EMC CENTERA CAPACITY REPORTING FOR GEN4LP ON CENTRASTAR 4.2.2
A detailed review

Abstract
This white paper discusses EMC® Centera® capacity reporting metrics that will allow Centera storage administrators to correctly understand Centera capacity usage. The focus of this white paper is on the reporting statistics available for EMC Centera Generation 4 Low Power (Gen4LP) hardware running the CentraStar® 4.2.2 release.

May, 2013
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Executive summary

It is vital for storage administrators to be able to understand the EMC® Centera® capacity utilization in their environment so that they can plan their storage allocation and scalability needs accordingly. Often a storage administrator would want to correlate the amount of user data written by an application with the used space reported by EMC Centera. However, having little or no knowledge about the EMC Centera capacity reporting metrics and how they translate to the Centera used capacity reported could result in the misinterpretation of capacity numbers and also cause a state of confusion for the administrator. This white paper intends to summarize the capacity reporting metrics available to storage administrators to help them understand EMC Centera capacity.

Introduction

This white paper discusses the EMC Centera capacity reporting metrics available from the Centera Viewer CLI and how storage administrators should interpret that information. It also discusses capacity management of Object bound and Capacity bound systems.

The information presented in this white paper should be used to understand and differentiate between the reserved, used, and available EMC Centera storage space in a storage environment. This white paper specifically addresses the storage metrics available in the CentraStar® 4.2.2 release running on EMC Centera Generation 4 Low Power (Gen4LP) hardware.

Audience

This white paper is intended for storage architects and administrators who have a good technical background and understanding of the storage technology. This white paper is not intended to act as a best practices document for capacity utilization and allocation.

Terminology

The following table summarizes the commonly used terms used in this white paper.

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLOB</td>
<td>Denotes the finite bit string that is the customer data. A single C-Clip can contain pointers to multiple BLOBs. The content of a BLOB is opaque to CentraStar. BLOBs also have associated Content Addresses, but they are not exposed to the applications accessing EMC Centera. This is to ensure the path to the data is always through the appropriate pointer (C-Clip).</td>
</tr>
<tr>
<td>CDF</td>
<td>Clip Descriptor File that contains the associated metadata for the clip.</td>
</tr>
<tr>
<td>C-Clip</td>
<td>The union of a CDF and its associated data BLOB(s). The CA (content address) returned to the access application upon data storage is the address of the C-Clip.</td>
</tr>
<tr>
<td>Content Protection Parity (CPP)</td>
<td>CPP segments a data object into six parts and stores each one on a different node in the same cluster. CPP calculates a parity fragment from the stored</td>
</tr>
</tbody>
</table>
fragments and stores that as the seventh data segment on yet another node.

<table>
<thead>
<tr>
<th>Capacity Reporting for EMC Centera Gen4LP on CentraStar 4.2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPM stores a complete copy of the data object on a different node in the same cluster.</td>
</tr>
<tr>
<td>CPM stores a complete copy of the data object on a different node in the same cluster.</td>
</tr>
<tr>
<td>The total physical capacity of the cluster/cube/node or disks.</td>
</tr>
<tr>
<td>The capacity that is used by the CentraStar software and is never available for storing data.</td>
</tr>
<tr>
<td>The capacity that can be made available by assigning a storage role to nodes that currently do not have a storage role.</td>
</tr>
<tr>
<td>The capacity that is temporarily unavailable due to nodes that are offline (for example, restarting or failed) and/or disks that have failed and are offline.</td>
</tr>
<tr>
<td>The capacity taken by user data, including CDFs, reflections, and protected copies of user files.</td>
</tr>
<tr>
<td>The “used” portion of the reserved capacity for managing the objects stored on the system. This includes work space, indexes, and databases for the location system of EMC Centera.</td>
</tr>
<tr>
<td>The “available” portion of the reserved capacity for managing the objects stored on the system. This allows indexes and databases to fail over and grow to the supported number of stored objects.</td>
</tr>
<tr>
<td>Space that is reserved for re-protection of content when disks or nodes fail. On CentraStar 4.2.2 this capacity is not available to write new content.</td>
</tr>
<tr>
<td>The amount of capacity available to write new content.</td>
</tr>
<tr>
<td>Current quota for the pool. This is the maximum amount of data that can be written to the pool.</td>
</tr>
<tr>
<td>The total capacity of all user files written to the pool.</td>
</tr>
<tr>
<td>Current available capacity until the quota is reached.</td>
</tr>
<tr>
<td>Number of C-Clips stored in the pool.</td>
</tr>
<tr>
<td>Number of user files stored in the pool.</td>
</tr>
<tr>
<td>Number of objects that can be stored.</td>
</tr>
<tr>
<td>Total object capacity already used.</td>
</tr>
<tr>
<td>Total number of objects that can still be written to the cluster.</td>
</tr>
</tbody>
</table>

