidder’s compliance sheet |
| 2. The switch should support sFlow or equivalent for traffic analysis. In general switch should have in built features for monitoring, as well as troubleshooting network issues and related metrics | Verified through datasheet and bidder’s compliance sheet |
| 3. The switch should support RADIUS and TACACS+ for securing administrative access. | Verified through datasheet and bidder’s compliance sheet |
| 4. The switch should have Command Line Interface (CLI) with a hierarchical structure. | Verified through datasheet and bidder’s compliance sheet |
| 5. The switch should be programmable via declarative style scripting or model centric programmability | Verified through datasheet and bidder’s compliance sheet |
| 6. The switch should be manageable from third-party On-premises NMS solution. | Verified through datasheet and bidder’s compliance sheet |
| **Compliance Requirements** | |
| 2. The device should be IPv6 ready certified from day one. | Verified through datasheet and bidder’s compliance sheet |
| **Support and Warranty Requirements** | |
| 1. The switch shall be offered with minimum five (05) years comprehensive warranty with 24x7 Technical support from OEM directly. Warranty must include Same-day Rapid Dispatch of Parts and advanced RMA. |  |
| 2. All the features mentioned in the specifications shall be enabled/activated. Any licenses required shall be included from Day 1. | Bidder needs to demonstrate the configuration/specification as per user’s requirement and submit the report. |

**Annexure V**

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| **KVM Switch** | | |
| **Quantity: 01** | | |
| Make/Model | Industry leading OEMs |  |
| Form Factor | Rackmount LCD Console with Keyboard and TouchPad, |  |
| Display | 17’’ 1280 x 1024 @ 75 Hz |  |
| Number of host | 8 |  |
| USB support | Yes |  |
| Access control | Password and optional fingerprint |  |
| Auto scan mode | Hot pluggable - add or remove computers without having to power down the switch |  |
| Daisy Chain | Yes, up to 16 additional units, supporting at least 128 hosts |  |
| Supported OS Platforms | Windows, Linux |  |
| Support for external mouse | Yes |  |
| Warranty | 5 years on-site |  |

**Annexure VI**

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| --- | --- | --- |
| **Server Rack** | | |
| **Quantity: 01** | | |
| Make/Model | Industry leading OEMs |  |
| Mount Type | Floor Mount Server Rack with lockable castor wheels |  |
| Size | 19”, 42U, other dimensions should be suitable to install the quoted servers, switch and KVM switch |  |
| Material | Powdered coated steel body, toughened glass doors |  |
| Door type | Swivel type, minimum 180-degree, front and rear glass doors |  |
| Side panels | Removable, steel side panels |  |
| Lock type | Combination lock, single key for front and rear door locks |  |
| Ventilation | 4 nos of installed fans on top panel |  |
| Accessories | 1. Should have at least one power strip with 8 sockets, compatible with 16A, India, power cords  2. Should have vertical cable manager |  |
| Warranty | 5 years on-site |  |

|  |  |  |
| --- | --- | --- |
| **Items** | **Specifications** | **Verification /  Test Methodology** |
| **Switch** | **Annex I of Bid documents** |  |
| **Type-1 Servers** | **Annex II of Bid documents** |  |
| **Type-2 Servers** | **Annex III of Bid documents** |  |
| **Firewall** | **Annex IV of Bid documents** |  |
| **Kvm Switch** | **Annex V of Bid documents** |  |
| **Rack** | **Annex VI of Bid documents** |  |

**3. Quality Assurance testing**

|  |  |  |  |
| --- | --- | --- | --- |
| Test Area | Test Method | Tools Used | Observations |
| Switch | Network Throughput | iperf3 | At least between two nodes |
| Server Storage | Ceph Benchmark | rados bench | Read/write test |
| Server CPU | CPU Benchmark | sysbench/ PhoronixTestSuite/ Geekbench | We may consider **SPECrate2017\_int\_base score atleast 310** or **SPECrate2017\_fp\_base score atleast 400** |
| Server Memory | Memory Benchmark | dd or fio | For all Nodes |
| Firewall | ? |  |  |
| Some other Tests? | ? |  |  |
| Firmware update to the latest version |  |  |  |
| Integration testing | ? | ? | Datacenter unit integration and OpenStack integration |

**Integration tests**

Integration testing includes the project and all related components operating in as realistic a manner as possible. The goal is to identify bugs that are only likely to appear in production, before they are found in production. Often, when a bug is found in integration testing, it may indicate a gap in functional testing.

**6. Performance Summary**

**Network Throughput (iperf3):** 10 Gbps

**Ceph Write Throughput:** 500MB/s  
**Ceph Read Throughput:** 500MB/s

**CPU Benchmark:**

**Memory Benchmark:**

**4. Test Cases and Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test Area | Description | Method/Tools Used | Observations | Comments |
| Switch HA | Device-level Redundancy | Power off one Switch | Seamless failover |  |
| Switch HA | Link-level Redundancy | Cut a link | Seamless failover |  |
| Compute Node HA | Device-level Redundancy | Power off one Node |  |  |
| Network Routing | VLANs, routing | show vlan |  | Trunking and routing verified |
| Server Health | CPU, memory, disk check | iDRAC, smartctl | Health Ok | Done |
| **Server Security** | **Intrusion Alert/** Chassis Being Open | iDRAC |  |  |
| Ceph Health | Cluster status | ceph -s |  |  |
| Ceph Benchmark | Read/write test | rados bench |  |  |
| VM Boot | Launch instance | Dashboard/CLI |  | Done |
| New KeyPair Generation | SSH Key Pair | Dashboard/CLI |  | Done |
| Volume Attach and Detach | Cinder volume to VM | Dashboard/CLI | Volumes attached successfully | Done |
| Volume Delete | Method Provided by Vendor | Only CLI (Not possible in Horizon) | Confirmed by the vendor | Failed  [Resolution](https://platform9.com/kb/openstack/openstack-volume-deletion-fails) |
| Volume Snapshots Creation |  | Dashboard/CLI |  |  |
| Live VM Migration | From one to another node | Dashboard/CLI | **Error:** Failed to live migrate instance to host "compute3". [Details](http://192.168.145.192/horizon/admin/instances/#message_details)  Migration pre-check error: Unacceptable CPU info: CPU doesn't have compatibility. 0 Refer to http://libvirt.org/html/libvirt-libvirt-host.html#virCPUCompareResult (HTTP 400) (Request-ID: req-83689832-4126-44cb-b55c-1082f5b0b885) | Failed |
| VM CPU Load Test |  | sysbench |  |  |
| VM Storage Read Write Speed Test |  | fio | Read Speed: 5000kbps  Write Speed: 5000kbps |  |
| New Image addition | Ubuntu/ Rocky/ Alma/ Windows Server and Desktop | Dashboard/CLI | Only the server version is available | Ubuntu Server 22.04 image has added |
| New Instance Flavour Creation |  | Dashboard/CLI | VM IP: 192.168.142.15 | Done |
| Standalone Website Hosting | Lab Booking Website |  |  | Done |
| VM for Compute | Load Test by users | Any feedback form required? |  |  |
| New Provision Network addition | New subnet for VMs |  |  |  |
| Instance Ping | Inter-VM network test | ping |  | <1ms latency |
| Resource Load | CPU/RAM/disk stress test | stress-ng |  |  |
| User creation and Role assignment |  | Dashboard/CLI |  |  |
| Security Group Rules |  | Dashboard/CLI | 02 New Role added | Done |
| New Router Creation |  |  |  |  |