

| Cerinte tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Conform | Specificatii tehnice solutie ofertata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| <p>Echipament nou și nerecondiționat, produs minim trim. I anul 2024, corespunzător tipului de dispozitive de nivel Enterprise, produs de producători renumiți (Brand name internațional). Configurația echipamentului trebuie să fie compusă din componente reciproc compatibile și să asigure funcționarea optimă a sistemului în ansamblu.</p> <p><b>Type:</b> Enterprise-grade Storage with SAS SSDs.</p> <p><b>Form Factor:</b> min. 2U rack-mountable chassis, fully compatible with the EIA-310 standard for rack mounting. The solution must include all necessary components (e.g., rails, mounting brackets).</p> | DA      | <p>Echipament oferat: IBM FlashSystem 9500</p> <p>Echipamentul este nou și nerecondiționat, si va fi produs la momentul plasarii comenzii catre IBM, corespunzător tipului de dispozitive de nivel Enterprise, produs de IBM. Configurația echipamentului este compusă din componente reciproc compatibile și asigure funcționarea optimă a sistemului în ansamblu.</p> <p><b>Type:</b> Enterprise-grade Storage with SAS SSDs, NVMe,</p> <p><b>Form Factor:</b> 2U rack-mountable chassis, fully compatible with the EIA-310 standard for rack mounting. The solution include all necessary components (e.g., rails, mounting brackets).</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500<br/><a href="https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10">https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10</a></li> <li>- IBM Storage Virtualize Software for FlashSystem 9500 Controller 8.7<br/><a href="https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86">https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86</a></li> </ul> |
| <p><b>Availability requirements:</b></p> <p>The equipment must be working in Symmetric Active-Active mode, which means that in the case of 100% utilization, ensures following:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                         | DA      | <p><b>Availability requirements:</b></p> <p>The equipment is working in Symmetric Active-Active mode, which means that in the case of 100% utilization, ensures following:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p>- The storage system architecture must ensure that, in the event of a controller failure, the write cache of the surviving controller(s) remains fully operational and protected. The equipment must utilize mechanisms such as cache mirroring or equivalent protection to guarantee data integrity. Under no circumstances should the write cache be deactivated, operated without mirroring, or left without an alternative protection mechanism to prevent data loss or corruption.</p>                                                                                                                              | DA      | <p>The equipment utilize cache mirroring to guarantee data integrity, data loss or corruption.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500<br/><a href="https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10">https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10</a></li> <li>- IBM Storage Virtualize Software for FlashSystem 9500 Controller 8.7<br/><a href="https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86">https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.ibm.com/docs/en/redbooks/implementation-guide-spectrum-virtualize-version-85">https://www.ibm.com/docs/en/redbooks/implementation-guide-spectrum-virtualize-version-85</a></li> </ul>                                                                                                                                                                                                                                                                |
| <p>- The system must ensure a high availability rate of at least 99.9999%, minimizing downtime and guaranteeing continuous operation,</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DA      | <p>The system ensure a high availability rate of 99.9999%, minimizing downtime and guaranteeing continuous operation</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Storage FlashSystem 9500 Product Guide for IBM Storage Virtualize 8.6<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p>- The system's efficiency must remain unaffected in the event of a failure of up to 50% of the controllers, maintaining consistent operational capability - alive with a single active controller,</p>                                                                                                                                                                                                                                                                                                                                                                                                                   | DA      | <p>The system's efficiency remain unaffected in the event of a failure of up to 50% of the controllers, maintaining consistent operational capability - alive with a single active controller</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |         | Documentatie tehnica:<br>- IBM Storage FlashSystem 9500 Performnace sizing.xlsx                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| - The system must sustain its required performance levels without degradation in the event of a failure affecting half of the controllers,                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DA      | The system sustain its required performance levels without degradation in the event of a failure affecting half of the controllers<br><br>Documentatie tehnica:<br>- IBM Storage FlashSystem 9500 Performnace sizing.xlsx                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| - The system must include robust, built-in mechanisms for non-disruptive software updates, ensuring no compromise in availability or loss of access to stored data during version upgrades.                                                                                                                                                                                                                                                                                                                                                                                                                | DA      | The system include robust, built-in mechanisms for non-disruptive software updates, ensuring no compromise in availability or loss of access to stored data during version upgrades<br><br>Documentatie tehnica:<br>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| The storage system must ensure uninterrupted data availability and full operational continuity in the following failure scenarios:<br>- failure of a single power supply line, ensuring redundancy in power management,<br>- failure of any individual controller, with automatic failover mechanisms to maintain functionality alive with a single active controller,<br>- simultaneous failures of up to two user data storage drives, with no loss of data integrity or accessibility,<br>- failures of any Fibre Channel (FC) or iSCSI port, with seamless rerouting of traffic to alternate pathways. | DA      | The storage system because of components redundancy and hot-swap capabilities ensure uninterrupted data availability and full operational continuity in the following failure scenarios:<br>- failure of a single power supply line, ensuring redundancy in power management,<br>- failure of any individual controller, with automatic failover mechanisms to maintain functionality alive with a single active controller,<br>- because of RAID 6 protection assure simultaneous failures of up to two user data storage drives, with no loss of data integrity or accessibility,<br>- because of redundant path (path failover), in case of failures of any Fibre Channel (FC) or iSCSI port, will seamless rerouting of traffic to alternate pathways.<br><br>Documentatie tehnica:<br>- IBM FlashSystem 9500 Product Guide<br><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a><br>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a> |
| The equipment must support hot-swappable replacement of critical components without interrupting access to data or degrading system performance. These components include, but are not limited to: controllers, power supplies, cooling fans, front-end and back-end ports, and storage drives. The hot replacement process must ensure seamless operation and maintain data availability throughout.                                                                                                                                                                                                      | DA      | The equipment assure full internal redundancy support hot-swappable replacement of critical components without interrupting access to data or degrading system performance. These components include: controllers, power supplies, boot drives, batteries, cooling fans, PCI Express adapters and storage drives. The hot replacement process must ensure seamless operation and maintain data availability throughout.<br><br>Documentatie tehnica:<br>- IBM FlashSystem 9500 Product Guide<br><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| The system must be designed to withstand the simultaneous failure of at least two storage devices (e.g., drives, NVMe, or flash modules), regardless of the system's scale or configuration. In such scenarios, the equipment must ensure uninterrupted data access and maintain full data integrity.                                                                                                                                                                                                                                                                                                      | DA      | The system is designed though RAID 6 protection to withstand the simultaneous failure of at least two storage devices (e.g., drives, NVMe, or flash modules), regardless of the system's scale or configuration. In such scenarios, the equipment ensure uninterrupted data access and maintain full data integrity.<br><br>Documentatie tehnica:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |         | <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p>The system must include functionality to safely disable the storage drives without causing any loss or corruption of user data, ensuring seamless operational continuity during maintenance or decommissioning.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DA      | <p>The system include functionality to safely disable the storage drives (remove) without causing any loss or corruption of user data, ensuring seamless operational continuity during maintenance or decommissioning.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <p><b>Type Drives:</b><br/><b>Enterprise-grade SAS SSDs</b> utilizing TLC (Triple-Level Cell) or eTLC (Enhanced Triple-Level Cell) technology, optimized for high-performance, high-reliability applications in enterprise environments.</p> <p><b>Capacity:</b><br/>The system must provide a marked usable storage capacity (before data reduction) of <b>minimum 200 TB</b>, ensuring sufficient space for high-demand enterprise applications.</p> <p><b>Hot Spare Configuration(optional):</b><br/>The solution must optionally support Hot Spare components, including spare controllers or disks, to enhance system redundancy. These spare components must remain inactive during regular operations but should automatically activate to maintain full system functionality in case of hardware failure.</p> | DA      | <p><b>Type Drives:</b><br/><b>Enterprise-grade NVME (Superior technology compared with SAS SSDs)</b> utilizing TLC (Triple-Level Cell) or eTLC (Enhanced Triple-Level Cell) technology, optimized for high-performance, high-reliability applications in enterprise environments.</p> <p><b>Capacity:</b><br/>The system provide a marked usable storage capacity (before data reduction) of <b>258 TB</b>, ensuring sufficient space for high-demand enterprise applications.</p> <p><b>Hot Spare Configuration(optional not included):</b><br/>The solution optionally support Hot Spare components, including spare nodes (controllers) or disks, to enhance system redundancy. These spare components remain inactive during regular operations but automatically become activate to maintain full system functionality in case of hardware failure.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM Storage FlashSystem 9500 capacity sizing.xlsx</li> </ul> |
| <p><b>RAID (if the equipment involves the use of RAID):</b></p> <ul style="list-style-type: none"> <li>- The system must support advanced RAID levels, including minimum: RAID 6: Ensuring double parity protection, allowing the system to tolerate simultaneous failure of two drives without data loss.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DA      | <p><b>RAID (if the equipment involves the use of RAID):</b></p> <ul style="list-style-type: none"> <li>- The system support advanced RAID levels: Distributed RAID 6: Ensuring double parity protection, allowing the system to tolerate simultaneous failure of two drives without data loss.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

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| <p><b>Cache requirement</b><i>(if the equipment involves the use of memory cache for data)</i>: If the storage system includes a cache mechanism, the system must provide a <b>minimum of 512 GB</b> of dedicated cache memory per node, ensuring high-speed data processing and optimal system performance. The cache must support advanced features such as:</p> <ul style="list-style-type: none"> <li>- Cache mirroring - to ensure data integrity and protection in the event of a node failure.</li> <li>- Dynamic allocation - enabling efficient use of cache resources based on real-time workload demands.</li> <li>- Non-volatile cache - to prevent data loss during power failures or unexpected shutdowns, ensuring all cached data is retained.</li> <li>- The cache must be optimized for handling high IOPS workloads and ensuring low latency operations, particularly for enterprise-grade applications.</li> </ul>                                                                                                                                                     | DA      | <p><b>Cache requirement</b><i>(if the equipment involves the use of memory cache for data)</i>: The system provide <b>1024 GB</b> of dedicated cache memory per system (512 GB per node controller) , ensuring high-speed data processing and optimal system performance. The cache support advanced features such as:</p> <ul style="list-style-type: none"> <li>- Cache mirroring - to ensure data integrity and protection in the event of a node failure.</li> <li>- Through the mechanism of Quality of Services (QoS), a scheme of distribution of controller resources enabling efficient use of resources based on real-time workload demands.</li> <li>- Non-volatile cache - to prevent data loss during power failures or unexpected shutdowns, ensuring all cached data is retained.</li> <li>- The cache is optimized for handling high IOPS workloads and ensuring low latency operations, particularly for enterprise-grade applications.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> </ul>                                                                                                                                                   |
| <p><b>Controllers requirement:</b></p> <p>The storage system must include minimum one node equipped with a minimum of two fully redundant controllers configured in High Availability (HA) mode.</p> <p>The controllers must:</p> <ul style="list-style-type: none"> <li>- Operate in an Active-Active configuration, ensuring balanced workload distribution and seamless failover capabilities without performance degradation.</li> <li>- Support advanced fault-tolerant mechanisms to maintain uninterrupted access to data during hardware failures or maintenance.</li> <li>- Be hot-swappable, allowing replacement or upgrade without disrupting system operations or data availability.</li> <li>- Include built-in synchronization mechanisms to maintain consistency between controllers, including mirroring of critical operational data such as cache contents and configuration settings.</li> <li>- The system must ensure that the failure of one controller does not impact the performance, availability, or operational integrity of the other controller.</li> </ul> | DA      | <p><b>Controllers requirement:</b></p> <p>The storage system include one node equipped with a two fully redundant controllers configured in High Availability (HA) mode.</p> <p>The controllers :</p> <ul style="list-style-type: none"> <li>- Operate in an Active-Active configuration, ensuring balanced workload distribution and seamless failover capabilities without performance degradation.</li> <li>- Support advanced fault-tolerant mechanisms to maintain uninterrupted access to data during hardware failures or maintenance.</li> <li>- Be hot-swappable, allowing replacement or upgrade without disrupting system operations or data availability.</li> <li>- Include built-in synchronization mechanisms to maintain consistency between controllers, including mirroring of critical operational data such as cache contents and configuration settings.</li> <li>- The system ensure that the failure of one controller does not impact the performance, availability, or operational integrity of the other controller.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Storage FlashSystem 9500 Performance Reports</li> </ul> |