**Table 1. Capacity reporting terminology**

**EMC Centera single instancing**

Single instance storage (SIS) is a feature that eliminates redundant content from an EMC Centera cluster. This can be achieved by both Proactive and Reactive means.

- **Proactive single instance storage** is achieved by computing the content address (CA) for the object upfront, checking if the content already exists on the cluster, and only streaming the content if it does not exist.

- **Reactive single instance storage** is achieved via the organic regeneration background task, which will eliminate the redundant copies, effectively de-duplicating the content over time.

**Capacity components overview**

Capacity reporting consists of the following components:

- **System Resources**: Space taken by the CentraStar software

- **Protected User Data**: Sum of all capacity used to store and protect user data (user files and CDF)
- Audit & Metadata: Sum of all capacity used for managing the objects on the system
- System Buffer: Space for audit and metadata to grow
- Regeneration Buffer: Space kept available for re-protection of objects when disks or nodes fail (self-healing)
- Available Capacity: Available capacity to write new content
- Total Raw Capacity: Sum of all disks in the system

Figure 1 provides a graphical view of the capacity components breakdown:

Assuming that no hardware or software configuration changes are made (for example, addition of new nodes on the existing EMC Centera hardware, changing the supported number of objects, and so on), the reservations portion of the capacity components remains static throughout the EMC Centera system.
Understanding raw capacity

Raw capacity per disk

On each disk, CentraStar has a number of system partitions that are used to store the CentraStar software and include some working directories and swap space. These partitions are reported as “System Resources” and are not available for data storage. The following table shows the available total raw capacity in Gen4LP 750 GB, 1 TB, 2 TB and 3 TB drives:

<table>
<thead>
<tr>
<th>GB (1024 notation)</th>
<th>Gen4LP (750 GB)</th>
<th>Gen4LP (1 TB)</th>
<th>Gen4LP (2 TB)</th>
<th>Gen4LP (3 TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Raw Capacity</td>
<td>698.7</td>
<td>931.5</td>
<td>1863.0</td>
<td>2794.5</td>
</tr>
<tr>
<td>System Resources (CentraStar/Operating System)</td>
<td>2.6</td>
<td>2.6</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Free Capacity (Raw Capacity – System Resources)</td>
<td>696.1</td>
<td>928.9</td>
<td>1860.4</td>
<td>2791.9</td>
</tr>
</tbody>
</table>

Table 2. Total raw capacity for Gen4LP drives

Raw capacity per node

On each disk, CentraStar has a number of system partitions that are used to store the CentraStar software and include some working directories and swap space. These partitions are reported as “System Resources” and are not available for data storage. The following table shows the available total raw capacity in Gen4LP 750 GB, 1 TB, 2 TB and 3 TB drives:

<table>
<thead>
<tr>
<th>GB (1024 notation)</th>
<th>Gen4-LP (750 GB)</th>
<th>Gen4-LP (1 TB)</th>
<th>Gen4-LP (2 TB)</th>
<th>Gen4-LP (3 TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Raw Capacity</td>
<td>2794.6</td>
<td>3726.1</td>
<td>7452.0</td>
<td>11178.0</td>
</tr>
</tbody>
</table>

Table 3. Raw capacity per node

Available capacity reporting

Available or “usable” capacity reporting is dependent on the way EMC Centera systems are configured. One factor that changes the available capacity is the Supported Object Count (SOC). On a newly installed EMC Centera Gen4LP system running CentraStar 4.2.2 the supported object count is 50 million objects per node. Upon request this limit can be increased up to 100 million objects per node. Changing the object count requires allocating additional space for system buffer and system resources and as a result minimally affects the available capacity.

