

Migration Methodologies for SAP on Azure

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1 Abstract

The purpose of this whitepaper is to provide an overview of various migration options to move SAP applications to Azure. In this paper, we also provide details on SAP Database Migration Option (DMO) and comparison with the "Classical Migration" options and highlight DMO optimizations that help accelerate your migration. SAP course [HA250](#) ("Migration to SAP HANA using DMO") is a recommended training course from SAP Learning for further education about the solution.

This whitepaper is intended for technical architects, SAP Basis administrators, SAP OS/DB migration consultants and SAP technical consultants

2 Migration Options

2.1 - Classical Migration

With the Classical Migration option, SAP's Software Provisioning Manager (SWPM) is used as the Software Logistics (SL) tool and is exclusively for database migrations.

SWPM exports data from a source system and imports it to a target system where the target can be *anyDB* (SQL server, Oracle, DB2, etc). This method in particular uses a file-based approach.

2.2 - DMO

DMO facilitates both an SAP upgrade and a database migration to the SAP HANA database via one tool.

As both steps are handled at once, the DMO process is often referred to as a *one-step* migration. In comparison, Classical Migration uses a heterogeneous system copy approach (thus garnering it the title of a *two-step* migration) with the first step being that of a migration followed by a second step facilitating an SAP upgrade.

2.3 - Classical Migration vs DMO

The following table compares Classical Migration with DMO.

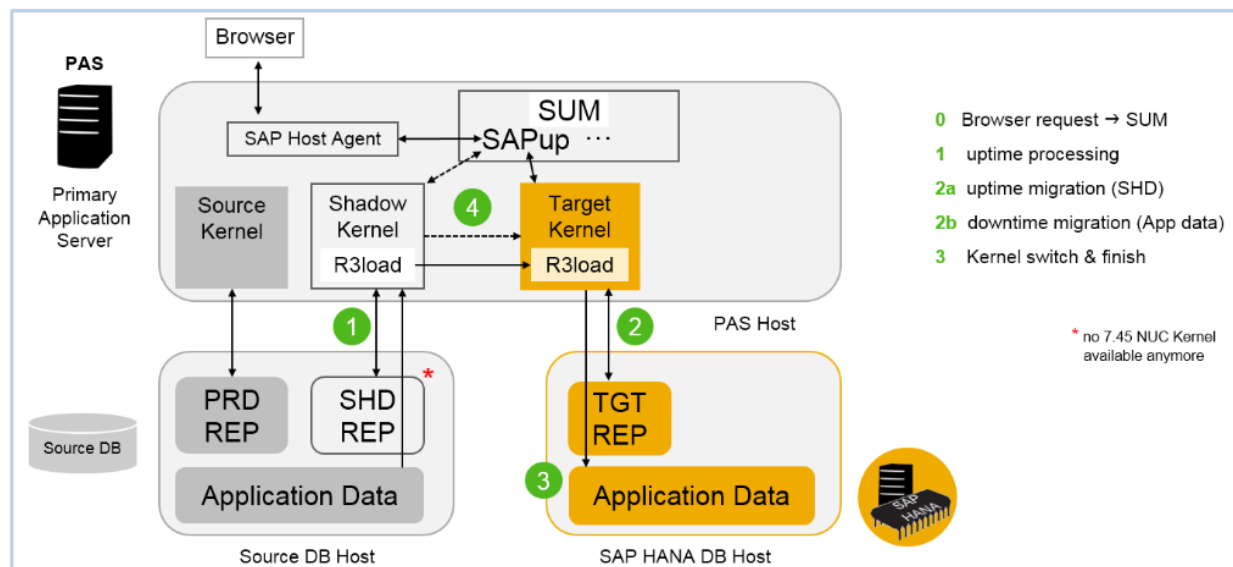
Parameter	Classical Migration	DMO
Purpose/Use Case	Migration only	Upgrade + Migration New DMO version available for migration-only option
Downtime Optimization Flexibility	High	Medium
Migration	Manual	Automated
Migration Expertise	OS/DB certification is mandatory	OS/DB is not mandatory, but highly recommended
Data Consistency	Manual	Automatic
Options for Data Transfer	Socket mode option Net exchange mode option FTP mode option to transfer data	Memory pipes Filesystem dump
Migration Check Service	Migration check service required for classical approach on productive systems	No migration check service required for DMO on productive systems.
Monitoring Progress	Distribution monitor and migration monitor tools available	Built-in SAPUI application for monitoring progress