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| <p><b>Cluster and replication requirements:</b></p> <ol style="list-style-type: none"> <li>1. Synchronous replication capability: <ul style="list-style-type: none"> <li>- The storage solution must support synchronous replication to enable the creation of an Active-Active cluster between two physically separated server rooms (located in separate buildings).</li> <li>- The system must ensure zero Recovery Point Objective (RPO) by maintaining data consistency across the cluster in real time.</li> </ul> </li> <li>2. Comprehensive hardware inclusion: <ul style="list-style-type: none"> <li>- The solution must include all necessary hardware components to fully implement synchronous replication functionality, utilizing Fibre Channel (FC) protocols for highspeed, low-latency data transmission.</li> </ul> </li> <li>3. Flexible volume replication: <ul style="list-style-type: none"> <li>- The system must support synchronous replication for a minimum of one Logical Unit Number (LUN) and scale seamlessly to replicate multiple LUNs simultaneously.</li> <li>- Changes to the number of replicated volumes must not require modifications to the physical hardware configuration of the storage system.</li> </ul> </li> <li>4. Data consistency and synchronization: <ul style="list-style-type: none"> <li>- The contents of all cluster volumes must remain identical across both systems in the cluster at all times, ensuring data consistency and integrity.</li> <li>- The system must include mechanisms to handle data synchronization efficiently during recovery scenarios, ensuring minimal impact on performance and availability.</li> </ul> </li> <li>5. Resiliency and high availability: <ul style="list-style-type: none"> <li>- The cluster must provide continuous operation in the event of a hardware failure, network disruption, or planned maintenance at one site, without compromising data integrity or availability.</li> <li>- The system must be designed to support failover and failback between the two sites automatically and transparently.</li> </ul> </li> </ol> | DA      | <p><b>Cluster and replication requirements:</b></p> <ol style="list-style-type: none"> <li>1. Synchronous replication capability: <ul style="list-style-type: none"> <li>- The storage solution support synchronous replication to enable the creation of an Active-Active cluster between two physically separated server rooms (located in separate buildings).</li> <li>- The system ensure zero Recovery Point Objective (RPO) by maintaining data consistency across the cluster in real time.</li> </ul> </li> <li>2. Comprehensive hardware inclusion: <ul style="list-style-type: none"> <li>- The solution include all necessary hardware components to fully implement synchronous replication functionality, utilizing Fibre Channel (FC) protocols for highspeed, low-latency data transmission.</li> </ul> </li> <li>3. Flexible volume replication: <ul style="list-style-type: none"> <li>- The system support synchronous replication for a minimum of one Logical Unit Number (LUN) and scale seamlessly to replicate multiple LUNs simultaneously.</li> <li>- Changes to the number of replicated volumes does not require modifications to the physical hardware configuration of the storage system.</li> </ul> </li> <li>4. Data consistency and synchronization: <ul style="list-style-type: none"> <li>- The contents of all cluster volumes remain identical across both systems in the cluster at all times, ensuring data consistency and integrity.</li> <li>- The system include mechanisms to handle data synchronization efficiently during recovery scenarios, ensuring minimal impact on performance and availability.</li> </ul> </li> <li>5. Resiliency and high availability: <ul style="list-style-type: none"> <li>- The cluster provide continuous operation in the event of a hardware failure, network disruption, or planned maintenance at one site, without compromising data integrity or availability.</li> <li>- The system is designed to support failover and failback between the two sites automatically and transparently.</li> </ul> </li> </ol> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- Policy-Based Replication with IBM Storage FlashSystem, IBM SAN Volume Controller and IBM Storage Virtualize<br/><a href="https://www.ibm.com/docs/en/redbooks/policy-based-replication-storage-flashsystem-san-volume-controller-storage-virtualize">https://www.ibm.com/docs/en/redbooks/policy-based-replication-storage-flashsystem-san-volume-controller-storage-virtualize</a></li> </ul> |
| <p><b>Performance requirements:</b></p> <ol style="list-style-type: none"> <li>1. Minimum performance metrics: <ul style="list-style-type: none"> <li>- the storage solution must deliver a combined performance of <b>minimum 300,000 Input/Output Operations Per Second (IOPS)</b> with inline data reduction (deduplication and compression).</li> </ul> </li> <li>2. Performance calculation parameters: <p>IOPS performance must be evaluated based on the following metrics:</p> <ul style="list-style-type: none"> <li>- read/write ratio: 70% read / 30% write.</li> </ul> </li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DA      | <p><b>Performance requirements:</b></p> <ol style="list-style-type: none"> <li>1. Performance metrics: <ul style="list-style-type: none"> <li>- the storage solution deliver a combined performance of <b>600,000 Input/Output Operations Per Second (IOPS)</b> with allow to provide the minimum <b>300.000 Input/Output Operations Per Second (IOPS)</b> in case of one controller failure or it is in maintenance operations.</li> </ul> </li> <li>2. Performance calculation parameters: <p>IOPS performance is based on the following metrics:</p> <ul style="list-style-type: none"> <li>- read/write ratio: 70% read / 30% write.</li> </ul> </li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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| <ul style="list-style-type: none"> <li>- block sizes: support for operations with block sizes of 16 KB, 32 KB, and 64 KB to accommodate varying workload requirements.</li> <li>- I/O patterns: include both sequential and random I/O workloads.</li> <li>- latency: ensure a maximum delay of 1 millisecond (0.001 s) under full load conditions.</li> </ul> <p>3. Consistency of performance:</p> <ul style="list-style-type: none"> <li>- the system must maintain the required performance levels even under high concurrency and mixed workload conditions.</li> <li>- performance must remain unaffected during maintenance operations, including firmware updates, drive rebuilds, or component failures.</li> </ul> <p>4. Performance verification:</p> <ul style="list-style-type: none"> <li>- <u>vendors must provide detailed benchmark test results to validate the stated performance – for operations with block sizes 16 KB(mandatory), 32 KB and 64 KB(optionall), using industry-standard tools such as IOMeter or FIO, under the specified conditions.</u></li> <li>- <u>results must demonstrate compliance with all stated parameters, including latency and I/O patterns.</u></li> </ul> <p>5. Monitoring and optimization:</p> <ul style="list-style-type: none"> <li>- the system must include tools to monitor and optimize performance dynamically, offering real-time insights into throughput, latency, and IOPS for proactive performance tuning.</li> </ul> |         | <ul style="list-style-type: none"> <li>- block sizes: support for operations with block sizes of 16 KB (support also for 32 KB, and 64 KB to accommodate varying workload requirements)</li> <li>- I/O patterns: include both sequential and random I/O workloads.</li> </ul> <p>latency: ensure a delay less the 1 millisecond (0.001 s) under full load conditions. (IBM Storage FlashSystem 9500 Performance Reports.xlsx)</p> <p>3. Consistency of performance:</p> <ul style="list-style-type: none"> <li>- the system maintain the required performance levels even under high concurrency and mixed workload conditions.</li> <li>- performance remain unaffected during maintenance operations, including firmware updates, drive rebuilds, or component failures.</li> </ul> <p>4. Performance verification:</p> <ul style="list-style-type: none"> <li>- <u>We provide detailed benchmark test results to validate the stated performance – for operations with block sizes 16 KB(mandatory), using IBM industry-standard tools for sizing storage solutions under the specified conditions.</u></li> <li>- <u>results demonstrate compliance with all stated parameters, including latency and I/O patterns.</u></li> </ul> <p>5. Monitoring and optimization:</p> <ul style="list-style-type: none"> <li>- the system include tools to monitor and optimize performance dynamically, offering real-time insights into throughput, latency, and IOPS for proactive performance tuning.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Spectrum Control: User's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></li> <li>- IBM Spectrum Control: Administrator's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></li> </ul> <p>IBM Storage FlashSystem 9500 Performance Reports.xlsx</p> |
| <p><b>Supported protocols:</b></p> <ul style="list-style-type: none"> <li>- FC,</li> <li>- iSCSI,</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DA      | <p><b>Supported protocols:</b></p> <ul style="list-style-type: none"> <li>- FC,</li> <li>- iSCSI,</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Features:</b></p> <p>Dedicated system management interfaces:</p> <ol style="list-style-type: none"> <li>1. The system must include dedicated physical and/or virtual interfaces specifically for system management.</li> <li>2. These interfaces should allow out-of-band management, ensuring that administrative tasks can be performed without impacting data traffic.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DA      | <p><b>Features:</b></p> <p>Dedicated system management interfaces:</p> <ol style="list-style-type: none"> <li>1. The system include dedicated physical interfaces specifically for system management.</li> <li>2. These interfaces allow out-of-band management, ensuring that administrative tasks can be performed without impacting data traffic.</li> <li>3. Management interfaces support the following functionalities:</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Cerinte tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Conform        | Specificatii tehnice solutie ofertata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <p>3. Management interfaces must support the following functionalities:</p> <ul style="list-style-type: none"> <li>- Web-based GUI for ease of access.</li> <li>- Command-line interface (CLI) for advanced configuration.</li> <li>- Support for industry-standard protocols such as SSH, SNMP, and REST API for integration with monitoring and orchestration tools.</li> <li>- Role-based access control (RBAC) to ensure secure system administration.</li> </ul> <p>4. Redundancy for management interfaces:</p> <ul style="list-style-type: none"> <li>- to ensure availability, the management interfaces must support redundancy, allowing continuous system management even in the event of a single interface failure.</li> </ul> <p>5. Protocol optimization:</p> <p>The system must include protocol-specific optimizations such as:</p> <ul style="list-style-type: none"> <li>- Multipath I/O (MPIO) for FC and iSCSI to ensure high availability and load balancing.</li> <li>- Support for jumbo frames in iSCSI for improved performance in high-throughput environments.</li> </ul> <p>6. Compliance and Interoperability:</p> <p>The system must be compliant with industry standards for both FC and iSCSI protocols. It must ensure interoperability with third-party devices, including servers, switches, and network adapters.</p> | <p>Conform</p> | <ul style="list-style-type: none"> <li>- Web-based GUI for ease of access.</li> <li>- Command-line interface (CLI) for advanced configuration.</li> <li>- Support for industry-standard protocols such as SSH, SNMP, and REST API for integration with monitoring and orchestration tools.</li> <li>- Role-based access control (RBAC) to ensure secure system administration.</li> </ul> <p>4. Redundancy for management interfaces:</p> <ul style="list-style-type: none"> <li>- to ensure availability, the management interfaces support redundancy, allowing continuous system management even in the event of a single interface failure.</li> </ul> <p>5. Protocol optimization:</p> <p>The system include protocol-specific optimizations such as:</p> <ul style="list-style-type: none"> <li>- Multipath I/O (MPIO) for FC and iSCSI to ensure high availability and load balancing.</li> <li>- Support for jumbo frames in iSCSI for improved performance in high-throughput environments.</li> </ul> <p>6. Compliance and Interoperability:</p> <p>The system is compliant with industry standards for both FC and iSCSI protocols. It ensure interoperability with third-party devices, including servers, switches, and network adapters.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- <a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Concept Guide<br/><a href="https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf">IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family: Concept Guide - Version 873</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Command-Line Interface User's Guide<br/><a href="https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf">https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf</a></li> </ul> |
| <p><b>Deduplication and compression requirements:</b></p> <p>1. Functional capabilities:</p> <p>The storage system must provide deduplication functionality for data stored at the block level (iSCSI/FC LUN) and file level, with the following specifics:</p> <ul style="list-style-type: none"> <li>- Deduplication must operate both at the volume level and globally across the system, ensuring optimal storage efficiency.</li> </ul> <p>The system must also include compression functionality for:</p> <ul style="list-style-type: none"> <li>- Block-level volumes (iSCSI/FC LUN).</li> </ul> <p>2. Interoperability and unrestricted functionality:</p> <p>Deduplication and compression features must operate seamlessly without introducing limitations or restrictions on simultaneous use of other critical functionalities, including but not limited to:</p> <ul style="list-style-type: none"> <li>- Data replication.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                        | <p>DA</p>      | <p><b>Deduplication and compression requirements:</b></p> <p>1. Functional capabilities:</p> <p>The storage system provide deduplication functionality for data stored at system level, with the following specifics:</p> <ul style="list-style-type: none"> <li>- Deduplication operate both at the volume level and globally across the system, ensuring optimal storage efficiency.</li> </ul> <p>The system also include compression functionality for:</p> <ul style="list-style-type: none"> <li>- Block-level volumes (iSCSI/FC LUN).</li> </ul> <p>2. Interoperability and unrestricted functionality:</p> <p>Deduplication and compression features operate seamlessly without introducing limitations or restrictions on simultaneous use of other critical functionalities, including but not limited to:</p> <ul style="list-style-type: none"> <li>- Data replication.</li> <li>- Thin provisioning.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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| <ul style="list-style-type: none"> <li>- Thin provisioning.</li> <li>- Backups.</li> <li>- Volume cloning.</li> </ul> <p>3. Inline deduplication and compression:</p> <ul style="list-style-type: none"> <li>- Both deduplication and compression mechanisms must function in in-line mode, ensuring real-time data optimization without requiring post-processing. –</li> <li>- Deduplication must remain continuously active and cannot be disabled or bypassed by system administrators or any other means, ensuring consistent storage efficiency and data integrity.</li> </ul> <p><b><u>- Storage solutions that rely on scheduled or job-based data reduction processes are not acceptable.</u></b></p> | Conform | <ul style="list-style-type: none"> <li>- Backups.</li> <li>- Volume cloning.</li> </ul> <p>3. Inline deduplication and compression:</p> <ul style="list-style-type: none"> <li>- Both deduplication and compression mechanisms function in in-line mode, ensuring real-time data optimization without requiring post-processing.</li> <li>- Deduplication remain continuously active and cannot be disabled or bypassed by system administrators or any other means, ensuring consistent storage efficiency and data integrity.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- <a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Concept Guide<br/><a href="https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf">IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family: Concept Guide - Version 873</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Command-Line Interface User's Guide<br/><a href="https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf">https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf</a></li> </ul> |
| <p>4. Licensing and support:</p> <p>All features related to deduplication and compression must be:</p> <ul style="list-style-type: none"> <li>- Fully licensed (if required by vendor provisions) and included in the offer, eliminating additional licensing costs for essential functionality.</li> <li>- Supported by the storage system in its maximum configuration, ensuring scalability and compatibility across all deployment scenarios.</li> </ul>                                                                                                                                                                                                                                                   | DA      | <p>4. Licensing and support:</p> <p>All features related to deduplication and compression is included in IBM Storage Virtualize, no other licensing need it and is supported by the storage system in its maximum configuration, ensuring scalability and compatibility across all deployment scenarios.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p>5. Performance and reliability considerations:</p> <ul style="list-style-type: none"> <li>- The deduplication and compression mechanisms must not introduce significant latency or impact the system's performance metrics, such as IOPS or throughput.</li> <li>- Mechanisms should include built-in error detection and correction to maintain data integrity during deduplication and compression processes.</li> </ul>                                                                                                                                                                                                                                                                                  | DA      | <p>5. Performance and reliability considerations:</p> <ul style="list-style-type: none"> <li>- The deduplication and compression mechanisms does not introduce significant latency or impact the system's performance metrics, such as IOPS or throughput.</li> <li>- Mechanisms include built-in error detection and correction to maintain data integrity during deduplication and compression processes.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Introduction and Implementation of Data Reduction Pools and Deduplication<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248430.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248430.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Troubleshooting Guide</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |         | <a href="#">IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family: Troubleshooting Guide - Version 873</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p>6. Management and monitoring:<br/>The system must provide a dedicated interface or tools for monitoring deduplication and compression efficiency, including:</p> <ul style="list-style-type: none"> <li>- Space savings metrics.</li> <li>- Real-time and historical performance impacts.</li> <li>- Detailed logs of deduplication and compression activities.</li> </ul>                                                                                                                 | DA      | <p>6. Management and monitoring:<br/>The system provide a dedicated interface or tools for monitoring deduplication and compression efficiency, including:</p> <ul style="list-style-type: none"> <li>- Space savings metrics.</li> <li>- Real-time and historical performance impacts.</li> <li>- Detailed logs of deduplication and compression activities.</li> </ul> <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                        |
| <p><b>Snapshot requirements:</b><br/>1. General functionality:</p> <ul style="list-style-type: none"> <li>- The system must support snapshot functionality at a minimum for block-level volumes (LUNs), ensuring operational flexibility.</li> <li>- The snapshot functionality must be applicable to both LUNs and other supported volumes without imposing restrictions on the simultaneous use of other critical system functions, including replication, backups, and cloning.</li> </ul> | DA      | <p><b>Snapshot requirements:</b><br/>1. General functionality:</p> <ul style="list-style-type: none"> <li>- The system support snapshot functionality at a minimum for block-level volumes (LUNs), ensuring operational flexibility.</li> </ul> <p>The snapshot functionality be applicable to both LUNs and other supported volumes without imposing restrictions on the simultaneous use of other critical system functions, including replication, backups, and cloning.</p> <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p> |
| <p>2. Snapshot quantity and retention:</p> <ul style="list-style-type: none"> <li>- The system must provide the ability to create and manage a minimum of 365 snapshots per shared volume, supporting long-term operational and recovery needs.</li> <li>- Snapshots must be configurable with retention policies to optimize storage space and align with data governance requirements.</li> </ul>                                                                                           | DA      | <p>Snapshot quantity and retention:</p> <ul style="list-style-type: none"> <li>- The system provide the ability to create and manage up to 64.999 snapshoot per system and up to 15.864 FlashCopy mappings per system supporting long-term operational and recovery needs also through the policies of copy services that can be implemented</li> <li>- Snapshots are configurable with retention policies to optimize storage space and align with data governance requirements.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/> <a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> </ul>                                                                                                                                                                                                                                                                               |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |         | <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p>3. Performance efficiency:</p> <ul style="list-style-type: none"> <li>- The implementation of snapshots must not degrade overall system performance, regardless of the number of active snapshots or system workload.</li> <li>- The system must include optimization mechanisms, such as metadata indexing and intelligent snapshot scheduling, to minimize latency and maintain high performance.</li> </ul>                                                      | DA      | <p>3. Performance efficiency:</p> <ul style="list-style-type: none"> <li>- The implementation of snapshots not degrade overall system performance, regardless of the number of active snapshots or system workload.</li> <li>- The system include optimization mechanisms, such as metadata indexing and intelligent snapshot scheduling, to minimize latency and maintain high performance.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/> <a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a> </li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a> </li> </ul> |
| <p>4. Space efficiency:</p> <ul style="list-style-type: none"> <li>- Snapshot functionality must employ a cost-effective approach by storing only the delta (changes) from the original data. This ensures minimal storage consumption while preserving full data access and recovery capabilities.</li> </ul>                                                                                                                                                         | DA      | <p>4. Space efficiency:</p> <ul style="list-style-type: none"> <li>- Snapshot functionality employ a cost-effective approach by storing only the delta (changes) from the original data. This ensures minimal storage consumption while preserving full data access and recovery capabilities.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/> <a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a> </li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a> </li> </ul>                                                                                               |
| <p>5. Integration with storage QoS:</p> <ul style="list-style-type: none"> <li>- The system must support performance monitoring and prioritization mechanisms for snapshots, enabling administrators to enforce Storage QoS (Quality of Service) policies at both the volume and LUN levels.</li> <li>- These QoS policies should dynamically allocate resources to prioritize performance critical snapshots, ensuring minimal impact on other operations.</li> </ul> | DA      | <p>5. Integration with storage QoS:</p> <ul style="list-style-type: none"> <li>- The system support performance monitoring and prioritization mechanisms for snapshots, enabling administrators to enforce Storage QoS (Quality of Service) policies at both the volume and LUN levels.</li> <li>- These QoS policies dynamically allocate resources to prioritize performance critical snapshots, ensuring minimal impact on other operations.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/> <a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a> </li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a> </li> </ul>                                                                                                                                                                                                                       |

