ABSTRACT
This white paper describes how Dell EMC RecoverPoint continuous data protection provides proven protection and operational recovery over distance for SAP HANA in-memory databases.

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Executive summary

Business case
In a global business economy that works around the clock, downtime for business-critical systems is no longer an option. Business continuity in the event of a failure, whether caused by an infrastructure issue or by unforeseen external events, is essential. While SAP HANA supports multiple methods of disaster recovery—using backups, SAP HANA system replication, or storage replication of SAP HANA—Dell EMC RecoverPoint™ storage replication offers additional benefits such as asynchronous write protection and point-in-time recovery.

Solution overview
Dell EMC RecoverPoint data protection technology has been providing customers with replication over distance for traditional SAP landscapes for years, ensuring that different interdependent relational databases remain synchronized. Dell EMC brings this same capability to SAP HANA scale-up and scale-out in-memory databases, while supporting both physical and virtualized SAP HANA hosts.

Dell EMC RecoverPoint technology for SAP HANA provides a comprehensive data protection solution for complex business processing landscapes. It provides integrated continuous data protection as well as continuous local and remote replication to recover applications to any point in time.

Key benefits
Dell EMC RecoverPoint enables customers to seamlessly integrate SAP HANA into their existing business continuity solutions using storage-based replication. Storage-based replication provides better cross-database consistency, easier DR testing, and faster recovery times while meeting aggressive recovery time objective (RTO) and recovery point objective (RPO) service levels.

Protection over distance eliminates the possibility of one site becoming a single point of failure. Asynchronous replication ensures minimal application impact. It also ensures WAN optimization, which can mean significant financial savings on monthly WAN costs.

Document purpose
This white paper provides recommendations for sizing and the appropriate workloads for Dell EMC RecoverPoint technology for asynchronous protection of SAP HANA databases. This paper describes the solution benefits, primary use cases, and SAP HANA storage-related performance data from three companies.

Audience
This white paper is for customers who want to add disaster recovery over distance for SAP HANA to new or existing SAP landscapes. The audience includes database and system administrators, storage administrators, and system architects who are responsible for implementing, maintaining, and protecting SAP landscapes. Readers should be familiar with SAP HANA in-memory databases and Dell EMC software.

We value your feedback
Dell EMC and the authors of this document welcome your feedback on the solution and the solution documentation. Contact EMC.Solution.Feedback@emc.com with your comments.

Authors: Allan Stone, Pat Kelly, Karen Johnson
SAP HANA supports three levels of disaster recovery support—backups, SAP HANA system replication, and storage replication. Each level of support addresses different RPOs within the required RTO, where:

- RTO denotes the time that is allowed for a recovery of the SAP HANA appliance at the replica site to a specified point of consistency.
- RPO denotes the point of consistency to which SAP HANA needs to recover.

**Backups**

Backups protect the primary SAP HANA instance against a storage failure. Therefore, the SAP HANA backup target system must not be on the same storage array as the primary SAP HANA instance. Backup systems typically can replicate the backup storage to a remote system to protect against a site failure.

With SAP HANA backups, the RPO depends on the frequency at which the customer performs the backups, which can range from minutes to several hours. The RTO with backups can be several hours because the entire SAP HANA database backup must be restored to the primary persistence and then key database tables must be read into memory before the database is available.

Dell EMC offers SAP HANA backup solutions based on Dell EMC™ NetWorker™ backup and recovery software and the Dell EMC Data Domain™ system. See Dell EMC documentation on page 25 for links to white papers about these SAP-certified solutions.

**SAP HANA system replication**

SAP HANA system replication is an application-based disaster recovery solution where a secondary standby SAP HANA system is configured as an exact copy of the active primary system. SAP HANA system replication supports replication from the primary system to multiple secondary systems. SAP HANA system replication requires a reliable connection between the primary and secondary sites.

SAP HANA system replication supports multiple replication modes:

- Synchronous
- Synchronous in-memory
- Asynchronous

SAP HANA system replication replicates only the database content to the secondary site.

**SAP HANA storage replication**

SAP HANA storage replication in tailored data center integration (TDI) deployments provides a convenient method to protect SAP HANA against a primary site failure. The SAP HANA production site is replicated in total to one or more secondary sites.

