Successfully Planning and Executing Large-Scale Cloud and Data Center Migration Projects

Updated for PlateSpin® Transformation Manager 2019.2 and PlateSpin Migrate 2019.2
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Introduction

In today’s dynamic world, the need for cost reduction and the desire to increase operational efficiency have a constant impact on the organization of IT resources.

Enterprises are relentlessly looking for better ways to manage infrastructure, systems and applications, and this often leads to the execution of projects where large numbers of servers are moved from one platform or data center to another. Typical examples include the migration of physical servers onto a virtual platform, the migration of virtual machines from one virtual platform to another, the migration of on-premise servers into a public or managed cloud, and traditional data center consolidations.

Who Is this White Paper For?

This white paper is specifically written for project managers and project architects who are leading large-scale server migration projects using PlateSpin tools like PlateSpin Transformation Manager and PlateSpin Migrate. When used together, the combined solution of PlateSpin Transformation Manager and PlateSpin Migrate is referred to as “PlateSpin Migration Factory.” PlateSpin Migration Factory helps project managers and project architects to execute cloud and data center migration projects with near-zero application downtime, elimination of risk, flexible testing, less human error, and a dramatic reduction of overall project execution time.

PlateSpin Migration Factory allows you to migrate more servers, in less time, with better results.
Understanding Workloads and Workload Migrations

In this white paper, we’ll use the term “workload” as the aggregate term for an operating system with all the applications installed on it, all the patches and configuration settings, and also all the data files or blocks that reside on its data volumes.

In the context of cloud and data center migration projects, rebuilding a workload from scratch on a new platform is rarely a desired migration methodology. This is because rebuilding is a manual, slow and error-prone process that requires a vast amount of expensive work to ensure that the new workload is built in exactly the same way as the original workload. A true workload migration, as performed by PlateSpin Migration Factory, streams the blocks or files of the original workload into a replica on the new (“target”) platform. Using PlateSpin Migrate ensures that the new workload is created rapidly and automatically, and that it is functionally identical to the original workload.

Introduction to PlateSpin Migrate

PlateSpin Migrate is a powerful server portability solution that automates the process of migrating servers over the network between physical machines, virtual hosts, and enterprise cloud platforms—all from a single point of control. When migrating such servers, PlateSpin Migrate refers to these servers as “workloads.” PlateSpin Migrate provides enterprises and service providers with a mature, proven solution for migrating, testing, and rebalancing workloads across infrastructure boundaries. Some of the key features in PlateSpin Migrate are:

PlateSpin Migrate supports the following main types of workload migration:

- Anywhere-to-anywhere workload migration capabilities
- Horizontal scalability with up to 40 concurrently active migrations per individual PlateSpin Migrate server
- Zero service downtime during replication phases, and near-zero service downtime during final cutover
- Ability to fully test a migrated workload before cutting it over in production

Server Migration Dynamics

A typical workload migration with PlateSpin Migrate involves two kinds of replications: a full replication and one or more incremental replications. Incremental replications are also called synchronizations. The first replication of the workload is almost always a full replication: all blocks or files of the source workload are transferred to the target workload. After this first full replication, the target workload is tested. While tests are happening, changes occur on the source workload, which thus needs to be synchronized at least once more before the final cutover. The synchronization of the changes is done with an incremental replication.

Using PlateSpin Migrate ensures that the new workload is created rapidly and automatically, and that it is functionally identical to the original workload.
If the testing phase takes a long time, multiple incremental replications are usually applied, interleaved with the individual tests themselves. Finally, the cutover of the workload is performed, in combination with one final incremental replication to make sure all changes are captured. During this whole process, the source workload is online and fully accessible to its business users. It’s only during the very last synchronization and cutover that services need to be briefly shut down, before they come up again on the target workload. In order to keep this service downtime to an absolute minimum, PlateSpin aims to minimize the time needed for synchronizations. For this purpose, PlateSpin has developed an optional block-based transfer (BBT) driver. This driver can be installed in the source workload, where it tracks blocks that are modified in between replications. When the synchronization window starts, the driver immediately identifies “dirty” blocks and sends them to the target. Migrations can be performed with or without the driver, but using the driver reduces the time needed for a synchronization, and hence the downtime experienced at cutover.

Introduction to PlateSpin Migration Factory

PlateSpin Migration Factory is a migration solution based on the combined use of PlateSpin Migrate and PlateSpin Transformation Manager.