| Cerinte tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Conform | Specificatii tehnice solutie ofertata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <p>6. Advanced features:<br/>Snapshots must support:</p> <ul style="list-style-type: none"> <li>- Application-consistent snapshots, ensuring data integrity for workloads such as databases and virtualized environments.</li> <li>- Writable snapshots, allowing clones to be created for development, testing, or analytics without affecting the production environment.</li> <li>- Snapshots must be compatible with data replication workflows, ensuring consistent replication of both primary data and snapshot states across systems.</li> </ul> | DA      | <p>6. Advanced features:<br/>Snapshots support:</p> <ul style="list-style-type: none"> <li>- Application-consistent snapshots, ensuring data integrity for workloads such as databases and virtualized environments.</li> <li>- Writable snapshots, allowing clones to be created for development, testing, or analytics without affecting the production environment.</li> <li>- Snapshots are compatible with data replication workflows, ensuring consistent replication of both primary data and snapshot states across systems.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Spectrum Control: User's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></li> <li>- IBM Spectrum Control: Administrator's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></li> </ul> |
| <p>7. Monitoring and reporting:</p> <ul style="list-style-type: none"> <li>- The system must include a dedicated interface or tools for managing, monitoring, and reporting on snapshot performance, space utilization, and recovery operations.</li> <li>- Real-time alerts and historical logs must be available for visibility into snapshot performance and potential bottlenecks</li> </ul>                                                                                                                                                         | DA      | <p>7. Monitoring and reporting:</p> <ul style="list-style-type: none"> <li>- The system include a dedicated interface or tools for managing, monitoring, and reporting on snapshot performance, space utilization, and recovery operations.</li> <li>- Real-time alerts and historical logs available for visibility into snapshot performance and potential bottlenecks</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Spectrum Control: User's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></li> <li>- IBM Spectrum Control: Administrator's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></li> </ul>                                                                                                                                                             |

| Cerinte tehnice minimale                                                                                                                                                                                                                                                                                                                                                                     | Conform | Specificatii tehnice solutie ofertata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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| <b>Encryption requirements:</b><br>1. Encryption standard:<br>- The solution must support encryption of all stored data using a minimum of the AES256 algorithm or a stronger industry-standard encryption algorithm, ensuring compliance with modern security and regulatory standards.                                                                                                     | DA      | <b>Encryption requirements:</b><br>1. Encryption standard:<br>- The solution support encryption of all stored data using a minimum of the AES256 algorithm or a stronger industry-standard encryption algorithm, ensuring compliance with modern security and regulatory standards.<br><br>Documentatie tehnica:<br>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a>                                                                                                  |
| 2. Scope of encryption:<br>- Encryption must be applied to all drives, NVMe, and flash storage within the device, covering the entire data storage ecosystem.<br>- Encryption must extend to data at rest across all volumes, snapshots, backups, and metadata associated with the system.                                                                                                   | DA      | 2. Scope of encryption:<br>- Encryption be applied to all drives, NVMe, and flash storage within the device, covering the entire data storage ecosystem.<br>- Encryption extend to data at rest across all volumes, snapshots, backups, and metadata associated with the system.<br><br>Documentatie tehnica:<br>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a>                                                                                                     |
| 3. Performance integrity:<br>- Encryption functionality must operate with no measurable impact on system performance, ensuring IOPS, throughput, and latency metrics remain consistent with non-encrypted operations.<br>The system must leverage hardware-accelerated encryption or equivalent technologies to maintain optimal performance during data encryption and decryption processes | DA      | 3. Performance integrity:<br>- Encryption functionality operate with no measurable impact on system performance, ensuring IOPS, throughput, and latency metrics remain consistent with non-encrypted operations.<br>- The system leverage hardware-accelerated encryption or equivalent technologies to maintain optimal performance during data encryption and decryption processes<br><br>Documentatie tehnica:<br>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a> |
| 4. Key management:<br>- The solution must generate encryption keys using a secure hardware-based random number generator, ensuring keys are robust and resistant to attacks.<br>- Encryption keys must be securely stored on the equipment, leveraging a dedicated hardware security module (HSM) or equivalent secure enclave to isolate keys from unauthorized access.                     | DA      | 4. Key management:<br>- The solution generate encryption keys using a secure hardware-based random number generator, ensuring keys are robust and resistant to attacks.<br>- Encryption keys be securely stored on the equipment, leveraging a dedicated hardware security module (HSM) or equivalent secure enclave to isolate keys from unauthorized access.<br>- The system ensure that data stored on drives/NVMe/flash cannot be accessed if the storage media is removed from the device or if the device itself is compromised.                                                                                                                                                                                                                                                                                                                                               |