The RTO in the event of a disaster depends on customer requirements, the distance between the primary and secondary sites, and the data change rates. The RTO is typically the time it takes to start up the SAP HANA database at the secondary site, which depends on the version of SAP HANA and the amount of required data to be loaded. Lazy read changes have greatly reduced this time. The achievable RPO always varies, but with SAP HANA it can vary even more because of observed high levels of I/O intensity. The
RPO is a function of the SAP HANA peak writes and the sizing around these infrequent peaks. For example, if you size for a 1-hour RPO around the worst-case peak, the RPO will not be more than 1 hour but will often be much lower between the peaks.

**Dell EMC RecoverPoint**

The Dell EMC RecoverPoint enterprise-scale solution protects application data on heterogeneous storage area network (SAN)-attached servers and storage arrays. Dell EMC RecoverPoint software runs on dedicated physical or virtual appliances and combines continuous data protection technology with a bandwidth-efficient, no-data-loss replication technology, which enables it to protect data locally and remotely for any point-in-time recovery.

Dell EMC RecoverPoint technology dramatically improves application protection and recovery times compared to traditional host and array snapshots.

Dell EMC RecoverPoint technology can replicate up to four different production copies at up to four different sites. Typical topologies include:

- **Local**—Replica copy on the same site or same Dell EMC RecoverPoint cluster as the production copy
- **Remote**—Replica copy on a different site or different Dell EMC RecoverPoint cluster than the production copy
- **Concurrent local and remote**—A replica copy on the same site or same Dell EMC RecoverPoint cluster as the production copy and up to three replica copies on other independent sites or independent Dell EMC RecoverPoint clusters

The Dell EMC RecoverPoint solution includes user bookmark capabilities, enabling a rollback to key business checkpoints to support software upgrade testing restarts or actual production upgrade failure backouts.

For remote replication, the systems use an existing IP-connections or Fibre Channel infrastructure to replicate data asynchronously or synchronously.

In a disaster occurs at the primary site, Dell EMC RecoverPoint solution enables access to the image at the replica site so that work can continue. The solution also provides the ability to recover the production copy from a replica.

**SAP HANA storage replication with Dell EMC RecoverPoint**

**Overview**

Table 1 provides an overview of the key RPO and RTO values that were tested with SAP HANA storage replication using Dell EMC RecoverPoint technology with asynchronous replication. The table also provides a summary of advantages and disadvantages of using the solution to replicate SAP HANA storage.
### Table 1. SAP HANA storage replication using Dell EMC RecoverPoint with asynchronous replication

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description/Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPO</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
| RTO               | < 20 min  
**Note:** RTO is based largely on the time that is required to start SAP HANA at the target site. |
| Distance          | Thousands of kilometers with latency less than 200 ms round trip time (RTT); network dropped packet error rate less than 1% |
| Impact to production servers | Minimal                                                                 |

### Business decision considerations

#### Advantages
- Protection over distance
- Reduced WAN bandwidth costs
- Recovery to any point in time
- Cross-business application data consistency during recovery
- No host resources needed

#### Disadvantage
RPO of zero not supported

### Benefits

SAP HANA storage replication, compared to SAP HANA system replication, provides several benefits to customers, including:

- Consistent point-in-time image of all data-dependent interrelated databases, not just one database
- Simple recovery to any point in time or user-created bookmark

Adding Dell EMC RecoverPoint data protection provides a complete end-to-end solution that includes:

- Scale-out consistency across databases and applications
- Journaling that enables the collection of point-in-time snapshots including bookmarked snapshots that facilitate testing of a copy

Consistency groups between SAP HANA nodes and across applications that feed SAP HANA or get data from SAP HANA ensure that recovery is consistent, not just in SAP HANA but in the interrelated feeds as well. With Dell EMC RecoverPoint data protection, you can include a single SAP HANA database or multiple SAP HANA databases with other related systems, all sharing in a common consistency group.