Post-migration Consistency Check	Process is manual and requires MIGCHECK tool and the time analyzer tool to generate reports	Built-in feature in DMO
Table Splitting	Dedicated table splitting and package splitting tools available – R3TA, R3ZCHECK	Table splitting is built-in and tuned
Import and Export Table Splitting	Table splitting for export and import can be changed on the fly	Table splitting and sorting requires adjustment as part of uptime (not on the fly)
DDL Statements	Manual process to generate all DDL statements prior to migration	Built-in process for DDL statement calculations and deployment
SWPM, MIGMON, DISMON	SWPM, Migration Monitor (MIGMON) and Distribution Monitor (DISTMON) can be started and stopped manually Not recommended to run from remote desktops for MIGMON tools	No such option available in DMO No such restrictions in DMO
Export/Import	Ability to add multiple application servers to run the export/import	Only one application server can be used
R3 Load Process Limit	No limits	Limit of 999 R3 load processes
Table Splits Limit	No limit on number of table splits	Limit of 200 table splits
Target DB	<i>anyDB</i> (e.g. SAP HANA, SQL server, Oracle, DB2, etc.)	Only SAP HANA, AS (other databases are available upon request)

SAP Recommendation	SAP recommended option if no software change is involved	SAP recommended option if SAP upgrade is in scope
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3 DMO Methodology

The following diagram illustrates the DMO upgrade and migration process.



Source: SAP

3.1 - DMO processing

SUM creates the shadow repository (development components/target version for ABAP workbench) on the traditional database until the downtime phase. The target database is built-up in parallel where the shadow repository is subsequently copied and the SAP database connection is switched to the target database and the downtime process starts.

Following the migration of the application data (which includes data conversion), the upgrade is finalized and the SAP system is running on the target database. The source database retains the unmodified application data and therefore a fallback is always possible.

3.1.1 - Prerequisites

When migrating an existing SAP system running on *anyDB* to an SAP HANA database, the following steps could be required:

- Dual-Stack split
- Unicode conversion (for versions prior to SAP NetWeaver 7.5)
- Database upgrade of *anyDB*
- Upgrade of SAP software

3.1.2 - DMO for SAP BW and SAP Business Suite Systems

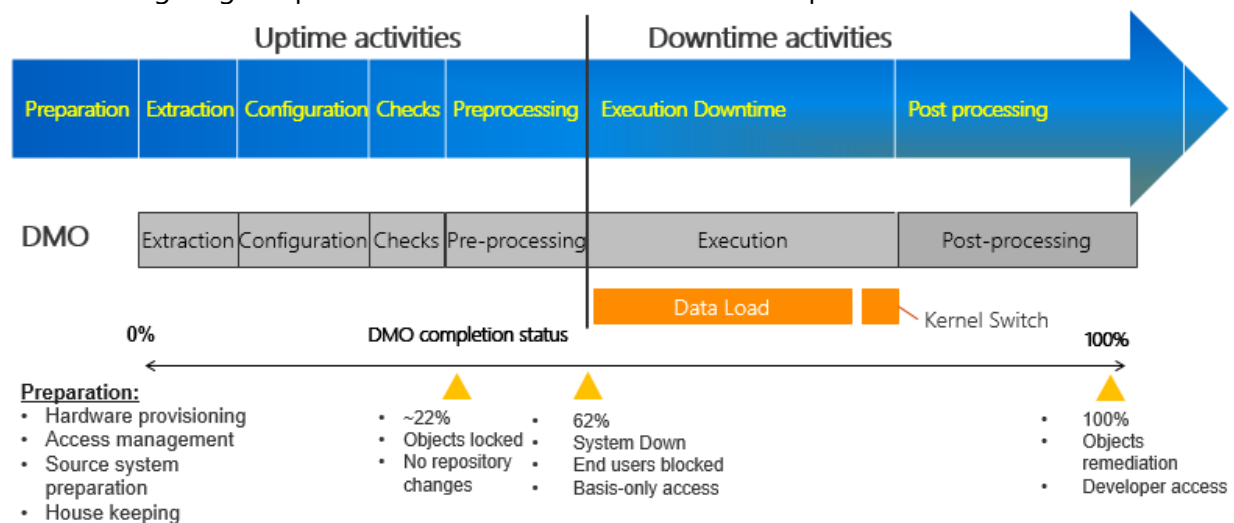
DMO can be used for AS-ABAP systems and with SUM 1.0 SP09 or higher. DMO can also be used for SAP HANA and ASE targets. Furthermore, DMO can also be leveraged for SQL Server, DB2 and MaxDB upon request.