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| <p>5. Key backup and recovery:</p> <ul style="list-style-type: none"> <li>- The system must include mechanisms for secure backup and recovery of encryption keys, supporting integration with external key management systems (KMS) compliant with KMIP (Key Management Interoperability Protocol) standards.</li> <li>- Key rotation and lifecycle management should be automated and configurable to align with organizational policies and compliance requirements.</li> </ul> | DA      | <p>5. Key backup and recovery:</p> <ul style="list-style-type: none"> <li>- The system include mechanisms for secure backup and recovery of encryption keys, supporting integration with external key management systems (KMS) compliant with KMIP (Key Management Interoperability Protocol) standards.</li> <li>- Key rotation and lifecycle management be automated and configurable to align with organizational policies and compliance requirements.</li> </ul> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p> <p><a href="https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs">https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs</a></p> |
| <p>6. Encryption for replication and snapshots:</p> <ul style="list-style-type: none"> <li>- The encryption functionality must extend to replicated data and snapshots, ensuring consistency in encryption across all replicated sites or volumes.</li> <li>- Encryption must not disrupt or degrade replication workflows, including synchronous and asynchronous modes.</li> </ul>                                                                                              | DA      | <p>6. Encryption for replication and snapshots:</p> <ul style="list-style-type: none"> <li>- The encryption functionality extend to replicated data and snapshots, ensuring consistency in encryption across all replicated sites or volumes.</li> </ul> <p>Encryption must not disrupt or degrade replication workflows, including synchronous and asynchronous modes.</p> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p> <p><a href="https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs">https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs</a></p>                                                                                           |
| <p><b>Monitoring requirements:</b></p> <p>1. Analytical platform or portal:</p> <ul style="list-style-type: none"> <li>- The system must include a robust analytical platform or virtual machine (VM) accessible via a web browser-based portal.</li> <li>- The platform must provide an intuitive, user-friendly interface with interactive dashboards for data visualization and management.</li> </ul> <p>Log collection and reporting:</p>                                    | DA      | <p><b>Monitoring requirements:</b></p> <p>1. Analytical platform or portal:</p> <ul style="list-style-type: none"> <li>- The system include a robust analytical platform or virtual machine (VM) accessible via a web browser-based portal.</li> <li>- The platform provide an intuitive, user-friendly interface with interactive dashboards for data visualization and management.</li> </ul> <p>Log collection and reporting:</p> <ul style="list-style-type: none"> <li>- The platform automatically collect and analyze logs from the device and present them as customizable graphs, reports, and alerts, covering the following:</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Cerinte tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| <p>- The platform must automatically collect and analyze logs from the device and present them as customizable graphs, reports, and alerts, covering the following:</p> <p>2.1. Storage utilization:</p> <ul style="list-style-type: none"> <li>- Real-time and historical monitoring of used space.</li> <li>- Display of the data reduction indicator, accounting for deduplication and compression (excluding thin provisioning, if applicable).</li> <li>- Granular visibility at both the global device level and the local LUN level.</li> </ul> <p>2.2. Space growth prediction:</p> <ul style="list-style-type: none"> <li>- Advanced forecasting tools for predicting space growth, factoring in deduplication, compression, and provisioning trends.</li> <li>- Tools for future expansion analysis, including recommendations for scaling.</li> </ul> <p>3. Component monitoring:</p> <p>The system must include an application or hardware-based monitoring solution to oversee and report detailed events for the following physical and logical components:</p> <ul style="list-style-type: none"> <li>- Physical components: controllers, drives, ports, power supplies, and network interfaces.</li> <li>- Logical components: volumes, LUNs, replication processes, deduplication, and compression algorithms.</li> </ul> <p>4. Performance monitoring:</p> <p>The portal must provide minimum:</p> <ul style="list-style-type: none"> <li>- Real-time and historical performance metrics for individual resources.</li> <li>- Key parameters to monitor: Latency, Read and Write IOPS, Bandwidth.</li> </ul> <p>Performance data must be available at both the global system level and the LUN level.</p> <p>5. Storage QoS and prioritization:</p> <ul style="list-style-type: none"> <li>- The system must include a performance monitoring and prioritization mechanism for Storage QoS, configurable at both the volume and LUN levels.</li> <li>- QoS metrics should be adjustable in real-time to meet dynamic workload demands.</li> </ul> <p>6. Reporting and alerting:</p> <p>The portal must provide comprehensive reporting capabilities, including at least:</p> <ul style="list-style-type: none"> <li>- Capacity reports: current usage, available space, and forecasted capacity needs.</li> <li>- Performance reports: historical trends and real-time analytics of system performance.</li> <li>- Future space predictions: automated simulations for capacity increases based on application type and workload.</li> </ul> |         | <p>2.1. 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Operational monitoring:</p> <ul style="list-style-type: none"> <li>- Snapshot and replication status: display the real-time status of operations such as snapshots, synchronous/asynchronous replication, and recovery tasks.</li> <li>- Threat alerts: warnings related to system integrity, user activity, or misconfigurations.</li> <li>- Optimization insights: recommendations for system performance improvement, resource reallocation, or energy efficiency.</li> </ul> <p>8. Configuration verification and upgrades:</p> <ul style="list-style-type: none"> <li>- The platform include an algorithm for verifying configuration correctness and compatibility with potential device or cluster upgrades.</li> </ul> <p>9. Simulation and optimization:</p> |

| Cerinte tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Conform | Specificatii tehnice solutie ofertata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| <ul style="list-style-type: none"> <li>- Event logs: authorization attempts, executed commands, and system alerts for security and operational events.</li> <li>- Technical support logs: level of support received, resolution times, and incident history.</li> </ul> <p>7. Operational monitoring:</p> <ul style="list-style-type: none"> <li>- Snapshot and replication status: display the real-time status of operations such as snapshots, synchronous/asynchronous replication, and recovery tasks.</li> <li>- Threat alerts: warnings related to system integrity, user activity, or misconfigurations.</li> <li>- Optimization insights: recommendations for system performance improvement, resource reallocation, or energy efficiency.</li> </ul> <p>8. Configuration verification and upgrades:</p> <ul style="list-style-type: none"> <li>- The platform must include an algorithm for verifying configuration correctness and compatibility with potential device or cluster upgrades.</li> </ul> <p>9. Simulation and optimization:</p> <ul style="list-style-type: none"> <li>- The platform must enable capacity simulation tools to project storage needs based on application types and expected workloads.</li> <li>- Display real-time system consumption metrics with actionable optimization guidelines for improving performance and efficiency.</li> </ul> |         | <ul style="list-style-type: none"> <li>- The platform enable capacity simulation tools to project storage needs based on application types and expected workloads.</li> </ul> <p>Display real-time system consumption metrics with actionable optimization guidelines for improving performance and efficiency.</p> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p> <ul style="list-style-type: none"> <li>- IBM Spectrum Control: User's Guide</li> </ul> <p><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></p> <ul style="list-style-type: none"> <li>- IBM Spectrum Control: Administrator's Guide</li> </ul> <p><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></p> |
| <p><b>NICs included per controller:</b></p> <p>Min. 1 x 1GE for management;<br/>Min. 2 x 32G FC SFP28(850nm SFP+ SR MM module included) for data transfer; Min. 2 x 32G FC dedicated for replication (metro cluster).</p> <p><b>Supported operating environments:</b></p> <p>Microsoft Windows Server;<br/>Red Hat Enterprise Linux;<br/>VMware (VMware ESXi);</p> <p><b>Power supplies included:</b></p> <p>The system must include a minimum of two (2) hot-swappable (hot-plug) Power Supply Units (PSUs).<br/>The PSUs must support at least 1+1 redundancy, ensuring continuous operation in case of failure of one PSU.<br/>Power cables included must meet the following specifications:</p> <ul style="list-style-type: none"> <li>- Type: IEC C13 to C14.</li> <li>- Minimum length: 0.6 meters (24 inches).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DA      | <p><b>NICs included per controller:</b></p> <p>1 x 1GE for management;<br/>4 x 32G FC SFP28(850nm SFP+ SR MM module included) for data transfer;<br/>4 x 32G FC dedicated for replication.</p> <p><b>Supported operating environments:</b></p> <p>Microsoft Windows Server;<br/>Red Hat Enterprise Linux;<br/>VMware (VMware ESXi);</p> <p><b>Power supplies included:</b></p> <p>The system include 4 hot-swappable (hot-plug) Power Supply Units (PSUs).<br/>The PSUs support 1+1 redundancy, ensuring continuous operation in case of failure of one PSU.<br/>Power cables included meet the following specifications:</p> <ul style="list-style-type: none"> <li>- Type: IEC C13 to C14.</li> </ul> <p>Length: 1,5 meters .</p> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                                                                                                            |

| Cerințe tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Conform | Specificatii tehnice solutie ofertata                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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| <p><b><u>Cerințe obligatorii pentru prestarea serviciilor de punere în funcțiune, a garanției și a serviciilor de suport (deservire și mentenanță) a bunurilor - conform Anexei la Anunțul de participare.</u></b></p> <p>Toate licențele necesare (dacă se aplică conform termenilor și condițiilor producătorului) pentru caracteristicile platformei/portalului de monitorizare (analitică) și software-ului/firmware-ului specific sistemului de stocare, inclusiv actualizările/patch-urile periodice, trebuie să fie incluse în ofertă și furnizate pe o bază perpetuă - valabile obligatoriu pentru durata integrală de viață a sistemului de stocare.</p> <p><b>Termeni și condiții:</b><br/>Toate cerințele sunt minime și obligatorii;<br/>O cerință nu trebuie să limiteze o altă cerință;<br/>Toate componentele trebuie să fie actuale și să nu fie promovate ca EOS (sfârșitul vânzării/suportului) / EOL (sfârșitul duratei de viață);<br/>Extinderea memoriei (ram) și a capacității de stocare nu trebuie să includă limitări hardware sau software.</p> | DA      | <p><b><u>Service Centru autorizat de IBM se obligă în prestarea serviciilor de punere în funcțiune, a garanției și a serviciilor de suport (deservire și mentenanță) a bunurilor - conform Anexei la Anunțul de participare.</u></b></p> <p>Toate licențele necesare pentru caracteristicile platformei/portalului de monitorizare (analitică) și software-ului/firmware-ului specific sistemului de stocare sunt incluse în ofertă și furnizate pe o bază perpetuă - valabile pentru durata integrală de viață a sistemului de stocare.</p> <p><b>Termeni și condiții:</b><br/><b>Am luat la cunoștință și confirmăm îndeplinirea următoarelor:</b><br/>Toate cerințele sunt minime și obligatorii;<br/>O cerință nu limiteze o altă cerință;<br/>Toate componentele sunt actuale și nu sunt promovate ca EOS (sfârșitul vânzării/suportului) / EOL (sfârșitul duratei de viață);<br/>Extinderea memoriei (ram) și a capacității de stocare nu include limitări hardware sau software.</p> |