Replicating the SAP HANA instance using a single storage consistency group across all your complex interrelated databases creates a point of consistency across these business applications. For actual and simulated disaster recovery situations, this single storage consistency group enables a data-consistent restore between databases that is not possible with other restore options. The result is a significant reduction in recovery complexity and downtime, especially with rolling failures.
The Dell EMC RecoverPoint solution provides multisite protection with no data loss at one site and with data loss that is within the architected RPO at the others.

The Dell EMC RecoverPoint multisite solution enables concurrent continuous replication for up to four copies. The same data can be protected with four remote copies or one local copy and three remote copies. A local copy and one remote copy can be synchronous with zero data loss. The remaining remote copies are asynchronous.

The three main use cases for Dell EMC RecoverPoint data protection are as follows.

**Use case #1: Failover and failback**

In this scenario, you initiate a failover to the disaster recovery site and the database is restored in accordance with the recovery objectives that are defined by the criticality of the business application.

Failover to a remote site using a storage-based consistency group enables system operations to continue as usual from the copy. All the hosts included in the consistency group continue operations by restarting to a cross-application, data-consistent point in time. You can use the same failover procedure for planned maintenance at the production site while the copy site takes over normal operations. When the production storage has been restored or the planned maintenance completed, you can resume system operations at the original production source by failing back.

**Use case #2: Nondisruptive testing and undoing changes of replica site**

Mandated corporate and government regulations often require validation of business continuity after a complete primary site failure. Unlike other options for SAP HANA, Dell EMC RecoverPoint data protection enables full testing of the entire landscape from a consistent restart point while still providing continued production protection during the disaster recovery testing time frame. Nondisruptive testing not only helps to test disaster recovery at the remote data center but also provides a way to use the secondary disaster recovery site for sandbox testing without affecting the production site. The changes at the remote disaster recovery site are written to the journal log, and Dell EMC RecoverPoint technology can undo the changes once testing is completed.

This functionality provides the following benefits:

- Helps to test the replica copy and provides a way to use the remote disaster recovery site or sites to perform periodic disaster recovery testing
- Replaces full restores of every database with a simple replacement of the changed blocks automatically after the disaster recovery test

**Use case #3: Point-in-time recovery and rollback to previous point in time**

In this scenario, you revert to any previous point-in-time replica of the SAP HANA database. Reverting to a previous replica can be required if bad inputs cause database corruption. It also enables you to quickly and automatically recover from any failure, such as an upgrade or patch install failure, during planned maintenance.
The automated point-in-time recovery and rollback functionality of Dell EMC RecoverPoint data protection provides the following benefits:

- Saves manual efforts in the recovery of the SAP HANA database
- Minimizes downtime of the production environment in the event of an SAP HANA database upgrade or OS upgrade failure
- Provides flexibility and business continuity to return to normal business operations without requiring full database restores

Testing a point in time is a prerequisite to performing a failover or recover-to-production activity.

Virtualized SAP HANA

Traditional Dell EMC RecoverPoint technology protects many virtualized applications, including VMware applications. It protects at the LUN level, using Dell EMC™ Unity™, Dell EMC VNX™, and Dell EMC VNXe™ splitter technology. It does not protect individual virtual machines but instead protects all those on the protected LUN. VMware vCenter Site Recovery Manager is fully supported with traditional Dell EMC RecoverPoint technology and SAP HANA virtualized by VMware.

Dell EMC RecoverPoint licensing

All three types of Dell EMC RecoverPoint licenses are valid with SAP HANA on Unity, VNX, and VNXe arrays:

- Dell EMC RecoverPoint/SE, now also referred to as Dell EMC RecoverPoint Basic, is supported from a single array locally to the same array and/or remotely to one other array. The two arrays can be any combination of Unity, VNX, and VNXe. These Dell EMC RecoverPoint licenses are tied to the specific array frames.

- Dell EMC RecoverPoint/EX, now also referred to as Dell EMC RecoverPoint Advanced, allows any number and type of arrays to replicate locally to other same-cluster arrays and/or remotely to any number and type of arrays. Supported arrays include Unity, VNX, VNXe, Dell EMC VMAX1™, Dell EMC VMAX2™, Dell EMC VPLEX™, VPLEX supported block arrays behind VPLEX, and (via snapshot-based replication) Dell EMC XtremIO™. Dell EMC VMAX3™ is only supported behind VPLEX, but a snapshot-based replication approach is planned. These Dell EMC RecoverPoint licenses are tied to the specific array frames.