Please refer to the following SAP Notes:

- [2426315 on Database Migration Option for SUM 1.0 SP 21](#)
- [2472850 on Database Migration Option for SUM 2.0 SP 01](#)

3.2 - DMO Phases

The following diagram provides an overview of the main DMO phases.

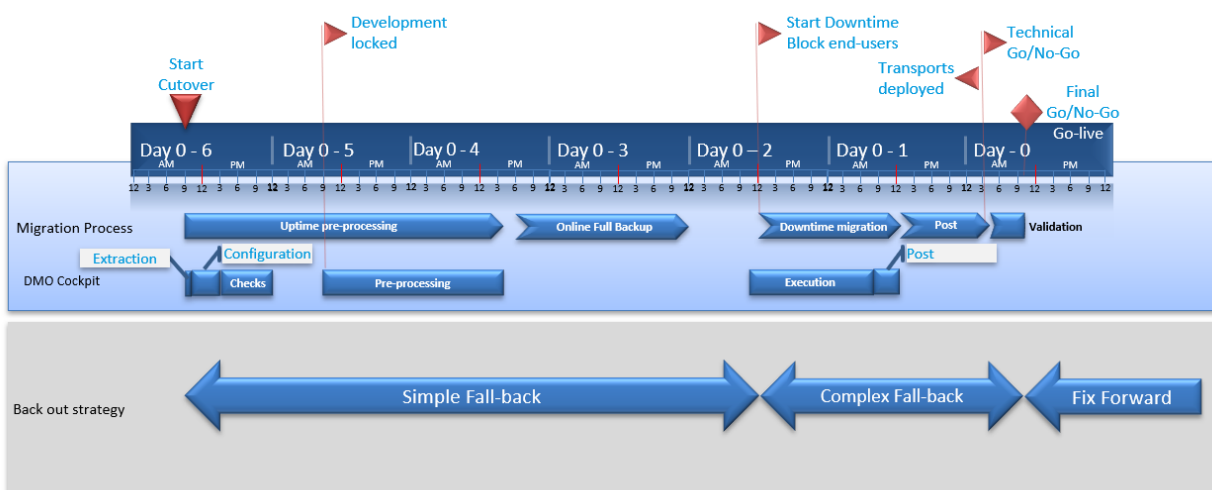


Phase	Comment
Preparation	Phase that takes place prior to the SUM tool starting and covers areas such as the source pre-check / readiness, housekeeping, validating the source and target environments, verification of client 000, DDIC, and sidadm passwords.
Extraction	Phase that is part of the actual SUM process and where the tool checks all available software downloads for both source and target systems. The tool then unpacks SAR files which are part of the download directory.
Configuration	SUM checks source and target system connectivity.

Checks	SUM tool checks the available space for creating the shadow repository.
Pre-Processing	Phase where the shadow repository is created and target table structures are created in SAP HANA. This includes creating the table groups in a distributed/scale-out system.
Execution	This phase includes the downtime activities. The SAP source system is locked for users and actual data transfer is initiated. An SAP kernel switch is executed following the data loads.
Post-Processing	All post processing steps are executed, including SAP HANA content activation and cleaning up of logs in the SUM directory.

3.3 - DMO “Cutover Week” Depiction

With DMO, you have a fallback option during any phase as shown in the diagram below.



Beginning DMO up-processing at least one week in advance of the cutover follows published SAP best practices and allows for ample time for the shadow repository. Furthermore, taking a backup must be done prior to commencing the downtime activities.

In the event of an issue during uptime activities, a simple fallback approach is to remove the shadow instance, this means dropping the shadow instance schema from the source database. Should errors occur during the downtime phase, it's likely related to data problems which must be rectified before moving forward. As such, it's important to execute multiple migration test cycles to iron-out all problems in advance of the productive migration.

3.4 - DMO with System Move

The option "*Enable the migration with system move*" is available from SUM 1.0 SP21 where the application server driving the migration can be changed as part of the process i.e. SUM started on on-prem application server and switched to an application server running in Azure.