The following sections discuss the available capacity per node for both object count limitations.

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**Note:** The change to 100 million objects per node can be done only by EMC service personnel.
Available capacity per node (50M objects per node)

Available capacity per node is the capacity available to store and protect actual user data. The system buffer refers to space reserved for the audit and metadata to grow. The audit and metadata space is used for storing databases and indexes to manage the user data. A breakdown of the total capacity allocation in a Gen4LP node with a set limit of 50 million objects per node is shown in Table 4:

<table>
<thead>
<tr>
<th>GB (1024 notation)</th>
<th>Gen4LP (750 GB)</th>
<th>Gen4LP (1 TB)</th>
<th>Gen4LP (2 TB)</th>
<th>Gen4LP (3 TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Raw Capacity</td>
<td>2794.6</td>
<td>3726.1</td>
<td>7452.0</td>
<td>11178.0</td>
</tr>
<tr>
<td>System Resources</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
</tr>
<tr>
<td>Audit &amp; Metadata</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>System Buffer</td>
<td>124.2</td>
<td>124.2</td>
<td>124.2</td>
<td>124.2</td>
</tr>
<tr>
<td>Available Capacity</td>
<td>2659.2</td>
<td>3590.7</td>
<td>7316.1</td>
<td>11042.5</td>
</tr>
</tbody>
</table>

Table 4. Available capacity per node (50M objects per node)

The following figures show the Centera Viewer CLI commands used to check for capacity reporting on a newly installed Gen4LP four-node system with 1 TB drives.

**Figure 2. CLI command show capacity availability**

```
Config# show capacity availability
Number of nodes: 4
Number of nodes with storage role: 4
Total Raw Capacity: 14,904 GB (100%)
Used Raw Capacity: 45 GB (0%)
Free Raw Capacity: 14,859 GB (100%)
System Buffer: 499 GB (4%)
Regeneration Buffer: 1,863 GB (13%)
Available Capacity: 12,498 GB (83%)
Total Object Count: 201 M (100%)
Used Object Count: 0 M (0%)
Free Object Count: 201 M (100%)
```

**Figure 3. CLI command show capacity detail all**

```
Config# show capacity detail all
Number of nodes: 4
Number of nodes with storage role: 4
Node  Roles  Status  Total Raw  System  Offline  Used  Free Raw
c001n01  A,B,M,R,S  on   3,726 GB  10 GB  0 GB   840 MB  3,715 GB
c001n02  A,B,M,R,S  on   3,726 GB  10 GB  0 GB   840 MB  3,715 GB
c001n03  A,B,M,R,S  on   3,726 GB  10 GB  0 GB   840 MB  3,715 GB
c001n04  A,B,M,R,S  on   3,726 GB  10 GB  0 GB   840 MB  3,715 GB
Total (online nodes: 4) 15 TB  41 GB  0 GB  3 GB  15 TB
Roles: A(ccess), B(ic), M(anagement), R(eplication), S(orage)
```
Available capacity per node (100M objects per node)

A breakdown of the total capacity allocation in a Gen4LP node with a set limit of 100 million objects per node is shown in the following table:

<table>
<thead>
<tr>
<th>GB (1024 notation)</th>
<th>Gen4LP (750 GB)</th>
<th>Gen4LP (1 TB)</th>
<th>Gen4LP (2 TB)</th>
<th>Gen4LP (3 TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Raw Capacity</td>
<td>2794.6</td>
<td>3726.1</td>
<td>7452.0</td>
<td>11178.0</td>
</tr>
<tr>
<td>System Resources</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
<td>10.4</td>
</tr>
<tr>
<td>Audit &amp; Metadata</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>System Buffer</td>
<td>248.1</td>
<td>248.1</td>
<td>248.1</td>
<td>248.1</td>
</tr>
<tr>
<td>Available Capacity</td>
<td>2535.3</td>
<td>3466.8</td>
<td>7192.6</td>
<td>10918.6</td>
</tr>
</tbody>
</table>

Table 5. Available capacity per node (100M objects per node)

Note: The factory default configuration for an EMC Centera node is 50 million objects. It requires EMC services’ intervention to configure 100 million objects per node.