- Dell EMC RecoverPoint/CL, formerly referred to as Dell EMC RecoverPoint Classic, has the same flexibility as Dell EMC RecoverPoint/EX, but its licenses are tied to the Dell EMC RecoverPoint system (the set of Dell EMC RecoverPoint clusters that communicate with one another). This licensing enables you to replace the protected data on one array with a different array without requiring the purchase of additional or different Dell EMC RecoverPoint licenses.

The RecoverPoint Ordering and Licensing Guide, available on Dell EMC Online Support, describes all aspects of Dell EMC RecoverPoint licensing.

SAP HANA performance observations

This section shows real-world examples of SAP HANA storage performance. It provides performance data from three companies and shows how Dell EMC RecoverPoint data
SAP HANA performance observations

Protection under high load conditions can still be a great option for many asynchronous RPO needs. For detailed information about Dell EMC RecoverPoint high loads, see What is a Dell EMC RecoverPoint high load? on page 15.

**Company 1**

Figure 1 through Figure 4 show the performance that was observed at company 1.

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**Figure 1.** Company 1: Front-end IOPS as seen from storage array

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**Figure 2.** Company 1: Volume IOPS (data and log)
SAP HANA performance observations

Figure 3. Company 1: Front-end throughput (KB/s)

Figure 4. Company 1: One-time go-live peak
Figure 5, Figure 6, and Figure 7 show the performance that was observed at company 2.

Company 2

Figure 5. Company 2: Workload profile

Figure 6. Company 2: I/O size and read percent

Figure 7. Company 2: IOPS thresholds
Figure 8, Figure 9, and Figure 10 show the performance that was observed at company 3.
Summary of SAP HANA performance observations

The following is a summary of the SAP HANA performance observed at the three companies:

- **Company 1:**
  - Steady state less than 1,200 IOPS
  - One-time spike to 3,200 IOPS at go-live
  - Highest peak throughput of 450 MB/s (omit from sizing calculations)
  - Typical peak range of 240–280 MB/s
  - Average throughput of 50 MB/s (consider for sizing calculations)

- **Company 2:**
  - Peak at 1,900 IOPS and 314 MB/s
  - 95th percentile I/O sizes: 494 KB read, 332 KB write
  - 95th percentile front end: 889 IOPS, 314 MB/s
  - 95th percentile read/writes: 19 percent reads, 81 percent writes
  - Average throughput of 200 MB/s (consider for sizing calculations)

- **Company 3:**
  - Steady state 500 IOPS
  - One-time spike to 800 IOPS
  - Highest peak throughput of 160 MB/s (omit from sizing calculations)
  - Typical peak range of 120 MB/s
  - Average throughput of 60 MB/s (consider for sizing calculations)

Conclusions

Based on the customer data, we can draw the following conclusions for at least a subset of SAP HANA databases:

- SAP HANA activity does not generate high IOPS.
- The average throughput activity outside of SAP HANA peaks can be very low.
- Peak activity might cause some Dell EMC RecoverPoint high load conditions for short durations.
What is a Dell EMC RecoverPoint high load?

Overview

The *EMC RecoverPoint Administrator’s Guide* provides an overview of Dell EMC RecoverPoint replication. This section describes a Dell EMC RecoverPoint high load, a replication condition that is particularly relevant to SAP HANA, and provides key considerations and recommendations. While Dell EMC sizes legacy databases to prevent high load, an occasional high load occurrence for SAP HANA might be appropriate.

A Dell EMC RecoverPoint high load is a system state that indicates resource saturation during replication. Under typical workloads, Dell EMC RecoverPoint technology can process the incoming information and be ready to continue processing subsequent information. However, at times it cannot keep pace. Possible reasons include a high write-throughput rate to the RecoverPoint appliances (RPAs), not enough bandwidth, and slow distribution to target journals or remote disk resources that are not sufficiently sized.