**Lotul nr. 4**

**Enterprise Storage (Sisteme de stocare) tip 2 (Full flash)**

| Cerințe tehnice minimale                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Conform | Specificații tehnice soluție oferită                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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| <p>Echipament nou și nerecondiționat, produs minim trim. 1 anul 2024, corespunzător tipului de dispozitive de nivel Enterprise, produs de producători renumiți (Brand name internațional). Configurația echipamentului trebuie să fie compusă din componente reciproc compatibile și să asigure funcționarea optimă a sistemului în ansamblu.</p> <p><b>Type:</b> Enterprise-grade Storage with Full Flash.</p> <p><b>Form Factor:</b> min. 2U rack-mountable chassis, fully compatible with the EIA-310 standard for rack mounting. The solution must include all necessary components (e.g., rails, mounting brackets).</p> | DA      | <p>Echipament oferit: IBM FlashSystem 9500</p> <p>Echipamentul este nou și nerecondiționat, și va fi produs la momentul plasării comenzii către IBM, corespunzător tipului de dispozitive de nivel Enterprise, produs de IBM. Configurația echipamentului este compusă din componente reciproc compatibile și asigure funcționarea optimă a sistemului în ansamblu.</p> <p><b>Type:</b> Enterprise-grade Storage with SAS SSDs, NVMe,</p> <p><b>Form Factor:</b> 2U rack-mountable chassis, fully compatible with the EIA-310 standard for rack mounting. The solution include all necessary components (e.g., rails, mounting brackets).</p> <p>Documentație tehnică:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500<br/><a href="https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10">https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10</a></li> <li>- IBM Storage Virtualize Software for FlashSystem 9500 Controller 8.7<br/><a href="https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86">https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86</a></li> </ul> |
| <p><b>Availability requirements:</b></p> <p>The equipment must be working in Symmetric Active-Active mode, which means that in the case of 100% utilization, ensures following:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                           | DA      | <p><b>Availability requirements:</b></p> <p>The equipment is working in Symmetric Active-Active mode, which means that in the case of 100% utilization, ensures following:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p>- The storage system architecture must ensure that, in the event of a controller failure, the write cache of the surviving controller(s) remains fully operational and protected.</p> <p>The equipment must utilize mechanisms such as cache mirroring or equivalent protection to guarantee data integrity. Under no circumstances should the write cache be deactivated, operated without mirroring, or left without an alternative protection mechanism to prevent data loss or corruption.</p>                                                                                                                         | DA      | <p>The equipment utilize cache mirroring to guarantee data integrity, data loss or corruption.</p> <p>Documentație tehnică:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500<br/><a href="https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10">https://www.ibm.com/docs/en/announcements/flashsystem-9500-2023-10-10</a></li> <li>- IBM Storage Virtualize Software for FlashSystem 9500 Controller 8.7<br/><a href="https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86">https://www.ibm.com/docs/en/announcements/storage-virtualize-software-flashsystem-9500-controller-86</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.ibm.com/docs/en/redbooks/implementation-guide-spectrum-virtualize-version-85">https://www.ibm.com/docs/en/redbooks/implementation-guide-spectrum-virtualize-version-85</a></li> </ul>                                                                                                                                                                                                                                                                |
| <p>- The system must ensure a high availability rate of at least 99.9999%, minimizing downtime and guaranteeing continuous operation;</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | DA      | <p>The system ensure a high availability rate of 99.9999%, minimizing downtime and guaranteeing continuous operation</p> <p>Documentație tehnică:</p> <ul style="list-style-type: none"> <li>- IBM Storage FlashSystem 9500 Product Guide for IBM Storage Virtualize 8.6<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| - The system's efficiency must remain unaffected in the event of a failure of up to 50% of the controllers, maintaining consistent operational capability - alive with a single active controller;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | DA | <p>The system's efficiency remain unaffected in the event of a failure of up to 50% of the controllers, maintaining consistent operational capability - alive with a single active controller</p> <p>Documentatie tehnica:</p> <p> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a><br/>           IBM Storage FlashSystem 9500 Performnace sizing.xlsx         </p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| - The system must sustain its required performance levels without degradation in the event of a failure affecting half of the controllers;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | DA | <p>The system sustain its required performance levels without degradation in the event of a failure affecting half of the controllers</p> <p>Documentatie tehnica:</p> <p> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a><br/>           IBM Storage FlashSystem 9500 Performnace sizing.xlsx         </p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| - The system must include robust, built-in mechanisms for non-disruptive software updates, ensuring no compromise in availability or loss of access to stored data during version upgrades.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DA | <p>The system include robust, built-in mechanisms for non-disruptive software updates, ensuring no compromise in availability or loss of access to stored data during version upgrades</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5</li> </ul> <p> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a> </p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p>The storage system must ensure uninterrupted data availability and full operational continuity in the following failure scenarios:</p> <ul style="list-style-type: none"> <li>- failure of a single power supply line, ensuring redundancy in power management,</li> <li>- failure of any individual controller, with automatic failover mechanisms to maintain functionality - alive with a single active controller,</li> <li>- failures simultaneous failures of up to two user data storage drives, with no loss of data integrity or accessibility,</li> <li>- failures of any Fibre Channel (FC) or iSCSI port, with seamless rerouting of traffic to alternate pathways.</li> </ul> | DA | <p>The storage system because of components redundancy and hot-swap capabilities ensure uninterrupted data availability and full operational continuity in the following failure scenarios:</p> <ul style="list-style-type: none"> <li>- failure of a single power supply line, ensuring redundancy in power management,</li> <li>- failure of any individual controller, with automatic failover mechanisms to maintain functionality alive with a single active controller,</li> <li>- because of RAID 6 protection assure simultaneous failures of up to two user data storage drives, with no loss of data integrity or accessibility,</li> <li>- because of redundant path (path failover), in case of failures of any Fibre Channel (FC) or iSCSI port, will seamless rerouting of traffic to alternate pathways.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide</li> </ul> <p> <a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a> </p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5</li> </ul> <p> <a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a> </p> |
| The equipment must support hot-swappable replacement of critical components without interrupting access to data or degrading system performance. These components include, but are not limited to: controllers, power supplies, cooling fans, front-end and back-end ports, and storage drives. The hot replacement process must ensure seamless operation and maintain data availability throughout.                                                                                                                                                                                                                                                                                         | DA | <p>The equipment assure full internal redundancy support hot-swappable replacement of critical components without interrupting access to data or degrading system performance. These components include: controllers, power supplies, boot drives, batteries, cooling fans, PCI Express adapters and storage drives. The hot replacement process must ensure seamless operation and maintain data availability throughout.</p> <p>Documentatie tehnica:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

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| The system must be designed to withstand the simultaneous failure of at least two storage devices (e.g., drives, NVMe, or flash modules), regardless of the system's scale or configuration. In such scenarios, the equipment must ensure uninterrupted data access and maintain full data integrity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | DA | <p>The system is designed though RAID 6 protection to withstand the simultaneous failure of at least two storage devices (e.g., drives, NVMe, or flash modules), regardless of the system's scale or configuration. In such scenarios, the equipment ensure uninterrupted data access and maintain full data integrity.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                      |
| The system must include functionality to safely disable the storage drives without causing any loss or corruption of user data, during maintenance or relocation of the device..                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DA | <p>The system include functionality to safely disable the storage drives (remove) without causing any loss or corruption of user data, ensuring seamless operational continuity during maintenance or decommissioning.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Type Drives:</b><br/>Enterprise-grade NVMe/Flash utilizing TLC (Triple-Level Cell) or eTLC (Enhanced Triple-Level Cell) technology, optimized for high-performance, high-reliability applications in enterprise environments.</p> <p><b>Capacity:</b><br/>The system must provide a marked usable storage capacity (before data reduction) of minimum 600 TB, ensuring sufficient space and maximum performance for high demand enterprise applications.</p> <p><b>Hot Spare Configuration(optional):</b><br/>The solution must optionally support Hot Spare components, including spare controllers or disks, to enhance system redundancy. These spare components must remain inactive during regular operations but should automatically activate to maintain full system functionality in case of hardware failure.</p> | DA | <p><b>Type Drives:</b><br/><b>Enterprise-grade NVMe/Flash utilizing TLC</b> (Triple-Level Cell) or eTLC (Enhanced Triple-Level Cell) technology, optimized for high-performance, high-reliability applications in enterprise environments.</p> <p><b>Capacity:</b><br/>The system provide a marked usable storage capacity (before data reduction) of <b>764 TB</b>, ensuring sufficient space for high-demand enterprise applications.</p> <p><b>Hot Spare Configuration(optional not included):</b><br/>The solution optionally support Hot Spare components, including spare nodes (controllers) or disks, to enhance system redundancy. These spare components remain inactive during regular operations but automatically become activate to maintain full system functionality in case of hardware failure.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM Storage FlashSystem 9500 capacity sizing.xlsx</li> </ul> |
| <p><b>RAID (if the equipment involves the use of RAID):</b><br/>- The system must support advanced RAID levels, including minimum: RAID 6: Ensuring double parity protection, allowing the system to tolerate simultaneous failure of two drives without data loss.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | DA | <p><b>RAID (if the equipment involves the use of RAID):</b></p> <ul style="list-style-type: none"> <li>- The system support advanced RAID levels: Distributed RAID 6: Ensuring double parity protection, allowing the system to tolerate simultaneous failure of two drives without data loss.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

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| <p><b>Cache requirement</b>(if the equipment involves the use of memory cache for data): The storage must provide a minimum of 512 GB of dedicated cache memory per node, ensuring high-speed data processing and optimal system performance. The cache must support advanced features such as:</p> <ul style="list-style-type: none"> <li>- Cache mirroring - to ensure data integrity and protection in the event of a node failure.</li> <li>- Dynamic allocation - enabling efficient use of cache resources based on real-time workload demands.</li> <li>- Non-volatile cache - to prevent data loss during power failures or unexpected shutdowns, ensuring all cached data is preserved and immediately available after hardware recovery from power failures or unexpected shutdowns.</li> </ul> <p>The cache must be optimized for handling high IOPS workloads and ensuring low latency operations, particularly for enterprise-grade applications.</p>                                                                                                                                                                                                  | DA | <p><b>Cache requirement</b>(if the equipment involves the use of memory cache for data): The system provide <b>1024 GB</b> of dedicated cache memory per system (512 GB per node controller) , ensuring high-speed data processing and optimal system performance. The cache support advanced features such as:</p> <ul style="list-style-type: none"> <li>- Cache mirroring - to ensure data integrity and protection in the event of a node failure.</li> <li>- Through the mechanism of Quality of Services (QoS), a scheme of distribution of controller resources enabling efficient use of resources based on real-time workload demands.</li> <li>- Non-volatile cache - to prevent data loss during power failures or unexpected shutdowns, ensuring all cached data is retained.</li> <li>- The cache is optimized for handling high IOPS workloads and ensuring low latency operations, particularly for enterprise-grade applications.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> </ul> |
| <p><b>Controllers requirements:</b></p> <p>The storage system must include minimum one node equipped with a minimum of two fully redundant controllers configured in High Availability (HA) mode.</p> <p>The controllers must:</p> <ul style="list-style-type: none"> <li>- Operate in an Active-Active configuration, ensuring balanced workload distribution and seamless failover capabilities without performance degradation and data loss.</li> <li>- Support advanced fault-tolerant mechanisms to maintain uninterrupted access to data during hardware failures or maintenance (until the technical interventions are provided).</li> <li>- Be hot-swappable, allowing replacement or upgrade without disrupting system operations, performance or data availability.</li> <li>- Include built-in synchronization mechanisms to maintain consistency between controllers, including mirroring of critical operational data such as cache contents and configuration settings.</li> </ul> <p>The system must ensure that the failure of one controller does not impact the performance, availability, or operational integrity of the other controller.</p> | DA | <p><b>Controllers requirement:</b></p> <p>The storage system include one node equipped with a two fully redundant controllers configured in High Availability (HA) mode.</p> <p>The controllers :</p> <ul style="list-style-type: none"> <li>- Operate in an Active-Active configuration, ensuring balanced workload distribution and seamless failover capabilities without performance degradation.</li> <li>- Support advanced fault-tolerant mechanisms to maintain uninterrupted access to data during hardware failures or maintenance.</li> <li>- Be hot-swappable, allowing replacement or upgrade without disrupting system operations or data availability.</li> <li>- Include built-in synchronization mechanisms to maintain consistency between controllers, including mirroring of critical operational data such as cache contents and configuration settings.</li> <li>- The system ensure that the failure of one controller does not impact the performance, availability, or operational integrity of the other controller.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines</li> </ul>                                      |