Object bound EMC Centera systems

This section explains what can constitute an EMC Centera object and how it influences the capacity reporting metrics.

- CDF: A metadata file associated with each C-Clip written to EMC Centera. CentraStar always stores two copies of the CDF on the Centera irrespective of the CPM or CPP configurations

- User file/fragment (CPM): A full copy of a mirrored user file

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1 If a user file is larger than 100 MB, the user file is written in multiple fragments of 100 MB. For example a user file of 250 MB will result in two fragments of 100 MB and one of 50 MB. Each fragment mirror copy (CPM) or each one-sixth of the fragment (CPP) will be an object.
• User file/fragment (CPP): A one-sixth fragment of a user file
• Reflection: A metadata file associated with a deleted C-Clip, containing audit information about the deletes; a reflection replaces the CDF and possibly the EBR/LH metadata file

It should be noted here that capacity reporting is updated at periodic intervals and is affected by the user data files being written or deleted. It is important to understand how writes/deletes affect the object count on EMC Centera systems. A brief explanation of the object count and application writes/deletes scenarios is explained in the following sections.

**Object count behavior on CPM systems**

CPM systems store two copies of the data on separate nodes. Along with the data copies, EMC Centera also stores two copies of the CDF. Figure 5 steps through the process of an application writing a file to a CPM-configured EMC Centera system and how different operations affect the object count.

![Figure 5. Object count behavior on CPM systems](image-url)
Object count behavior on CPP systems

CPP EMC Centera configuration stores the objects in the order of 6+1 (six data fragments and one parity fragment). Figure 6 steps through the process of an application writing a file to a CPP configured EMC Centera system and how different operations affect the object count.

![Diagram showing object count behavior on CPP systems]

**Figure 6.** Object count behavior on CPP systems

Object count behavior with embedded BLOBs

EMC Centera SDK allows applications to use the embedded BLOBs feature. By using embedded BLOBs the “data/blob” is base64 encoded in to the CDF and then written to EMC Centera. This reduces the number of objects written to Centera as the CDF and BLOBs are now one object instead of two. Figure 7 steps through the scenario of an application writing data using embedded BLOBs and how different operations affect the object count.
Regeneration buffer and hard stop on capacity bound systems

This buffer reserves capacity to be used for regenerating data after disk and/or node failures. Regeneration buffer is the minimum capacity at which the system will stop writing to the EMC Centera cluster. With CentraStar 4.0 the regeneration buffer is always set to a hard stop limit. Setting the hard stop limit on an EMC Centera system will alert the system administrator when the available capacity on a cluster drops below the defined thresholds for capacity alerting. The default alert settings are 20% (warning) and 10% (error) of the available capacity and do not include the capacity set aside for regeneration buffer.

The actual capacity reserved for the regeneration buffer equals twice the size of the largest disk in the cube (irrespective of the roles assigned to the corresponding node). The buffer can be set to any number of disks provided there is sufficient available capacity.

Figure 8 shows how a regeneration buffer hard stop is set.
Note: The reserved space per cube is twice the largest disk. This means the default setting of one disk corresponds to a capacity of two disks per cube. In other words, the setting actually determines the number of disks per cube and per mirror group.

Figure 9 also shows how to check the current setting of regeneration buffer.

Note that once set, the regeneration buffer mode cannot be changed.

Virtual pool capacity reporting

Virtual pool capacity is defined and reported in terms of the front-end or application view. EMC Centera Viewer reports the total virtual pool capacity, number of C-Clips written to the virtual pool, and the number of user files that different applications wrote to a particular pool.

Virtual pool quota management

An important aspect of managing the capacity for any storage device shared by multiple applications is the ability to set and monitor quota. CentraStar 3.0 (when virtual pools were introduced) allowed the system administrator to define a quota at the virtual pool level and will issue an alert for any virtual pool that is close to using its entire quota.

Note: The virtual pool quota limit is not enforced and EMC Centera will still accept writes from the application. The system administrator can use the pool mask to disable write access to the virtual pool, or remove the write capability from the access profile(s) that have the virtual pool as their home pool.