One possible cause for these high load conditions is the occasional high bursts of writes by SAP HANA. During high bursts, the data is written as usual to the production volumes and the RPAs. However, because the Dell EMC RecoverPoint solution cannot guarantee that all the data has reached or will reach the target site, metadata—not the actual data—is written to the production journal at the originating production site. The production copy journal can be the minimum journal size—10 GB for a normal consistency group or 40 GB for a distributed consistency group—because only pointers to data are stored here.

Once the high load has subsided, the owner RPA reads the metadata from the production copy journal and the actual data from the production storage. In the case of remote replication, the appropriate link policy is applied for WAN optimization. Writes are then sent to the target RPA and distributed to the journal and local replica by the same owner RPA.

Any point in time before or after the high load is a valid recovery point. While high load is occurring, remote data loss and RPO are increasing, which is why we recommend that you minimize high load conditions so that the target required maximum RPO is not exceeded.

Key considerations regarding high load conditions

Traditional Dell EMC RecoverPoint implementations always seek to avoid high loads. For legacy non-memory SAP databases, most I/O operations are reads, so you can easily size the Dell EMC RecoverPoint solution to completely avoid high load situations. With SAP HANA, much more write activity can occur, and some of it can be intense for short bursts of time, which can lead to high load.

Mitigating factors for how quickly the Dell EMC RecoverPoint solution can truly “catch up” after a high load include:

- Resource contention on the owner RPA
- The level of other I/O on the owner RPA at the same time
- The level of journal metadata duplication (which affects mandatory write folding, one component of WAN optimization)
- Read time associated with retrieving data from the source array
What is a Dell EMC RecoverPoint high load?

The number of RPAs working together on a particular consistency group is a major factor in determining whether the Dell EMC RecoverPoint solution can avoid a high load and/or quickly recover to keep the RPO below required service levels. Asynchronous approaches are as follows:

- Use a normal consistency group with a single RPA and use of a remote parallel partner RPA for remote replication, as shown in Figure 11.

![Figure 11. Normal consistency group using a single RPA](image)

- Use a distributed consistency group when the write throughput is more than a single RPA can process, and use up to four RPAs in unison for the replication, as shown in Figure 12.

![Figure 12. Distributed consistency group](image)
Solution requirements and considerations

- Use a set of multiple consistency groups that can be spread across multiple but disparate RPAs, where a parallel bookmark can be periodically synchronized to be write-order-consistent across each consistency group.

Recommendations for managing high load conditions

To manage high load conditions, consider the following:

- To best avoid high load situations, see the RecoverPoint Case Study about troubleshooting a high load issue.
- Dedicate a Dell EMC RecoverPoint system to each SAP HANA customer workload.
- Size the Dell EMC RecoverPoint source-side production journal from the minimum size up to the same as the target journal (if you want to have the same production window after failover).
- Plan to avoid high loads as much as possible but not always (depending on RPO).
- Reduce the consistency group rated throughput by a factor of 1.5–2 to leave room for the Dell EMC RecoverPoint system to catch up after high loads.
- Iteratively use the Dell EMC RecoverPoint CLI command detect_bottlenecks to identify the component that is most likely impeding performance. For command information, see the EMC RecoverPoint CLI Reference Guide.
- After deployment, use the Dell EMC RecoverPoint CLI command balance_load for recommendations as to which consistency groups should run on which RPAs for improved performance and to make changes.
- Obtain Dedicated Support Engineer (DSE) support if high load conditions routinely occur.

Solution requirements and considerations

Software requirements

Ensure that your environment has the following minimum versions of the software:

- SAP HANA 1.00.82.00

  Note: For optimal performance of the SAP HANA system, use SLES11 with patch level 3. For more information on SAP HANA installation, refer to the SAP Master Guide.

- SUSE Linux Enterprise Server 11 (x86_64) patch level 3
- Dell EMC RecoverPoint 4.1.2.1

  Note: The EMC RecoverPoint Installation and Deployment Guide provides instructions for upgrading to RecoverPoint 4.1. The RecoverPoint Deployment Manager Release Notes provides information about Dell EMC RecoverPoint Deployment Manager, which is a software package of GUI tools that help you install, upgrade, and modify Dell EMC RecoverPoint systems.