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| <b>Cluster and replication requirements:</b><br>1. Synchronous replication capability:<br>- The storage solution must support synchronous replication to enable the creation of an Active-Active cluster between two physically separated server rooms (located in separate buildings).<br>- The system must ensure zero Recovery Point Objective (RPO=0) by maintaining data consistency across the cluster in real time.<br>2. Comprehensive hardware inclusion:<br>- The solution must include all necessary hardware components to fully implement synchronous replication functionality, utilizing Fibre Channel (FC) protocols for highspeed, low-latency data transmission.<br>3. Flexible volume replication:<br>- The system must support synchronous replication for a minimum of one Logical Unit Number (LUN) and scale seamlessly to replicate multiple LUNs simultaneously.<br>- Changes to the number of replicated volumes must not require modifications to the physical hardware configuration of the storage system.<br>4. Data consistency and synchronization:<br>- The contents of all cluster volumes must remain identical across both systems in the cluster at all times, ensuring data consistency and integrity.<br>- The system must include mechanisms to handle data synchronization efficiently during recovery scenarios, ensuring minimal impact on performance, availability and corrupted/degraded data.<br>5. Resiliency and high availability:<br>- The cluster must provide continuous operation in the event of a hardware failure, network disruption, or planned maintenance at one site, without compromising data integrity or availability.<br>- The system must be designed to support failover and failback between the two sites automatically and transparently. | DA | <b>Cluster and replication requirements:</b><br>1. Synchronous replication capability:<br>- The storage solution support synchronous replication to enable the creation of an Active-Active cluster between two physically separated server rooms (located in separate buildings).<br>- The system ensure zero Recovery Point Objective (RPO) by maintaining data consistency across the cluster in real time.<br>2. Comprehensive hardware inclusion:<br>- The solution include all necessary hardware components to fully implement synchronous replication functionality, utilizing Fibre Channel (FC) protocols for highspeed, low-latency data transmission.<br>3. Flexible volume replication:<br>- The system support synchronous replication for a minimum of one Logical Unit Number (LUN) and scale seamlessly to replicate multiple LUNs simultaneously.<br>- Changes to the number of replicated volumes does not require modifications to the physical hardware configuration of the storage system.<br>4. Data consistency and synchronization:<br>- The contents of all cluster volumes remain identical across both systems in the cluster at all times, ensuring data consistency and integrity.<br>- The system include mechanisms to handle data synchronization efficiently during recovery scenarios, ensuring minimal impact on performance and availability.<br>5. Resiliency and high availability:<br>- The cluster provide continuous operation in the event of a hardware failure, network disruption, or planned maintenance at one site, without compromising data integrity or availability.<br>- The system is designed to support failover and failback between the two sites automatically and transparently.<br><br>Documentatie tehnica:<br>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br>- IBM FlashSystem Best Practices and Performance Guidelines<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a><br>- Policy-Based Replication with IBM Storage FlashSystem, IBM SAN Volume Controller and IBM Storage Virtualize<br><a href="https://www.ibm.com/docs/en/redbooks/policy-based-replication-storage-flashsystem-san-volume-controller-storage-virtualize">https://www.ibm.com/docs/en/redbooks/policy-based-replication-storage-flashsystem-san-volume-controller-storage-virtualize</a> |
| <b>Performance requirements:</b><br>1. Minimum performance metrics:<br>- the storage solution must deliver a combined performance of minimum 500,000 Input/Output Operations Per Second (IOPS) with inline data reduction (deduplication and compression).<br>2. Performance calculation parameters:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | DA | <b>Performance requirements:</b><br>1. Performance metrics:<br>- the storage solution deliver a combined performance of <b>1,000,000 Input/Output Operations Per Second (IOPS)</b> with allow to provide the minimum <b>500.000 Input/Output Operations Per Second (IOPS)</b> in case of one controller failure or it is in maintenance operations.<br>2. Performance calculation parameters:<br>IOPS performance is based on the following metrics:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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| <p>IOPS performance must be evaluated based on the following metrics: -</p> <ul style="list-style-type: none"> <li>- read/write ratio: 70% read / 30% write.</li> <li>- block sizes: support for operations with block sizes of 16 KB, 32 KB, and 64 KB to accommodate varying workload requirements.</li> <li>- I/O patterns: include both sequential and random I/O workloads.</li> <li>- latency: ensure a maximum delay of 1 millisecond (0.001 s) under full load conditions</li> </ul> <p>3. Consistency of performance:</p> <ul style="list-style-type: none"> <li>- the system must maintain the required performance levels even under high concurrency and mixed workload conditions.</li> <li>- performance must remain unaffected during maintenance operations, including firmware updates, drive rebuilds, or component failures.</li> </ul> <p>4. Performance verification:</p> <ul style="list-style-type: none"> <li>- vendors must provide detailed benchmark test results to validate the stated performance – for operations with block sizes 16 KB(mandatory), 32 KB and 64 KB(optional), using industry-standard tools such as Iometer or FIO, under the specified conditions.</li> <li>- results must demonstrate compliance with all stated parameters, including latency and I/O patterns.</li> </ul> <p>5. Monitoring and optimization:</p> <ul style="list-style-type: none"> <li>- the system must include tools to monitor and optimize performance dynamically, offering real-time insights into throughput, latency, and IOPS for proactive performance tuning.</li> </ul> |    | <ul style="list-style-type: none"> <li>- read/write ratio: 70% read / 30% write.</li> <li>- block sizes: support for operations with block sizes of 16 KB (support also for 32 KB, and 64 KB to accommodate varying workload requirements)</li> <li>- I/O patterns: include both sequential and random I/O workloads.</li> <li>- latency: ensure a maximum delay of 1 millisecond (0.001 s) under full load conditions.</li> </ul> <p>3. Consistency of performance:</p> <ul style="list-style-type: none"> <li>- the system maintain the required performance levels even under high concurrency and mixed workload conditions.</li> <li>- performance must remain unaffected during maintenance operations, including firmware updates, drive rebuilds, or component failures.</li> </ul> <p>4. <u>Performance verification:</u></p> <ul style="list-style-type: none"> <li>- <u>We provide detailed benchmark test results to validate the stated performance – for operations with block sizes 16 KB(mandatory), using IBM industry-standard tools for sizing storage solutions under the specified conditions.</u></li> <li>- <u>results demonstrate compliance with all stated parameters, including latency and I/O patterns.</u></li> </ul> <p>5. Monitoring and optimization:</p> <ul style="list-style-type: none"> <li>- the system include tools to monitor and optimize performance dynamically, offering real-time insights into throughput, latency, and IOPS for proactive performance tuning.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Spectrum Control: User's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></li> <li>- IBM Spectrum Control: Administrator's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></li> </ul> <p>IBM Storage FlashSystem 9500 Performance Reports.xlsx</p> |
| <p><b>Supported protocols:</b></p> <ul style="list-style-type: none"> <li>- FC,</li> <li>- iSCSI;</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | DA | <p><b>Supported protocols:</b></p> <ul style="list-style-type: none"> <li>- FC,</li> <li>- iSCSI,</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <p><b>Features:</b></p> <p>Dedicated system management interfaces:</p> <ol style="list-style-type: none"> <li>1. The system must include dedicated physical and/or virtual interfaces specifically for system management.</li> <li>2. These interfaces should allow out-of-band management, ensuring that administrative tasks can be performed without impacting data traffic.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DA | <p><b>Features:</b></p> <p>Dedicated system management interfaces:</p> <ol style="list-style-type: none"> <li>4. The system include dedicated physical interfaces specifically for system management.</li> <li>5. These interfaces allow out-of-band management, ensuring that administrative tasks can be performed without impacting data traffic.</li> <li>6. Management interfaces support the following functionalities: <ul style="list-style-type: none"> <li>- Web-based GUI for ease of access.</li> </ul> </li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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| <p>3. Management interfaces must support the following functionalities:</p> <ul style="list-style-type: none"> <li>- Web-based GUI for ease of access.</li> <li>- Command-line interface (CLI) for advanced configuration.</li> <li>- Support for industry-standard protocols such as SNMP and REST API for integration with monitoring and orchestration tools.</li> <li>- Role-based access control (RBAC) to ensure secure system administration.</li> </ul> <p>4. Redundancy for management interfaces:</p> <ul style="list-style-type: none"> <li>- to ensure availability, the management interfaces must support redundancy, allowing continuous system management even in the event of a single interface failure.</li> </ul> <p>5. Protocol optimization:</p> <p>The system must include protocol-specific optimizations such as:</p> <ul style="list-style-type: none"> <li>- Multipath I/O (MPIO) for FC and iSCSI to ensure high availability and load balancing.</li> <li>- Support for jumbo frames in iSCSI for improved performance in high-throughput environments.</li> </ul> <p>6. Compliance and Interoperability:</p> <p>The system must be compliant with industry standards for both FC and iSCSI protocols. It must ensure interoperability with third-party devices, including servers, switches, and network adapters.</p> |    | <ul style="list-style-type: none"> <li>- Command-line interface (CLI) for advanced configuration.</li> <li>- Support for industry-standard protocols such as SSH, SNMP, and REST API for integration with monitoring and orchestration tools.</li> <li>- Role-based access control (RBAC) to ensure secure system administration.</li> </ul> <p>4. Redundancy for management interfaces:</p> <ul style="list-style-type: none"> <li>- to ensure availability, the management interfaces support redundancy, allowing continuous system management even in the event of a single interface failure.</li> </ul> <p>5. Protocol optimization:</p> <p>The system include protocol-specific optimizations such as:</p> <ul style="list-style-type: none"> <li>- Multipath I/O (MPIO) for FC and iSCSI to ensure high availability and load balancing.</li> <li>- Support for jumbo frames in iSCSI for improved performance in high-throughput environments.</li> </ul> <p>6. Compliance and Interoperability:</p> <p>The system is compliant with industry standards for both FC and iSCSI protocols. It ensure interoperability with third-party devices, including servers, switches, and network adapters.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- <a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Concept Guide<br/><a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family: Concept Guide - Version 873</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Command-Line Interface User's Guide<br/><a href="https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf">https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf</a></li> </ul> |
| <p><b>Deduplication and compression requirements</b></p> <p>1. Functional capabilities:</p> <p>The storage system must provide deduplication functionality for data stored at the block level (iSCSI/FC LUN) and file level, with the following specifics:</p> <ul style="list-style-type: none"> <li>- Deduplication must operate both at the volume level and globally across the system, ensuring optimal storage efficiency.</li> </ul> <p>The system must also include compression functionality for:</p> <ul style="list-style-type: none"> <li>- Block-level volumes (iSCSI/FC LUN).</li> </ul> <p>2. Interoperability and unrestricted functionality:</p> <p>Deduplication and compression features must operate seamlessly without introducing limitations or restrictions on simultaneous use of other critical functionalities, including but not limited to:</p> <ul style="list-style-type: none"> <li>- Data replication.</li> <li>- Thin provisioning.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                     | DA | <p><b>Deduplication and compression requirements:</b></p> <p>1. Functional capabilities:</p> <p>The storage system provide deduplication functionality for data stored at system level, with the following specifics:</p> <ul style="list-style-type: none"> <li>- Deduplication operate both at the volume level and globally across the system, ensuring optimal storage efficiency.</li> </ul> <p>The system also include compression functionality for:</p> <ul style="list-style-type: none"> <li>- Block-level volumes (iSCSI/FC LUN).</li> </ul> <p>2. Interoperability and unrestricted functionality:</p> <p>Deduplication and compression features operate seamlessly without introducing limitations or restrictions on simultaneous use of other critical functionalities, including but not limited to:</p> <ul style="list-style-type: none"> <li>- Data replication.</li> <li>- Thin provisioning.</li> <li>- Backups.</li> <li>- Volume cloning.</li> </ul> <p>3. Inline deduplication and compression:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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| <ul style="list-style-type: none"> <li>- Backups.</li> <li>- Volume cloning.</li> </ul> <p>3. Inline deduplication and compression:</p> <ul style="list-style-type: none"> <li>- Both deduplication and compression mechanisms must function in in-line mode, ensuring real-time data optimization without requiring post-processing.</li> <li>- Deduplication must remain continuously active and cannot be disabled or bypassed by system administrators or any other means, ensuring consistent storage efficiency and data integrity.</li> <li>- Storage solutions that rely on scheduled or job-based data reduction processes are not acceptable.</li> </ul> |    | <ul style="list-style-type: none"> <li>- Both deduplication and compression mechanisms function in in-line mode, ensuring real-time data optimization without requiring post-processing.</li> <li>- Deduplication remain continuously active and cannot be disabled or bypassed by system administrators or any other means, ensuring consistent storage efficiency and data integrity.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- <a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Concept Guide<br/><a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family: Concept Guide - Version 873</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Command-Line Interface User's Guide<br/><a href="https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf">https://www.ibm.com/docs/en/STSLR9_8.7.x_cd/pdf/CLI_guide_version_873.pdf</a></li> </ul> |
| <p>4. Licensing and support:</p> <p>All features related to deduplication and compression must be:</p> <ul style="list-style-type: none"> <li>- Fully licensed (if required by vendor provisions) and included in the offer, eliminating additional licensing costs for essential functionality.</li> <li>- Supported by the storage system in its maximum configuration, ensuring scalability and compatibility across all deployment scenarios.</li> </ul>                                                                                                                                                                                                       | DA | <p>4. Licensing and support:</p> <p>All features related to deduplication and compression is included in IBM Storage Virtualize, no other licensing need it and is supported by the storage system in its maximum configuration, ensuring scalability and compatibility across all deployment scenarios.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM FlashSystem 9500 Product Guide<br/><a href="https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf">https://www.redbooks.ibm.com/redpapers/pdfs/redp5669.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>5. Performance and reliability considerations:</p> <ul style="list-style-type: none"> <li>- The deduplication and compression mechanisms must not introduce significant latency or impact the system's performance metrics, such as IOPS or throughput.</li> <li>- Mechanisms should include built-in error detection and correction to maintain data integrity during deduplication and compression processes.</li> </ul>                                                                                                                                                                                                                                      | DA | <p>5. Performance and reliability considerations:</p> <ul style="list-style-type: none"> <li>- The deduplication and compression mechanisms does not introduce significant latency or impact the system's performance metrics, such as IOPS or throughput.</li> <li>- Mechanisms include built-in error detection and correction to maintain data integrity during deduplication and compression processes.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- Introduction and Implementation of Data Reduction Pools and Deduplication<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248430.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248430.pdf</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></li> <li>- IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family Troubleshooting Guide<br/><a href="https://www.ibm.com/docs/en/flashsystem-9x00/8.7.x_cd?topic=problem-iscsi-performance-analysis-tuning">IBM Storage Virtualize for SAN Volume Controller and FlashSystem Family: Troubleshooting Guide - Version 873</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 6. Management and monitoring:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | DA | 6. Management and monitoring:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