An EMC Centera Viewer CLI snapshot that shows the virtual pool detail information is shown in Figure 10.
Virtual pool capacity calculation

CentraStar calculates and updates the virtual pool capacity at periodic intervals. Virtual pool capacity numbers do not reflect the extra capacity needed to protect the user file (CPM or CPP) or efficiencies because of being single instanced. If an application is continuously performing write and delete operations on the Centera, then the virtual pool capacity information will not be consistent and there will be a delay in reflecting the changes made. Each time a C-Clip is written to a pool, pool capacity is added; each time a C-Clip is deleted, capacity is removed.

As an application writes and deletes C-Clips from the virtual pool(s) it uses, the access nodes processing the write and delete calls adjust the virtual pool capacity according to the algorithm in Table 6:

<table>
<thead>
<tr>
<th></th>
<th>Write Clip</th>
<th>Delete Clip</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-Clip Count</td>
<td>Add 1</td>
<td>Subtract 1</td>
</tr>
<tr>
<td>User File Count</td>
<td>Add 1 for each User File</td>
<td>Subtract 1 for each User File</td>
</tr>
<tr>
<td></td>
<td>referenced or embedded in the C-Clip</td>
<td>referenced or embedded in the C-Clip</td>
</tr>
<tr>
<td>Pool</td>
<td>Add the capacity for each User</td>
<td>Remove the capacity for</td>
</tr>
</tbody>
</table>

Figure 10. CLI command show pool detail <poolname>
Table 6. Pool capacity calculation algorithm

### Virtual pool capacity reporting limitations

Virtual pool capacity statistics are provided on a best-effort basis. The following limitations must be taken into account when using virtual pool capacity reports:

- As virtual pool capacity statistics are not persisted in real time, the process is vulnerable to access nodes going offline, and the virtual pool capacity statistics will not be 100 percent accurate.

- Please note that if the application is deleting C-Clips while the virtual pool capacity is being initialized or recalculated, the deletes will not be reflected in the virtual pool capacity.

- If a C-Clip is written multiple times, or different versions (via clip update) are stored of the same C-Clip without deleting the original C-Clip, the virtual pool capacity will be updated each time for the entire capacity represented in the C-Clip.

- Virtual pool capacity does not reflect actual capacity taken on disk. Because of the protection scheme and the CDF and database overhead, more raw capacity is being used than reported in pool capacity.

### Monitoring and Alerting

#### Overview of Monitoring Channels

Each alert event\(^2\) triggered by Centera is available via the following monitoring channels, for all Compliance models, provided they are enabled and configured on the cluster. For more information on how to enable and setup these channels, please refer to the Centera Online Help, P/N 300-002-547.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Alerts Supported</th>
<th>Real-time</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConnectEMC</td>
<td>✅</td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>ConnectEMC Notification</td>
<td>✅</td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>Centera CLI</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>MoPI</td>
<td>✅</td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>SNMP</td>
<td>✅</td>
<td>✅</td>
<td></td>
</tr>
<tr>
<td>Centera Console</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>EMC Ionix Control Center</td>
<td>✅</td>
<td>✅</td>
<td>✅</td>
</tr>
</tbody>
</table>

---

\(^2\) The SDK alert and improvement alerts are only available via the MoPI interface.
### Table 7 – Monitoring Channels and Frequency

- **ConnectEMC**: If ConnectEMC is enabled alerts will automatically be sent to the EMC Customer Support Center where it is determined if intervention by an EMC engineer is necessary. Any alert can be masked from being sent to the EMC Customer Support Center whenever reactive action can be done by the customer only. The system operator uses the CLI to configure ConnectEMC and to view the ConnectEMC configuration.

- **ConnectEMC Notification**: After a message is sent to EMC, the system administrator (via the ConnectEMC Recipient List) can receive an email notification with an HTML formatted copy of the message. As of CentraStar 3.1, it is possible to receive email notifications without sending a message to the EMC Customer Support Center, this option is applicable for all alerts while as of CentarStar 4.2.1 and greater the system operator can configure it on per alert basis.