Unity considerations

Consider the following regarding Unity arrays:

- Unlike VNX arrays, Unity arrays use only storage pools, not RAID.
- Dell EMC recommends standard (not thin) provisioning for Dell EMC RecoverPoint journals.
Solution requirements and considerations

- Dell EMC recommends using Dell EMC RecoverPoint 4.4.1.1 or later with Unity arrays.
- Particularly with a Unity array as the replication target, tend toward faster models because of the replication overhead.
- The maximum number of RPA clusters connected to a splitter for a Unity array is one. A larger quantity might be available by special request.

VNX pool considerations

Consider the following regarding VNX pools:

- VNX pool performance can be 30–50 percent less than traditional RAID groups.
- The best VNX pool performance occurs with sequential large-block I/O.
- Inflate thin-provisioned pool volumes when possible to minimize reduced performance from on-demand inflation.
- Dell EMC recommends using RAID, not pools, for SAP HANA on VNX arrays, as noted in Storage Configuration Best Practices for SAP HANA Tailored Data Center Integration on EMC VNX Series Unified Storage Systems.

Dell EMC RecoverPoint replication recommendations

Consider the following information and recommendations regarding Dell EMC RecoverPoint replication for SAP HANA:

- Note that performance numbers provided in this white paper are aggregate, not per SAP HANA node.
- Use virtual RecoverPoint appliances (vRPAs) only for the lowest performance levels (no distributed consistency group support).
- To ensure proper SAP HANA database performance, use asynchronous Dell EMC RecoverPoint only and use the storage setup specified in Storage Configuration Best Practices for SAP HANA Tailored Data Center Integration on EMC VNX Series Unified Storage Systems.
- Dell EMC does not recommend the use of a Dell EMC RecoverPoint system with SAP HANA for VMAX systems at this time. The Dell EMC RecoverPoint solution is not yet available for VMAX3 arrays, although Dell EMC is planning a snapshot-based replication approach.
- Use the Dell EMC RecoverPoint sizing guidelines in this paper to quickly estimate the environment, and then, whenever possible before implementation, do more detailed sizing with the Dell EMC Business Continuity Solution Designer (BCSD), Mitrend, or the Dell EMC RecoverPoint Basic Sizer.
Dell EMC RecoverPoint sizing and best practices

This section provides sizing recommendations and best practices for using Dell EMC RecoverPoint for SAP HANA. Do not use the sizing information in this white paper to determine precise sizing of a specific configuration. For assistance with final system specifications to meet your requirements, consult your Dell EMC sales representative.

To size your Dell EMC RecoverPoint system, consider the following:

- Dell EMC RecoverPoint sizing is based on writes, so omit reads from your calculations.

- For the average write change rate:
  - Do not include very high peaks (like what you would see during an initial data load) in your calculation of average write rate.
  - Use one or more available options for estimating the average write change rate:
    - BCSD—Use Front-end Throughput in MB/s (most precise).
    - Mitrend—Use Front-end Throughput in MB/s (precise).
    - Dell EMC RecoverPoint Basic Sizer—Use Front-end Throughput in MB/s (fairly precise).
    - For daily incremental backups amount (least precise):
      1. Take the typical daily incremental backup quantity for MB/day, adding in the database logs that are created per day.
      2. Divide the result of the preceding step by the typical number of work hours per day (for example, 8 for one time zone, 12 across the U.S., 24 for worldwide operations) to get MB/hour.
      3. Divide the result of the preceding step by 3,600 seconds to get MB/s.

- For Gen5 and Gen6 RPAs, the average write throughput rates are as follows:
  - 1 x RPA = 60–80 MB/s
  - 2 x RPAs Distributed CG = 120–160 MB/s
  - 4 x RPAs Distributed CG = 220–300 MB/s

  **Note:** Additional high-availability RPAs per cluster (which do not handle workload) are not included here. Gen4 RPAs are also supported but with substantially lower throughput.

- For vRPAs, the average write throughput rate is one vRPA for 35–50 MB/s.

  **Note:** vRPAs do not support distributed consistency groups.

- Multiple distributed consistency groups can achieve performance demands beyond those of a single distributed consistency group. The use of a group set facilitates the creation of periodic parallel bookmarks, guaranteeing write-order integrity of the point-in-time snapshots.