SUM is running on the source system and will stop at the execution phase. Subsequently, the complete SUM directory is copied to Azure where the import process continues on the new/target application server

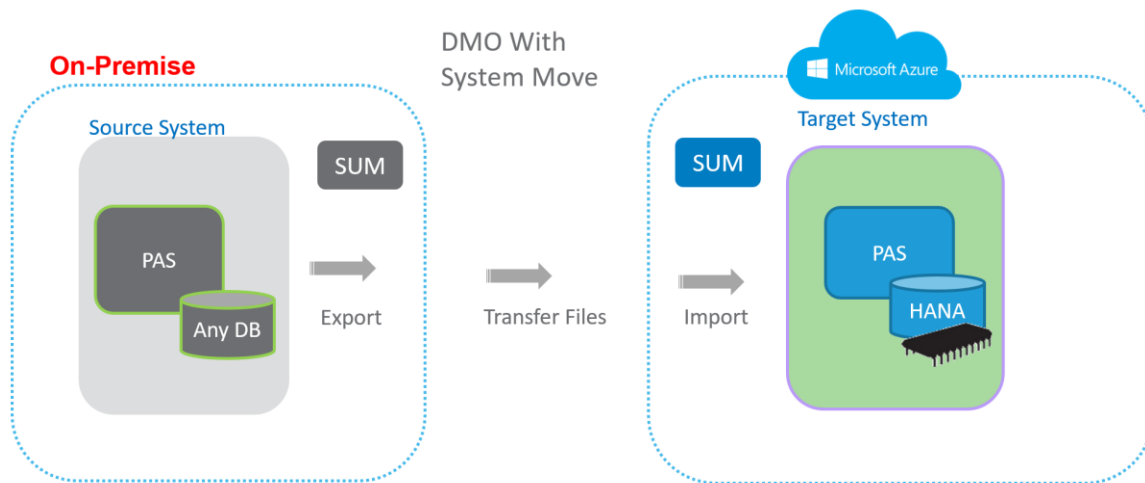
The following table compares the Classical DMO versus DMO with System Move Option

Parameter	Classical DMO	DMO with system Move
Purpose/ Use Case	In place upgrade and migration	Cloud/Azure-based migrations
Downtime Optimization Flexibility	High	Medium
Cloud Migration	Technically possible (but not currently officially supported by SAP)	Yes
Target servers	Same application server can be used to connect to SAP HANA after a migration	New servers need to be built in Microsoft Azure
Options for Data Transfer	<ul style="list-style-type: none">• Memory pipes• Filesystem dump	<ul style="list-style-type: none">• Filesystem dump• Can use sequential or parallel load options

4 Cloud Migration Options

This section outlines the prerequisites and benefits of migrating to Microsoft Azure in one-step via DMO with System Move compared to the two-step option of “lift and shift” and then DMO.