PlateSpin Transformation Manager is designed from the ground up to properly plan, track and streamline the execution of cloud and data center migration projects. It features a client-server based architecture, and allows multiple people with different roles to access and update project data at the same time safely, via a web browser. It can handle multiple projects for multiple end customers, with built-in multi-tenancy to ensure that all customer data is properly contained and cannot be accessed by other customers. Information about source workloads can be easily imported into a project via a spreadsheet or via the PlateSpin Transformation Manager API, or source workloads can be discovered in real-time by PlateSpin Transformation Manager itself. Imported information about source workloads can be updated at any time, even while the project is being executed, to make sure that it continuously reflects the changing reality in the source environment.

Once all workload information is imported, the project can be planned in PlateSpin Transformation Manager. Project managers can assign different people to different projects, and split up large projects in smaller chunks (called waves and batches) to organize the execution of the project in a more manageable way. For each workload, the final state and destination can be described long before the actual migrations take place. Migrations performed with PlateSpin Migrate are intelligently tracked by PlateSpin Transformation Manager. Because all information is centrally managed in the PlateSpin Transformation Manager database, the status of the project can be consulted at any point in time visualized in a dashboard, which can optionally be exposed to the end customer.
PlateSpin Transformation Manager allows multiple people with different roles to access and update the same data at the same time safely, via a web browser.

PlateSpin Transformation Manager features the following core roles:

- **Administrator.** The person who installs the product. The administrator can be the first project manager and/or can create other project managers.
- **Project Manager.** Typically creates new projects, and creates project architects and migration specialists. The project manager has all rights on a project.
- **Project Architect.** Has all rights on projects to which he has been assigned, but cannot create new projects. The project architect can create migration specialists as well.
- **Migration Specialist.** This role has no planning privileges. The migration specialist can only execute tasks in the context of planned workload migrations.
- **Dashboard Viewer.** Can only see the project dashboard.

### Planning Large-Scale Workload Migration Projects

#### Planning Resources for PlateSpin Servers

PlateSpin recommends to run all PlateSpin servers as virtual machines. This allows you to easily allocate more or less resources to these servers later on in the project. Example resource configurations can be found in the documentation for the respective products. Typically, plan on provisioning one virtual server for each of these:

![PlateSpin Transformation Manager dashboard](image)
PlateSpin recommends installing PlateSpin Migrate on a dedicated Microsoft Windows Server 2012 R2 operating system. No other applications should be installed on this system. A full description of the installation process can be found in the product documentation.

- The PlateSpin Transformation Manager server
- One PlateSpin Migrate server for each 200 workload migrations that are concurrently managed, 40 of which can be actively replicating at the same time

As a note: PlateSpin Transformation Manager comes as a downloadable appliance of about 1 GB in size. This product can only be run as a virtual machine.

Planning BBT Driver Certification and Maintenance Windows for BBT Driver Installations
The installation of the BBT driver (which yields faster synchronizations) requires a reboot for source workloads that are based on the Microsoft Windows operating system. A standalone installer for the driver is available. This installer can be run on the source workload at any time, and will simply register the driver for installation at the next reboot of the source workload. The source workload can then be rebooted at any time prior to its migration, e.g. during a standard maintenance window. Since maintenance windows can be sparse, planning these reboots is an important step in the project planning.

In some environments, the use of a new driver will require certification of this driver. To avoid unnecessary delays, PlateSpin recommends starting the certification process as soon as possible in the project.

Installing, Configuring and Initializing PlateSpin Transformation Manager (Software)
PlateSpin Transformation Manager comes as a downloadable Linux-based appliance, and requires attaching an additional data disk (typically 40 GB) before launching it. At first boot, the appliance will ask a couple of simple configuration questions. After this initial configuration the project manager will use a web browser to log in, perform discovery, and then create the project plan.

Installing PlateSpin Migrate Servers (Software)
PlateSpin recommends installing PlateSpin Migrate on a dedicated Microsoft Windows Server 2012 R2 operating system. No other applications should be installed on this system. A full description of the installation process can be found in the product documentation. One PlateSpin Migrate server can handle approximately 200 concurrently discovered source workloads, 40 of which can be replicating at the same time. Note that for migrations to Microsoft Azure and Amazon Web Services, a PlateSpin Migrate server can be easily and rapidly provisioned via a readily available Marketplace image (Azure) and Quick Start (Amazon Web Services).

Creating Effective Execution Teams
PlateSpin recommends that all team members who operate PlateSpin Migrate attend the PlateSpin Migrate Administration training. At least one team member should be a Certified PlateSpin Migration Specialist. More information about the certification is provided at the end of this white paper.