- Target journal performance = 3 * average MB/s write change rate.
- Target replica performance = 2 * average MB/s write change rate.
- Dell EMC RecoverPoint performance is far more demanding on the target than on the source, even for asynchronous replication that provides the flexibility of any-point-in-time rollback at the target.
- The performance guidelines provided in this section are based on what can be achieved with physical RPAs and vRPAs. Because arrays vary so widely in their performance capabilities (Unity 300 versus VNX 8000, for example), ensure that both the source and target arrays can achieve the necessary performance requirements.
- Network bandwidth = average write change rate / 3 (where / 3 is the assumed average level of compression).
- Target journal size (GB) without consolidation = [(average write MB/s change rate * protection window {seconds}) * 1.3] / 1024.

Notes:
- Source-side production journal size can range from the minimum up to the same as the target journal (if you want to have the same production window when SAP HANA is failed over, as during normal production).
- A factor of 1.3 is used for additional space for internally required processing needs.

Table 2, Table 3, and Table 4 provide sample sizing calculations for Dell EMC RecoverPoint systems.

### Table 2. Sample sizing calculations: Company 1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average write change rate</td>
<td>50 MB/s</td>
</tr>
</tbody>
</table>
| Active RPAs in normal consistency group and distributed consistency group for average write change rate | • 1 RPA for 60–80 MB/s
  • 2nd RPA for required high availability               |
| Target journal performance                            | 150 MB/s                         |
| Target replica performance                            | 100 MB/s                         |
| Target journal size                                   | 914 GB for 4 protected hours     |
| Network bandwidth                                     | 17 MB/s (126 Mb/s)               |

### Table 3. Sample sizing calculations: Company 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average write change rate</td>
<td>200 MB/s</td>
</tr>
</tbody>
</table>
| Active RPAs in normal consistency group and distributed consistency group for average write change rate | • 4 RPAs for 220–300 MB/s
  • Optional: 5th RPA for high availability              |
| Target journal performance                            | 600 MB/s                         |
Table 4. Sample sizing calculations: Company 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average write change rate</td>
<td>60 MB/s</td>
</tr>
<tr>
<td>Active RPAs in normal consistency group and distributed consistency group for average write change rate</td>
<td>• 1 RPA for 60–80 MB/s&lt;br&gt;• 2nd RPA for required high availability</td>
</tr>
<tr>
<td>Target journal performance</td>
<td>180 MB/s</td>
</tr>
<tr>
<td>Target replica performance</td>
<td>120 MB/s</td>
</tr>
<tr>
<td>Target journal size</td>
<td>1.1 TB for 4 protected hours</td>
</tr>
<tr>
<td>Network bandwidth</td>
<td>20 MB/s (160 Mb/s)</td>
</tr>
</tbody>
</table>

The following are tuning recommendations and best practices:

- To improve throughput performance, have a dedicated RAID group for the production and replica journals of each consistency group.
- Although during replication only the replica journal configuration is critical for performance, configure the production journals in a symmetrical way to enable flipping the replication direction if needed.
- For each RPA, configure journal LUNs at least as follows: Eight LUNs of 64 GB each on a single RAID I/O group with eight physical disks.
- Combine data and log LUNs across multiple consistency groups in a single group set for automatic management of consistent points in time across consistency groups that are dependent on one another for data consistency.
- Set maximum journal lag according to the required RTO. Small values yield faster access to the latest image at the replica site, thus reducing the RTO. Dell EMC recommends that maximum journal lag not exceed 1 GB if low RTO is important. When the journal lag exceeds the Maximum Journal Lag setting in the Journal Copy policy (which defines the RTO policy), the distribution process switches from the normal five-phase distribution to three-phase distribution. This switch decreases the performance that is required to distribute the write information to the replica but curtails the ability to roll backward and forward between point-in-time images while remaining in image access mode.
- Set journal compression to None.
**VNX sizing guidelines**

Follow these guidelines when sizing VNX arrays with Dell EMC RecoverPoint systems:

- **Maximum total bandwidth capability using SAS drives for VNX arrays:**
  - VNX5400™—Up to 7.5 GB/s
  - VNX5600™—Up to 10 GB/s
  - VNX5800™—Up to 14 GB/s
  - VNX7600™—Up to 14 GB/s
  - VNX8000™—Up to 31 GB/s

- **SAS drive performance:**
  - 10k rpm SAS drives have read/write bandwidth of 20–25 MB/s.
  - 15k rpm SAS drives have read/write bandwidth of 25–30 MB/s.
  - RAID 5 disk protection yields 50 percent more capacity at only 10–20 percent less performance.