4.1 – One-Step Migration: DMO with System Move Option

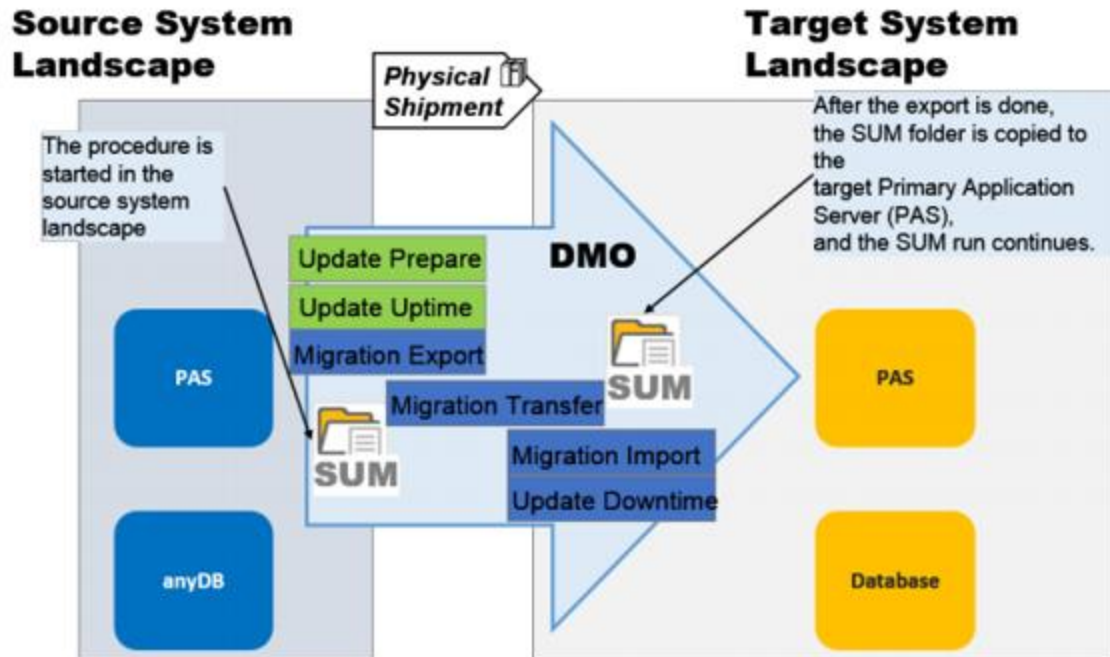


Steps for DMO with System Move to Microsoft Azure:

- Ensure connectivity to Azure is available via Express Route (highly recommended and with higher-speed connectivity) or Virtual Private Network (VPN) into Azure
- Provision the target infrastructure in Azure that includes SAP NetWeaver and SAP HANA database servers. Of note, the Azure infrastructure can be rapidly deployed using pre-defined [ARM templates](#).
- SUM is started on the on-premise source SAP application server.
- Uptime activities are executed from the on-premise SAP application server and the shadow repository is created.
- As part of the downtime phase, export files are generated on the source system and these files are then transferred to Azure via Express Route or VPN.
- File transfers can occur in “Sequential Data Transfer” or “Parallel Data Transfer” mode

Sequential Data Transfer Mode:

The diagram below illustrates DMO with System Move with Sequential Data Transfer mode.

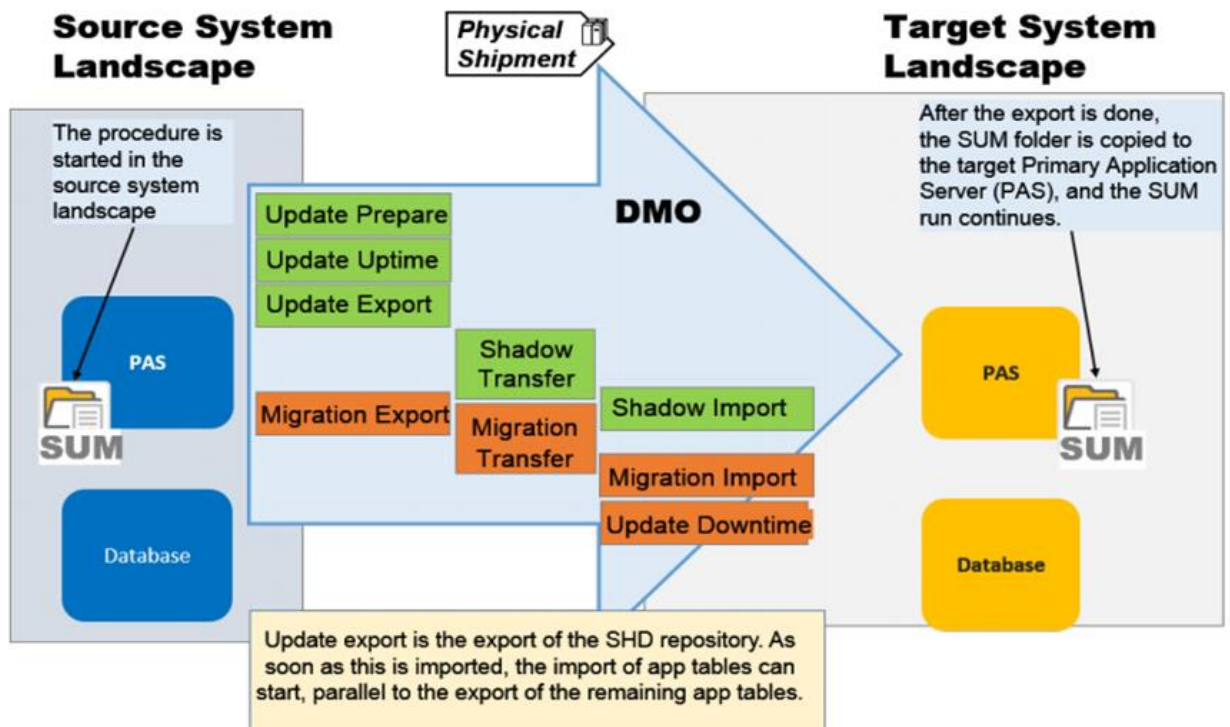


Source: SAP

- In Sequential Data Transfer mode, all tables are exported to the file system of the on-premise server
- Once the export is finalized, the complete SUM directory is transferred to the target application server in Azure
- The SUM directory is re-synchronized during the HOSTCHANGE phase of DMO
- SUM is initiated on the target Azure application server and the import is started
- Post-processing is completed