Besides PlateSpin Migrate administration skills, PlateSpin recommends the following skills, which can be spread over team members:
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PlateSpin highly recommends a good understanding of the target platforms to which workloads need to be migrated. Each target platform will have its own intricacies, and especially during problem resolution at least intermediate knowledge about the target platform is required. For migrations to VMware target platforms, it’s highly advised to have at least one team member be VMware certified. For migrations to other target platforms, it’s advised to investigate if any certification about the platform exists, and to subsequently have at least one team member obtain the certification.

If Linux workloads need to be migrated: basic Linux administration skills. For certain versions of Linux, a custom BBT driver may need to be compiled. This process is not difficult and is well-documented, but requires Linux command-line interface administration skills. Check the product documentation for an overview of Linux versions for which a pre-compiled BBT driver already exists.

If Windows workloads need to be migrated: basic Windows administration skills.

Network-related issues are the number one cause of migration challenges, whether they have to do with bandwidth constraints, firewalls, or network architectures which prevent necessary communication paths. A good understanding of the networks involved in the project is critical for project success. Furthermore, PlateSpin recommends to have at least one team member be certified in standard TCP/IP networking.

Collecting Information About Source Workloads
Since access to source workloads is not always available at the start of the project planning phase, PlateSpin Transformation Manager features a flexible data import mechanism that’s based on Microsoft Excel spreadsheets. On the main workload overview tab in the UI, a widget can be launched to import information about source workloads into the project. The widget has a download link that allows for an easy download of an example spreadsheet to a desktop system. The next step is populating this spreadsheet with data about the source workloads. Alternatively, information about source workloads can be added into PlateSpin Transformation Manager via a REST-based API.

As the planning phase moves on, more data about source workloads can become available. PlateSpin Transformation Manager allows for subsequent imports of information about systems that were previously imported. The fully qualified domain name (FQDN) is used as the key to find and update, or complete the existing information.

When access to source workloads is available, the imported data can be complemented with real-time discovery of source workload information.

Source Workload Space Requirements and Data Integrity Testing
It’s important to know that PlateSpin Migrate imposes two requirements on the source workload regarding free disk space:

For Microsoft Windows source workloads, 100 MB of free disk space is required for the installation of the PlateSpin Migrate controller. This controller is automatically installed on the C: volume in the
migration preparation phase. For Linux source workloads, the controller requires 600 MB of free disk space and is installed in the /usr directory.

- For Windows workloads, 10% of free space per volume is needed. This is because PlateSpin Migrate creates VSS snapshots during replication, to ensure data consistent replications. The 10% of free space is required to accommodate the volume snapshot. For Linux workloads, the same requirement exists, but at the level of the volume group, and only if LVM is used.

PlateSpin recommends to verify the integrity of every source workload’s file system before starting any replication. Data corruption may prevent the target workload from booting correctly, as the corruptions may be copied from the source to the target. This is especially true for block-based replications. For Windows workloads, the Check Disk (chkdsk) utility can be used for integrity checking.

**Planning Your Project in PlateSpin Transformation Manager**

A large cloud and data center migration project can contain up to tens of thousands of workloads, but even migrating a thousand workloads can be daunting without the ability to categorize and group workloads in more manageable chunks. PlateSpin Transformation Manager features three levels of grouping:

- **Batch.** A batch contains one or more workloads. Typically these workloads will belong to one or more applications, and will need to be cut over in the same time frame.

- **Wave.** A wave contains one or more batches.

- **Project.** A project contains one or more waves.

While planning the project, workloads can be easily grouped into waves and batches with the advanced search and bulk edit tools, as illustrated in the following figure.

**Figure 3.** Groups of workloads can easily be identified via the advanced search form.
Architecting a Migration Infrastructure for Scale

A determining factor for project success is the architecture of the PlateSpin migration infrastructure. Several scalability limits determine what kind of architecture is needed.

1. **PlateSpin Migrate Scalability Limits**

   One PlateSpin Migrate server can handle up to 40 concurrent replications, and about 200 concurrently discovered and/or configured workloads. Both of these scalability limits are “moving windows”: if a replication is finished, another one can be started, as long as the upper limit of 40 concurrent replications is not surpassed. Similarly, if a workload has been successfully migrated, then its information can be deleted from the PlateSpin Migrate server, to free up a slot for a new workload.

2. **Target Platform Scalability Limits**

   Replicating workloads onto the target platform generates network and storage related stress on that platform. If the platform features shared resources, as is the case for hypervisors, then this stress may negatively impact other workloads that are running on the platform while migrations are happening. If this needs to be avoided, a two-stage approach is recommended, where workloads are migrated into a “stage target platform” where no production workloads are running, and are then moved to their final production destination.