- **VNX configurations for SAP HANA use 9 SAS drives per node, so maximum RAID 5 bandwidth of 15k rpm SAS drives = 240 MB/s (parity drives do not add bandwidth).**

- **Supported number of SAP HANA nodes per production array:**
  - VNX5400—10 nodes = 2,400 MB/s
  - VNX5600—10 nodes = 2,400 MB/s
  - VNX5800—12 nodes = 2,880 MB/s
  - VNX7600—12 nodes = 2,880 MB/s
  - VNX8000—16 nodes = 3,840 MB/s

- **When sizing, take into account journal and replica target LUN bandwidth.**
Conclusion

Summary

The demand for database protection and availability increases as data grows in size and databases become more interconnected. Data centers face disasters that are caused by human errors, hardware and software failures, and natural disasters. When disaster strikes, an organization is measured by its ability to resume operations quickly, seamlessly, and with the minimum amount of data loss. Having a data-consistent restartable image of the entire information-infrastructure business landscape ensures that organizations can maintain business-mandated RPO and RTO service-level agreements.

Dell EMC RecoverPoint data protection offers the same reliable platform at the software and hardware layers for the SAP HANA database that it has always provided for traditional databases. It enables complete disaster recovery and business continuity for mission-critical environments, including scale-up and scale-out in-memory SAP HANA databases.

Using SAP HANA storage replication with Dell EMC RecoverPoint data protection over asynchronous distances provides proven protection for the SAP HANA mission-critical databases. Although high load conditions might occasionally occur because of SAP HANA write bursts, Dell EMC RecoverPoint technology can catch up and continue to provide essential protection.

Findings

Our investigation of SAP HANA performance with Dell EMC RecoverPoint data protection demonstrates the following:

- The Dell EMC RecoverPoint solution is appropriate for asynchronously protecting many SAP HANA workloads.
- Some Dell EMC RecoverPoint high load conditions are acceptable during the periodic write bursts of SAP HANA.
- Write-order integrity is achieved across multiple physical and virtualized SAP HANA servers as well as multiple volumes on multiple arrays. As is always the case with Dell EMC RecoverPoint technology, write-order integrity is achieved before and after, but not during, Dell EMC RecoverPoint high loads.
- You can size an asynchronous solution for SAP HANA for a Dell EMC RecoverPoint consistency group by mapping the average write change rate to less than the rated maximum, enabling resources to catch up after write bursts.
- A single distributed consistency group of four RPAs can protect up to an average write change rate of 300 MB/s.
- Dell EMC RecoverPoint sets of multiple consistency groups and/or distributed consistency groups can protect average write change rates beyond 300 MB/s.
- You can protect less-demanding SAP HANA workloads with fewer RPAs or vRPAs.
The following documentation on EMC.com or Dell EMC Online Support provides additional and relevant information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell EMC representative.

- **EMC RecoverPoint Administrator’s Guide**
- **RecoverPoint Case Study (troubleshooting a high load issue)**
- **EMC RecoverPoint CLI Reference Guide**
- **RecoverPoint Deployment Manager Release Notes**
- **EMC RecoverPoint Installation and Deployment Guide**
- **RecoverPoint Ordering and Licensing Guide**
- **Protecting SAP HANA with Data Domain Boost for Databases and Applications White Paper**
- **Protecting SAP HANA with EMC Networker White Paper**
- **Storage Configuration Best Practices for SAP HANA Tailored Data Center Integration on EMC VNX Series Unified Storage Systems Solution Guide**

The following documentation on SAP.com provides additional and relevant information:

- **SAP HANA Master Guide**