Parallel Data Transfer Mode:

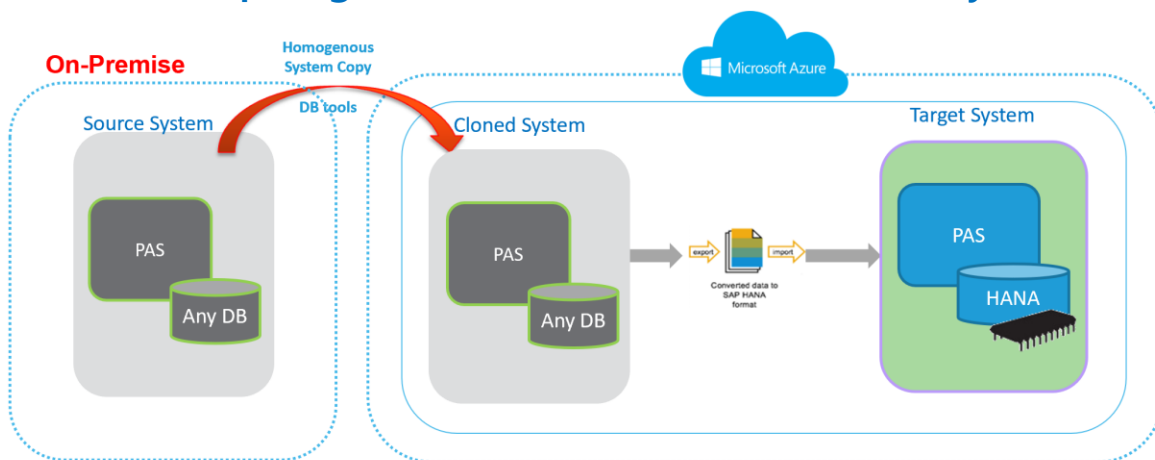
The diagram below illustrates the DMO with System Move with Parallel Data Transfer mode.



Source: SAP

- In Parallel Data Transfer mode, data is immediately transferred to the Azure target after the export is completed for each file via the *dmotocloud.sh* script
- This mode can be used to minimize migration downtime.

4.2 - Two-Step Migration: Lift and Shift followed by DMO



Consider the following for the *two-step* migration:

- Ensure connectivity to Azure is available via Express Route (recommended) or VPN .
- Provision the target infrastructure on Azure which includes the cloned system and target SAP NetWeaver and SAP HANA database servers. Of note, the Azure infrastructure can be deployed using predefined [ARM templates](#).
- The cloned system can be built with a homogeneous system copy (backup/restore) or via DBMS replication tools (e.g. Oracle Data Guard or SQL Always-On).
- Business and technical testing should be initiated (with functional, integration and acceptance testing to ensure the move of data has been successful).
- Following business and technical validation, the traditional DMO process can be followed to migrate and upgrade to SAP HANA.
- DMO can be leveraged with the memory pipe method (i.e. export/import occurs within the same application server and memory segment for accelerated migrations).
- Following the migration to SAP HANA, business and technical validation should again be initiated.
- In this approach, two downtimes and two testing cycles are required.

The following table illustrates additional pointers when considering the one-step and two-step approach.