- **SNMP**: The Simple Network Management Protocol (SNMP) is an Internet-standard protocol for managing devices on IP networks. SNMP allows Centera to send alerts to storage management software. The system operator uses the CLI to configure SNMP and to view the current state of the SNMP configuration.

- **Monitoring API (MoPI)**: The Centera SDK has a possibility to receive alerts with the MoPI call FPEventCallback_RegisterForAllEvents. Applications wishing to use this interface must have an access profile defined with the Monitoring capability enabled. Please refer to the Centera API Reference Guide, P/N 069001185 for more information on the MoPI interface.

- **Centera Console**: Any CentraStar v4.0 or later cluster can be monitored remotely via a Web browser GUI interface with Centera Console v2.5. Centera Console is available free of charge and is shipped with each new order of Centera or can be obtained from Powerlink.

- **EMC ControlCenter**: As of ECC v6.1, and CentraStar v2.2 up to v4.2.2, EMC ControlCenter users can monitor one or more Centera clusters in their storage environment. The EMC ControlCenter Storage Agent for Centera is available free of charge and is qualified to run on the EMC ControlCenter server. To enable the storage agent you need a license card for Base package with Part Number CC-CENPKG-BAS, which ships with each base cube, plus you need one 2-node license with Part Number CC-CENT-2NODE per 2 clustered nodes. Please refer to the *EMC Ionix ControlCenter Planning and Installation Guide Volume 1*, P/N 300-006-362 for more information on how to configure the EMC ControlCenter Storage Agent for Centera.

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3 ConnectEMC sends health reports in encrypted XML to the EMC Customer Service Center; it does this on a daily basis and after each Alert message; this allows the service engineer to have a good understanding of the state of the cluster at time of the alert.
Alert Event Follow-up

The following table shows the full list of Centera alerts, a brief description of the problem reported and a recommendation for resolution.

- Symptom Code uniquely determines an alert event (the first 5 numbers of the symptom code actually identify the sensor triggering the alert).
- Threshold indicates the value at which the Evaluator will issue an alert event
- Severity indicates the severity level of the problem found; We distinguish the following severities:
  - OK (used for improvements only)
  - Notification
  - Warning
  - Error
  - Critical

### Alert

<table>
<thead>
<tr>
<th>Stamp</th>
<th>Description</th>
<th>AvailableCapacityHardStop Percent</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.2.1.03.01</td>
<td>AvailableCapacityHardStop Percent</td>
<td>&lt; 20% (Warning)</td>
<td></td>
</tr>
<tr>
<td>5.2.2.1.03.02</td>
<td>AvailableCapacityHardStop Percent</td>
<td>&lt; 10% (Error)</td>
<td></td>
</tr>
<tr>
<td>5.2.2.1.03.03</td>
<td>AvailableCapacityHardStop Percent</td>
<td>&lt;= 5 % (Critical)</td>
<td></td>
</tr>
<tr>
<td>5.2.2.1.04.01</td>
<td>FreeObjectPercent</td>
<td>&lt; 10 % (Error)</td>
<td>Notification</td>
</tr>
<tr>
<td>5.2.2.1.04.02</td>
<td>FreeObjectPercent</td>
<td>&lt;= 0 % (Critical)</td>
<td>Error</td>
</tr>
<tr>
<td>5.2.2.1.04.03</td>
<td>FreeObjectPercent</td>
<td>&lt;= 0 % (Critical)</td>
<td>Critical</td>
</tr>
</tbody>
</table>

This sensor will be active when no Regeneration Buffer has been defined. The alerts are issued when available capacity on at least 1 cube in the cluster is less than 20%/10%/5% of the total raw capacity. As there is no regeneration buffer defined, it will soon not be possible to write to the affected cube(s) anymore and disk and node regenerations will not be able to complete.

For the Error and Critical levels, EMC Support will be notified of the problem and a case will automatically be opened.

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Contact your EMC sales representative to order more capacity.

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### Conclusion

This white paper provided an overview to the EMC Centera capacity reporting metrics (raw, available capacity) and how different protection schemes affect the EMC Centera capacity reporting in terms of object count. It also discussed the Centera Viewer CLI capacity reporting commands available to storage administrators.