   An additional consideration is the speed at which the target platform can handle incoming replications. PlateSpin recommends to not perform more than 10 concurrent replications into a VMware cluster.

3. **Source Platform Scalability Limits**

   Replicating workloads generates network stress on the source platform. CPU, RAM and storage related stress are less important here, as the data only needs to be read, not written. One important factor to take into consideration is the network bandwidth of the network card (NIC—virtual or physical) that links the source platform to the networking infrastructure: no matter the speed of the networking infrastructure, a migration will not be able to consume more bandwidth than offered by the connecting NIC. This is even more important in virtualized environments, where a physical NIC can be shared by multiple workloads: if that NIC is 1Gbps, and if multiple workloads are being replicated at the same time, then all replications will have to share the 1Gbps link, which will lead to poor migration times, even on a 10Gbps or better networking infrastructure.

4. **Human Error**

   PlateSpin Migrate is a multi-user migration tool, where multiple users can work on migrating workloads at the same time. To avoid human error—most often in the form of losing track of who’s working on what workload, or in the form of one administrator accidentally performing an operation on another administrator’s workload—PlateSpin recommends to not have more than three administrators share the same PlateSpin Migrate server.
workload—PlateSpin recommends to not have more than three administrators share the same PlateSpin Migrate server. One person can work on multiple PlateSpin Migrate servers, but one server should not be manned by more than three different people. Each migration team should be given a set of applications to migrate, and should use one and the same PlateSpin Migrate server to migrate all workloads belonging to these applications.

When PlateSpin Transformation Manager is used, the risk of this kind of human error is as good as eliminated due to its advanced planning and automation features.

5. Networking infrastructure

MEASURING BANDWIDTH

Even when fast theoretical (e.g., 10 Gbps) network speeds are available, calculations need to be made to ensure that the available bandwidth is sufficient for the amount of data that needs to be moved simultaneously. As early as possible in the project, the real available bandwidth should be determined between the source workload and the target platform, as this bandwidth will have a significant impact on the real migration speed. A good way to measure the actual available bandwidth is by using the iPerf tool. iPerf is a client-server based tool, where the server should be run on the target platform. For a VMware based target, this can be done in a small, dedicated virtual machine. The client part can then be downloaded and launched on the source workload, after which the bandwidth between source and target can be measured. PlateSpin highly recommends to measure all available bandwidth for all source to target platform network paths before the start of the actual migrations. Since version 12.2, PlateSpin Migrate ships with iPerf tools to measure real available bandwidth.

TUNING THE NETWORK

Depending on network latency, the TCP/IP receive window between source and target must be tuned to achieve greater throughput during replications. Consult the PlateSpin Migrate documentation for detailed steps on how to configure this. Furthermore, every networking infrastructure has a characteristic size of messages that may be transmitted, called the maximum transmission unit (MTU). PlateSpin Migrate allows administrators to set the MTU for any given replication, to avoid packet fragmentation and related loss of throughput performance. Consult the PlateSpin Migrate documentation for detailed steps on how set the MTU.

COMPRESSION

For very slow links such as WAN links, PlateSpin Migrate allows compression to be used to compress the data before it’s being sent over the network. Depending on the type of the data, compression of up to 70% can be obtained, leading to much faster replication times. However, since the CPU on the source workload is used to compress the data, an additional CPU overhead of about 5% has to be taken into account.
REQUIRED COMMUNICATION PATHS
For a complete overview of all communication paths, including what ports may need to be opened up in firewalls, consult the PlateSpin Migrate technical documentation, where this information is readily available. The most important requirements are:

- The PlateSpin Migrate server needs to be able to communicate with the target platform. Usually this happens over HTTPS (TCP/443).
- During replications, which occur on the user-selected network under “Replication Network for Target”:
  - Both the source workload and the target workload need to be able to connect to the PlateSpin Migrate server on port HTTPS (TCP/443)
  - The PlateSpin Migrate server needs to be able to connect to the target workload on port 22 (TCP)
  - The source workload needs to be able to connect to the target workload on port 3725 (TCP)
- During testing cycles, which occur on the user-selected network under “Target Workload Test Settings”:
  - The target workload needs to be able to connect to the PlateSpin Migrate server on port HTTPS (TCP/443)
- At cutover, which occurs on the user-selected network under “Target Workload Settings”:
  - Both the source workload and the target workload need to be able to connect to the PlateSpin Migrate server on port HTTPS (TCP/443)

IP ADDRESS MANAGEMENT
When PlateSpin Migrate is replicating a workload (i.e., during any full or incremental replication), the target workload is always booted from a Linux RAM Disk (LRD) ISO helper image. This helper image needs an IP address, so that it can communicate over the network with the source workload (for replication data) and the PlateSpin Migrate server (for instructions on what operations to perform). You configure the IP address of the LRD ISO helper image as part of the workload migration configuration in PlateSpin Migrate.