Decision Factors	1 Step - DMO With System Move	2 Step - Lift & Shift and then DMO	Recommendation
Infrastructure requirement	There is no need for any additional hardware(provided the source system has enough resources to run SUM) on premise	Additional Clone environment needs to be built in Cloud	Option depends on each customer situation . If the customer cannot add any more hardware on premise then two step is mostly preferred
Hardware, Network, Integration, system build	Minimal impact on source system and no complexity of building additional environment	We need to build additional environment and have all the integrations working before we do the DMO migration again	One step is preferred compared to Two step as there is effort involved to have lift & shift for cloned environment
File-system transfer in DMO	DMO uses flat file method to migrate exported dump on Cloud. Data dump required to transfer to cloud manually or by tool.	DMO uses pipe method since both cloned system and HANA DB is built on Azure Cloud. No manual data transfer required here.	DMO Pipe method is fastest, hence two step approach will minimize the effort of data transfer during uptime and downtime. This is more for the expertise needed for the personnel t
SUM Directory re-sync on cloud	Mandatory to re-sync SUM directory on certain DMO phase before downtime.	Not required to re-sync SUM directory	Two step recommended here, since DMO will run similar to on-premise scenario.
Overall downtime feasibility	Short downtime, shorter outage on source just before DMO downtime phase.	This option will have 2 downtime windows. One for Lift and shift and other for DMO process	One step is preferred for shorter downtime
Overall Testing effort	Testing effort is minimal .	Major testing effort for both lift and shift and also the DMO .	One step approach recommended to minimize the testing effort.
Cost	Overall cost is low	Cost is very high	One step is more cost effective compared to 2 steps

Note: recommendations change based on customer situation

5 DMO Optimization Options

There are many factors that influence the downtime associated with an SAP database migration and include (amongst others):

Scope	Software changes, unicode conversion, data center relocation
Source System Performance	CPU, I/O, memory, DBMS performance, SAP NetWeaver release
Source System Database Size	Database size, largest tables, status of housekeeping
Target System Performance	CPU, I/O, memory, DBMS performance, SAP NetWeaver release
Network	network speed, bandwidth, latency
Toolset	SWPM, SUM, DMO of SUM, version of the toolset
Migration Approach	Standard vs Minimize Downtime
Ramp-up / Ramp-down Activities	Interface management, batch job management
Pre and Post Migration Validation	Functional, integration and acceptance Testing.

Broadly speaking, the potential for performance optimizations can be seen in the following three areas:

- 1) Export
- 2) File Transfer
- 3) Import

5.1 - Infrastructure/Hardware

The infrastructure/hardware reduction lever consists of the following:

- On-premises
 - Deploy a dedicated migration server (PAS / AAS) with extensive compute capability to execute SUM
 - Deploy Solid State Disks (SSD) on the source database and migration servers. (PAS / AAS)
- Microsoft Azure
 - Express Route connectivity is recommended with the maximum bandwidth available (currently available up to 10 Gbps). <https://docs.microsoft.com/en-us/azure/expressroute/expressroute-introduction>
 - Leverage the *dmotocloud.sh* script (RSYNC) to move files from an on-premise source to an Azure target for the DMO System Move Option with Parallel Transfer.
 - Implement storage snapshots for time-efficient backups during the cutover period.

5.2 - Key Considerations for Downtime Optimization for DMO

- Source database optimization (index rebuild, DB statistics, DB parameters, DB file system). A useful reference can be found in the table below.

Database	Reference
Oracle	SAP Note 936441 - Oracle settings for R3load based system copy
DB2	http://www.redbooks.ibm.com/abstracts/sg247774.html
SQL Server	https://blogs.msdn.microsoft.com/saponsqlserver/2017/05/08/sap-osdb-migration-to-sql-server-faq-v6-2-april-2017/

- Use the latest version of migration tools, R3*, kernel, etc.
- Network parameterization (e.g. MTU settings, reset counters)
- OS-related parameterization (e.g. Q depth)
- SAP HANA database parameters (related to save points, log mode and timeouts)
- DMO Migration parameters (e.g/ duration files, manual table splits, manual table sequencing order, fast load for BLOB, etc.)

Supporting tools and methods are available to support DMO Optimization.

DMO Benchmarking:

- Used to capture export and import phases for a subset of data. It can be configured to run on specific tables.

Repeat Multiple Runs of Downtime Phase:

- Running the execution phase multiple times is possible by reworking the *table splitting* activity (thus optimizing table splitting that will reduce the downtime of the DMO procedure).