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| <p>The system must provide a dedicated interface or tools for monitoring deduplication and compression efficiency, including:</p> <ul style="list-style-type: none"> <li>- Space savings metrics.</li> <li>- Real-time and historical performance impacts.</li> <li>- Detailed logs of deduplication and compression activities.</li> </ul>                                                                                                                                               |    | <p>The system provide a dedicated interface or tools for monitoring deduplication and compression efficiency, including:</p> <ul style="list-style-type: none"> <li>- Space savings metrics.</li> <li>- Real-time and historical performance impacts.</li> <li>- Detailed logs of deduplication and compression activities.</li> </ul> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>Snapshot requirements:</p> <p>1. General functionality:</p> <ul style="list-style-type: none"> <li>- The system must support snapshot functionality at a minimum for block-level volumes (LUNs), ensuring operational flexibility.</li> <li>- The snapshot functionality must be applicable to both LUNs and other supported volumes without imposing restrictions on the simultaneous use of other critical system functions, including replication, backups, and cloning.</li> </ul> | DA | <p><b>Snapshot requirements:</b></p> <p>1. General functionality:</p> <ul style="list-style-type: none"> <li>- The system support snapshot functionality at a minimum for block-level volumes (LUNs), ensuring operational flexibility.</li> </ul> <p>The snapshot functionality be applicable to both LUNs and other supported volumes without imposing restrictions on the simultaneous use of other critical system functions, including replication, backups, and cloning.</p> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                                                                                                                                                        |
| <p>2. Snapshot quantity and retention:</p> <ul style="list-style-type: none"> <li>- The system must provide the ability to create and manage a minimum of 365 snapshots per shared volume, supporting long-term operational and recovery needs.</li> <li>- Snapshots must be configurable with retention policies to optimize storage space and align with data governance requirements.</li> </ul>                                                                                       | DA | <p>Snapshot quantity and retention:</p> <ul style="list-style-type: none"> <li>- The system provide the ability to create and manage up to 64.999 snapshot per system and up to 15.864 FlashCopy mappings per system supporting long-term operational and recovery needs also through the policies of copy services that can be implemented</li> <li>- Snapshots are configurable with retention policies to optimize storage space and align with data governance requirements.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager</li> </ul> <p><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></p> <ul style="list-style-type: none"> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5</li> </ul> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p> |
| <p>3. Performance efficiency:</p> <ul style="list-style-type: none"> <li>- The implementation of snapshots must not degrade overall system performance, regardless of the number of active snapshots or system workload.</li> </ul>                                                                                                                                                                                                                                                       | DA | <p>3. Performance efficiency:</p> <ul style="list-style-type: none"> <li>- The implementation of snapshots not degrade overall system performance, regardless of the number of active snapshots or system workload.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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| <p>- The system must include optimization mechanisms, such as metadata indexing and intelligent snapshot scheduling, to minimize latency and maintain high performance.</p>                                                                                                                                                                                                                                               |    | <p>- The system include optimization mechanisms, such as metadata indexing and intelligent snapshot scheduling, to minimize latency and maintain high performance.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <p>4. Space efficiency:</p> <p>- Snapshot functionality must employ a cost-effective approach by storing only the delta (changes) from the original data. This ensures minimal storage consumption while preserving full data access and recovery capabilities.</p>                                                                                                                                                       | DA | <p>4. Space efficiency:</p> <p>- Snapshot functionality employ a cost-effective approach by storing only the delta (changes) from the original data. This ensures minimal storage consumption while preserving full data access and recovery capabilities.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> <li>- Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>5. Integration with storage QoS:</p> <p>- The system must support performance monitoring and prioritization mechanisms for snapshots, enabling administrators to enforce Storage QoS (Quality of Service) policies at both the volume and LUN levels.</p> <p>- These QoS policies should dynamically allocate resources to prioritize performance critical snapshots, ensuring minimal impact on other operations.</p> | DA | <p>5. Integration with storage QoS:</p> <p>- The system support performance monitoring and prioritization mechanisms for snapshots, enabling administrators to enforce Storage QoS (Quality of Service) policies at both the volume and LUN levels.</p> <p>- These QoS policies dynamically allocate resources to prioritize performance critical snapshots, ensuring minimal impact on other operations.</p> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Spectrum Control: User's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></li> <li>- IBM Spectrum Control: Administrator's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></li> </ul> |
| <p>6. Advanced features:</p> <p>Snapshots must support:</p> <p>- Application-consistent snapshots, ensuring data integrity for workloads such as databases and virtualized environments.</p>                                                                                                                                                                                                                              | DA | <p>6. Advanced features:</p> <p>Snapshots support:</p> <p>- Application-consistent snapshots, ensuring data integrity for workloads such as databases and virtualized environments.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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| <p>- Writable snapshots, allowing clones to be created for development, testing, or analytics without affecting the production environment.</p> <p>Snapshots must be compatible with data replication workflows, ensuring consistent replication of both primary data and snapshot states across systems.</p>                                          |    | <ul style="list-style-type: none"> <li>- Writable snapshots, allowing clones to be created for development, testing, or analytics without affecting the production environment.</li> <li>- Snapshots are compatible with data replication workflows, ensuring consistent replication of both primary data and snapshot states across systems.</li> </ul> <p>Documentatie tehnica:</p> <ul style="list-style-type: none"> <li>- IBM Copy Services Manager<br/><a href="https://www.ibm.com/docs/en/csm/6.3.13">https://www.ibm.com/docs/en/csm/6.3.13</a></li> <li>- IBM FlashSystem Best Practices and Performance Guidelines<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248503.pdf</a></li> <li>- IBM Spectrum Control: User's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a></li> <li>- IBM Spectrum Control: Administrator's Guide<br/><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a></li> </ul> |
| <p>Encryption requirements:</p> <p>1. Encryption standard:</p> <ul style="list-style-type: none"> <li>- The solution must support encryption of all stored data using a minimum of the AES-256 algorithm or a stronger industry-standard encryption algorithm, ensuring compliance with modern security and regulatory standards.</li> </ul>           | DA | <p><b>Encryption requirements:</b></p> <p>1. Encryption standard:</p> <ul style="list-style-type: none"> <li>- The solution support encryption of all stored data using a minimum of the AES256 algorithm or a stronger industry-standard encryption algorithm, ensuring compliance with modern security and regulatory standards.</li> </ul> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>2. Scope of encryption:</p> <ul style="list-style-type: none"> <li>- Encryption must be applied to all drives, NVMe, and flash storage within the device, covering the entire data storage ecosystem.</li> <li>- Encryption must extend to data at rest across all volumes, snapshots, backups, and metadata associated with the system.</li> </ul> | DA | <p><b>Encryption requirements:</b></p> <p>1. Encryption standard:</p> <ul style="list-style-type: none"> <li>- The solution support encryption of all stored data using a minimum of the AES256 algorithm or a stronger industry-standard encryption algorithm, ensuring compliance with modern security and regulatory standards.</li> </ul> <p>Documentatie tehnica:</p> <p>Implementation Guide for IBM Spectrum Virtualize Version 8.5</p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a></p> <p><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p>3. Performance integrity:</p> <ul style="list-style-type: none"> <li>- Encryption functionality must operate with no measurable impact on system performance, ensuring IOPS, throughput, and latency metrics remain consistent with non-encrypted operations.</li> </ul>                                                                            | DA | <p>3. Performance integrity:</p> <ul style="list-style-type: none"> <li>- Encryption functionality operate with no measurable impact on system performance, ensuring IOPS, throughput, and latency metrics remain consistent with non-encrypted operations.</li> <li>- The system leverage hardware-accelerated encryption or equivalent technologies to maintain optimal performance during data encryption and decryption processes</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