The above means that there are potentially four different IP addresses in play during the migration process:

- The IP address of the source workload
- The IP address of the PlateSpin Migrate server
- The IP address of the target workload during testing and after final cutover. This IP address may be the same as the source workload (assuming the source will be shut down after cutover), or it can be different.
- The IP address of the LRD ISO helper image during replications. If the IP address of the target workload after final cutover is going to be different than the IP address of the source workload, then usually that same target workload IP address can be used, as it will not conflict with the source’s IP address. However, if the IP address of the source will be transferred “as is” to the target workload, then a dedicated IP address needs to be planned for the replication. The IP address of the target workload cannot be used in this case, as it will conflict with the (identical) IP address of the source workload.
Note that if DHCP is used in the environment where the target workload will reside, IP address assignment will mostly be handled automatically by the DHCP service.

6. Projects, PlateSpin Migrate Servers, and Connectors
Because PlateSpin Transformation Manager can streamline the execution of multiple migration projects at the same time, it is important to know that each migration project requires its own set of PlateSpin Migrate servers. In other words, PlateSpin Migrate servers cannot be shared between projects.

PlateSpin Transformation Manager communicates with PlateSpin Migrate servers via a Connector. The PlateSpin Transformation Manager appliance ships with one Connector pre-installed.

Execution Dynamics of Large-Scale Workload Migration Projects

Project Progress Tracking with PlateSpin Transformation Manager
As workloads are being migrated, the information in the PlateSpin Transformation Manager database is constantly kept up to date to reflect the latest state of the project. If workload migration deadlines are missed, a warning is displayed to indicate that the attention of the project architect or project manager is needed. They can then choose to add that workload to a future batch, create a new batch for it, or take other necessary actions.

The most important project information can at any time be consulted by all roles that have rights to the project, in the project dashboard. Optionally, this dashboard can be exposed to any third party via a dashboard viewer role, which only has view-only rights.

Cutting Over Your Workloads: Test Early, Test Often
Before cutting over services to the new server, a certain amount of testing is required. With PlateSpin Migrate, testing the target workload can be done in a sandboxed environment, while the source workload is still online in production. There is no limit on the duration of a test, or on the number of tests performed before cutover. Once testing is completed, a nightly incremental replication is automatically performed to synchronize the source and the target workload, so that the target workload contains the latest updates for the next test. This process of testing and synchronizing can be repeated any number of times. Once the test teams sign off on the target workload, a final synchronization between source and target is performed, after which the cutover takes place.

To ensure 100 percent data consistency between the source and the target, it’s considered a best practice to shut down the services on the source workload during the final synchronization. Shutting down the services ensures that no data changes are being made while the final deltas are transferred from the source to the target workload. PlateSpin Migrate features a widget that allows for easy selection of services that need to be brought down before the final synchronization.
Because business services are down during cutover, it’s paramount to make sure that the cutover is done as fast as possible. Regular synchronizations (typically interleaved with testing as described earlier) will ensure that the overall services downtime during the final synchronization and cutover is kept to an absolute minimum and, equally important, that the downtime of the services is predictable: the final synchronization should not take longer than any of the previous synchronizations.

Migration specialists who want to become experts in the use of PlateSpin Migrate can register for the PlateSpin Migrate Administration course.

**Figure 4.** Scheduling a workload for replication is easy and wizard-driven in the PlateSpin Migrate web UI.

### Becoming a Certified PlateSpin Migration Specialist

Migration specialists who want to become experts in the use of PlateSpin Migrate can register for the PlateSpin Migrate Administration course. The course covers all aspects of working with PlateSpin Migrate, including product installation, understanding migration dynamics, understanding licensing, use of the command line interface, driver management, and troubleshooting. Upon course completion, the student can register for the Certified PlateSpin Migration Specialist exam, which consists of a set of multiple-choice questions to test the student’s knowledge on all relevant topics.

Consult the Micro Focus® website on microfocus.com for more information on training options and certification.
Useful Links

1. A best practices tutorial: www.youtube.com/watch?v=aAW8tlPghCY
2. PlateSpin Migrate documentation: www.netiq.com/documentation/platespin-migrate
3. More PlateSpin Migrate resources: www.microfocus.com/products/migrate/resources