5.3 - Downtime Optimized DMO

Downtime Optimized DMO is a migration option where large tables are migrated as part of the uptime phase. Triggers will capture the changes that can be replayed back as part of the downtime process. (Note: as of August 2018, this scenario is in pilot phase and SAP Support must be involved in the migration execution. Refer to the following SAP Note:

- [2442926 - Prerequisites and Restrictions of downtime-optimized DMO](#)

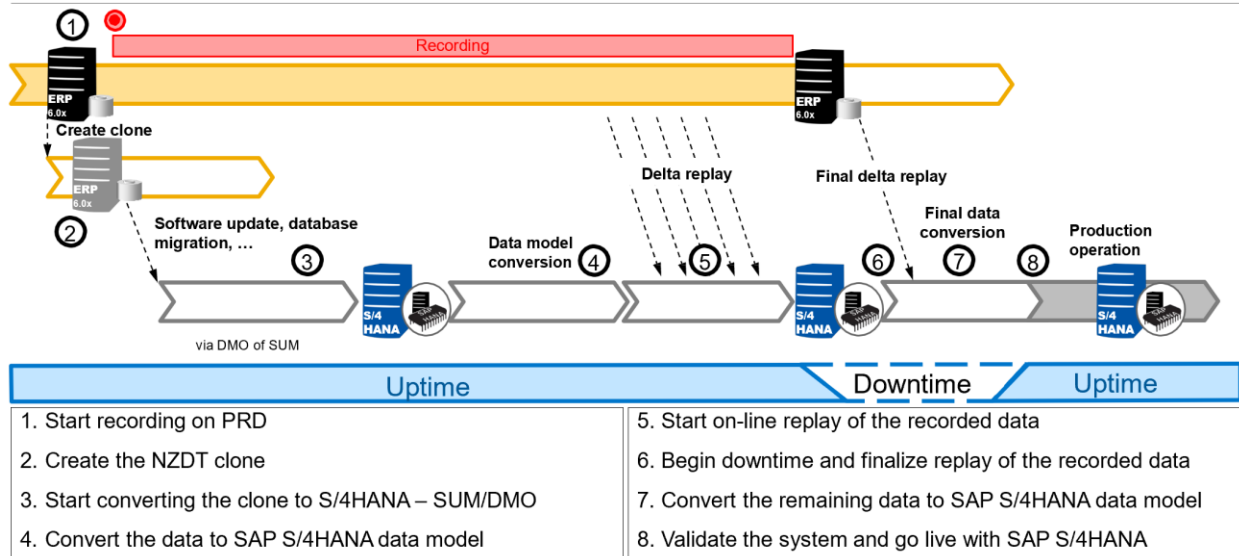
In the table below, see the comparison between Classic DMO and Downtime Optimized DMO.

Classic DMO	Downtime Optimized DMO
DMO can be performed by any resource	A SAP employee needs to execute the project and is a SAP Services-based project only
All tables are replicated as part of the downtime	Large tables are replicated as part of the uptime using SLT
Longer downtime duration	Reduced downtime duration
All scenarios are supported	<p>Scenario "DMO without Software Update" can be combined with "downtime-optimized DMO"</p> <p>Scenario "DMO with System Move" does not support "downtime-optimized DMO"</p>
No need to add the DMIS in stack.xml generation	Manually add DMIS in Maintenance Optimizer (MOPZ) to create the stack configuration file (stack.xml)
No Restrictions	<p>Products supported:</p> <p>SAP ECC 6.0 and higher</p> <p>SAP CRM 7.0 and higher</p>
No Restrictions	<p>Restrictions on Tables which cannot be replicated in uptime:</p> <ul style="list-style-type: none"> • Basis tables containing deep components (e.g. STRG) • Pool tables • Application exchange tables (transferred in uptime anyhow) • Tables to be converted • Tables without primary key • Tables which start with /BI in the name • Tables from Transport Management System (TMS) starting with E07*

5.4 – Near-Zero Downtime (NZDT)

NZDT uses clone-based methodology and following the cloning of the production system, DMO executes on the clone. Transaction activities are captured from the production system and replayed back to the clone system. Please refer to the following SAP Note for further information: [693168 - Minimized Downtime Service \(MDS\)](#).

Near Zero Downtime (NZDT) Approach – DMO of SUM Conversion Steps



Source: SAP

Note:

NZDT and Downtime Optimized DMO are not yet supported for cloud migrations.

6 Conclusion

Our goal is to provide you the information needed to make an educated decision about the migration options available to you and using the above considerations, you can effectively evaluate your SAP system to determine which database migration option will be the best fit to support your SAP migration in Microsoft Azure migration.

Disclaimer

SAP is continually developing their SUM / DMO tools and some of the options described above may become outdated in the future. As such, please refer to the official blog series from the SAP Product Management team (Boris Rubarth): <https://blogs.sap.com/2013/11/29/database-migration-option-dmo-of-sum-introduction/>

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