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| <p>- The system must leverage hardware-accelerated encryption or equivalent technologies to maintain optimal performance during data encryption and decryption processes.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                           |    | <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p>4. Key management:</p> <ul style="list-style-type: none"> <li>- The solution must generate encryption keys using a secure hardware-based random number generator, ensuring keys are robust and resistant to attacks.</li> <li>- Encryption keys must be securely stored on the equipment, leveraging a dedicated hardware security module (HSM) or equivalent secure enclave to isolate keys from unauthorized access.</li> <li>- The system must ensure that data stored on drives/NVMe/flash cannot be accessed if the storage media is removed from the device or if the device itself is compromised.</li> </ul> | DA | <p>4. Key management:</p> <ul style="list-style-type: none"> <li>- The solution generate encryption keys using a secure hardware-based random number generator, ensuring keys are robust and resistant to attacks.</li> <li>- Encryption keys be securely stored on the equipment, leveraging a dedicated hardware security module (HSM) or equivalent secure enclave to isolate keys from unauthorized access.</li> <li>- The system ensure that data stored on drives/NVMe/flash cannot be accessed if the storage media is removed from the device or if the device itself is compromised.</li> </ul> <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a><br/><a href="https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs">https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs</a></p> |
| <p>5. Key backup and recovery:</p> <ul style="list-style-type: none"> <li>- The system must include mechanisms for secure backup and recovery of encryption keys, supporting integration with external key management systems (KMS) compliant with KMIP (Key Management Interoperability Protocol) standards.</li> <li>- Key rotation and lifecycle management should be automated and configurable to align with organizational policies and compliance requirements.</li> </ul>                                                                                                                                       | DA | <p>5. Key backup and recovery:</p> <ul style="list-style-type: none"> <li>- The system include mechanisms for secure backup and recovery of encryption keys, supporting integration with external key management systems (KMS) compliant with KMIP (Key Management Interoperability Protocol) standards.</li> <li>- Key rotation and lifecycle management be automated and configurable to align with organizational policies and compliance requirements.</li> </ul> <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a><br/><a href="https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs">https://www.ibm.com/support/pages/ibm-security-guardium-key-lifecycle-manager-documentation-pdfs</a></p>                                                                                                                                    |
| <p>6. Encryption for replication and snapshots:</p> <ul style="list-style-type: none"> <li>- The encryption functionality must extend to replicated data and snapshots, ensuring consistency in encryption across all replicated sites or volumes.</li> <li>- Encryption must not disrupt or degrade replication workflows, including synchronous and asynchronous modes.</li> </ul>                                                                                                                                                                                                                                    | DA | <p>6. Encryption for replication and snapshots:</p> <ul style="list-style-type: none"> <li>- The encryption functionality extend to replicated data and snapshots, ensuring consistency in encryption across all replicated sites or volumes.</li> </ul> <p>Encryption must not disrupt or degrade replication workflows, including synchronous and asynchronous modes.</p> <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

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| <b>7. Audit and compliance:</b><br>- The system must provide audit logs and reports detailing encryption operations, key management activities, and access attempts, ensuring transparency and regulatory compliance.<br>- Logs should be exportable and compatible with industry-standard security information and event management (SIEM) systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | DA | <b>7. Audit and compliance:</b><br>- The system provide audit logs and reports detailing encryption operations, key management activities, and access attempts, ensuring transparency and regulatory compliance.<br>- Logs be exportable and compatible with industry-standard security information and event management (SIEM) systems.<br><br>Documentatie tehnica:<br>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a><br>- IBM Spectrum Control: User's Guide<br><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf</a><br>- IBM Spectrum Control: Administrator's Guide<br><a href="https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf">https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf</a>                                                                                                                                                            |
| <b>Monitoring requirements:</b><br>1. Analytical platform or portal:<br>- The system must include a robust analytical platform or virtual machine (VM) accessible via a web browser-based portal.<br>- The platform must provide an intuitive, user-friendly interface with interactive dashboards for data visualization and management.<br>2. Log collection and reporting:<br>The platform must automatically collect and analyze logs from the device and present them as customizable graphs, reports, and alerts, covering the following:<br>2.1. Storage utilization:<br>- Real-time and historical monitoring of used space.<br>- Display of the data reduction indicator, accounting for deduplication and compression (excluding thin provisioning, if applicable).<br>- Granular visibility at both the global device level and the local LUN level.<br>2.2. Space growth prediction:<br>- Advanced forecasting tools for predicting space growth, factoring in deduplication, compression, and provisioning trends.<br>- Tools for future expansion analysis, including recommendations for scaling.<br>3. Component monitoring: | DA | <b>Monitoring requirements:</b><br>1. Analytical platform or portal:<br>- The system include a robust analytical platform or virtual machine (VM) accessible via a web browser-based portal.<br>- The platform provide an intuitive, user-friendly interface with interactive dashboards for data visualization and management.<br>Log collection and reporting:<br>- The platform automatically collect and analyze logs from the device and present them as customizable graphs, reports, and alerts, covering the following:<br>2.1. Storage utilization:<br>- Real-time and historical monitoring of used space.<br>- Display of the data reduction indicator, accounting for deduplication and compression (excluding thin provisioning, if applicable).<br>- Granular visibility at both the global device level and the local LUN level.<br>2.2. Space growth prediction:<br>- Advanced forecasting tools for predicting space growth, factoring in deduplication, compression, and provisioning trends.<br>- Tools for future expansion analysis, including recommendations for scaling.<br>3. Component monitoring:<br>The system include an application or hardware-based monitoring solution to oversee and report detailed events for the following physical and logical components:<br>- Physical components: controllers, drives, ports, power supplies, and network interfaces.<br>- Logical components: volumes, LUNs, replication processes, deduplication, and compression algorithms. |

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- Physical components: controllers, drives, ports, power supplies, and network interfaces.
- Logical components: volumes, LUNs, replication processes, deduplication, and compression algorithms.

4. Performance monitoring:

The portal must provide minimum:

- Real-time and historical performance metrics for individual resources.
- Key parameters to monitor: Latency, Read and Write IOPS, Bandwidth.

Performance data must be available at both the global system level and the LUN level.

5. Storage QoS and prioritization:

- The system must include a performance monitoring and prioritization mechanism for Storage QoS, configurable at both the volume and LUN levels.
- QoS metrics should be adjustable in real-time to meet dynamic workload demands.

6. Reporting and alerting:

The portal must provide comprehensive reporting capabilities, including at least:

- Capacity reports: current usage, available space, and forecasted capacity needs.
- Performance reports: historical trends and real-time analytics of system performance.
- Future space predictions: automated simulations for capacity increases based on application type and workload.
- Event logs: authorization attempts, executed commands, and system alerts for security and operational events.
- Technical support logs: level of support received, resolution times, and incident history.

7. Operational monitoring:

- Snapshot and replication status: display the real-time status of operations such as snapshots, synchronous/asynchronous replication, and recovery tasks.
- Threat alerts: warnings related to system integrity, user activity, or misconfigurations.
- Optimization insights: recommendations for system performance improvement, resource reallocation, or energy efficiency.

8. Configuration verification and upgrades:

- The platform must include an algorithm for verifying configuration correctness and compatibility with potential device or cluster upgrades.

9. Simulation and optimization:

4. Performance monitoring:

The portal provide minimum:

- Real-time and historical performance metrics for individual resources.
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- Optimization insights: recommendations for system performance improvement, resource reallocation, or energy efficiency.

8. Configuration verification and upgrades:

- The platform include an algorithm for verifying configuration correctness and compatibility with potential device or cluster upgrades.

9. Simulation and optimization:

- The platform enable capacity simulation tools to project storage needs based on application types and expected workloads.

Display real-time system consumption metrics with actionable optimization guidelines for improving performance and efficiency.

Documentatie tehnica:

Implementation Guide for IBM Spectrum Virtualize Version 8.5

- <https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf>
- <https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf>
- <https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf>
- IBM Spectrum Control: User's Guide  
[https://www.ibm.com/docs/en/SS5R93\\_5.4.4/pdf/IBM\\_Spectrum\\_Control\\_544\\_Users\\_Guide.pdf](https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Users_Guide.pdf)
- IBM Spectrum Control: Administrator's Guide  
[https://www.ibm.com/docs/en/SS5R93\\_5.4.4/pdf/IBM\\_Spectrum\\_Control\\_544\\_Administrators\\_Guide.pdf](https://www.ibm.com/docs/en/SS5R93_5.4.4/pdf/IBM_Spectrum_Control_544_Administrators_Guide.pdf)

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| <ul style="list-style-type: none"> <li>- The platform must enable capacity simulation tools to project storage needs based on application types and expected workloads.</li> <li>- Display real-time system consumption metrics with actionable optimization guidelines for improving performance and efficiency.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <p><b>NICs included per controller:</b><br/>Min. x 1GE for management;<br/>Min. 2 x 32G FC SFP28(850nm SFP+ SR MM module included) for data transfer;<br/>Min. 2 x 32G FC dedicated for replication (metro cluster).</p> <p><b>Supported operating environments:</b><br/>Microsoft Windows Server;<br/>Red Hat Enterprise Linux;<br/>VMware (VMware ESXi);</p> <p><b>Power supplies included:</b><br/>The system must include a minimum of two (2) hot-swappable (hot-plug) power supply units (PSUs).<br/>The PSUs must support at least 1+1 redundancy, ensuring continuous operation in case of failure of one PSU</p> <p>Power cables included must meet the following specifications:<br/>- Type: IEC C13 - C14.<br/>- Minimum length: 0.6 meters (24 inches).</p>                            | DA | <p><b>NICs included per controller:</b><br/>1 x 1GE for management;<br/>4 x 32G FC SFP28(850nm SFP+ SR MM module included) for data transfer;<br/>4 x 32G FC dedicated for replication.</p> <p><b>Supported operating environments:</b><br/>Microsoft Windows Server;<br/>Red Hat Enterprise Linux;<br/>VMware (VMware ESXi);</p> <p><b>Power supplies included:</b><br/>The system include 4 hot-swappable (hot-plug) Power Supply Units (PSUs).<br/>The PSUs support 1+1 redundancy, ensuring continuous operation in case of failure of one PSU.<br/>Power cables included meet the following specifications:<br/>- Type: IEC C13 to C14.<br/>Length: 1,5 meters .</p> <p>Documentatie tehnica:<br/>Implementation Guide for IBM Spectrum Virtualize Version 8.5<br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248520.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248543.pdf</a><br/><a href="https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf">https://www.redbooks.ibm.com/redbooks/pdfs/sg248542.pdf</a></p> |
| <p><b>Cerințe obligatorii pentru prestarea serviciilor de punere în funcțiune, a garanției și a serviciilor de suport (deservire și mentenanță) a bunurilor - conform Anexei la Anunțul de participare.</b></p> <p>Toate licențele necesare (dacă se aplică conform termenilor și condițiilor producătorului) pentru caracteristicile platformei/portalului de monitorizare (analitică) și software-ului/firmware-ului specific sistemului de stocare, inclusiv actualizările/patch-urile periodice, trebuie să fie incluse în ofertă și furnizate pe o bază perpetuă - valabile obligatoriu pentru durata integrală de viață a sistemului de stocare.</p> <p><b>Termeni și condiții:</b><br/>Toate cerințele sunt minime și obligatorii;<br/>O cerință nu trebuie să limiteze o altă cerință;</p> | DA | <p><b><u>Service Centru autorizat de IBM se obligă în prestarea serviciilor de punere în funcțiune, a garanției și a serviciilor de suport (deservire și mentenanță) a bunurilor - conform Anexei la Anunțul de participare.</u></b></p> <p>Toate licențele necesare pentru caracteristicile platformei/portalului de monitorizare (analitică) și software-ului/firmware-ului specific sistemului de stocare sunt incluse în ofertă și furnizate pe o bază perpetuă - valabile pentru durata integrală de viață a sistemului de stocare.</p> <p><b>Termeni și condiții:</b><br/><b>Am luat la cunoștință și confirmăm îndeplinirea următoarelor:</b><br/>Toate cerințele sunt minime și obligatorii;<br/>O cerință nu limiteze o altă cerință;<br/>Toate componentele sunt actuale și nu sunt promovate ca EOS (sfârșitul vânzării/suportului) / EOL (sfârșitul duratei de viață);</p>                                                                                                                                                                                                                                                                                        |

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| <p>Toate componentele trebuie să fie actuale și să nu fie promovate ca EOS (sfârșitul vânzării/suportului) / EOL (sfârșitul duratei de viață);<br/>Extinderea memoriei (ram) și a capacității de stocare nu trebuie să includă limitări hardware sau software.</p> |  | <p>Extinderea memoriei (ram) și a capacității de stocare nu include limitări hardware sau software.</p> |
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