SAP Landscape Management 3.0 and IBM Power Systems Servers

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IBM Redbooks

SAP Landscape Management 3.0 and IBM Power Systems Servers

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Preface

This IBM® Redpaper publication is part of a series of technical documentation to help enablement of SAP on Linux for IBM Power Systems servers and IBM Systems Storage.

This book describes how by using SAP Landscape Management (SAP LaMa) 3.0 software, the clients gain full visibility and control over their SAP and non-SAP systems including the underlying physical, virtual, and cloud infrastructures. SAP LaMa allows to automate repetitive tasks to manage critical applications across complex, hybrid IT landscapes.

This publication helps to better control IT costs and to increase business agility, for example, by freeing staff to focus on more strategic work rather than manual, error-prone tasks.

The target audiences of this book are architects, IT specialist, and systems administrators deploying SAP Landscape Management 3.0 whom often spend a lot of time and effort managing and provisioning the SAP software systems and landscapes.

Authors

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This paper was produced in close collaboration with the IBM SAP International Competence Center (ISICC) in Walldorf, SAP Headquarters in Germany and IBM Redbooks.

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Introduction to SAP Landscape Management 3.0 and IBM Power Systems Servers

This document is part of a series of technical documentation for SAP on IBM Power Systems Servers and IBM System Storage™.

The target audience are architects or administrators deciding on purchasing and deploying SAP Landscape Management 3.0 (SAP LaMa) on IBM Power Systems.

This chapter contains the following:

- Introduction
1.1 Introduction

Clients often spend a lot of time and effort managing and provisioning the SAP software systems and landscapes.

By using SAP Landscape Management (SAP LaMa) software the clients gain full visibility and control over their SAP and non-SAP systems including the underlying physical, virtual, and cloud infrastructures. SAP LaMa allows to automate repetitive tasks to manage critical applications across complex, hybrid IT landscapes.

This enables the client to better control IT costs and to increase business agility, for example, by freeing staff to focus on more strategic work rather than manual, error-prone tasks.

IBM PowerVC is an advanced virtualization and cloud management offering. Built on OpenStack, it provides simplified virtualization management and cloud deployments for IBM AIX®, IBM i and Linux virtual machines (VMs) running on IBM Power Systems. The offer is designed to build private cloud on the Power Systems servers and improve administrator productivity. It can further integrate with multi-cloud environments through higher-level cloud orchestrators.

SAP Landscape Management provides a built-in integration with IBM PowerVC - this allows the SAP Basis administrator to holistically manage the critical SAP applications. The SAP Basis administrator gets a complete overview of the full landscape from storage, servers, LPARs, and SAP Application Server and Database Instances, and can efficiently manage and operate those components in an IBM Power Systems and IBM Storage Landscape.

Chapter 2, “SAP Landscape Management 3.0” on page 3 provides integration aspects with IBM Power Systems technologies.
Chapter 2. SAP Landscape Management 3.0

This section describes the SAP Landscape Management 3.0 integration aspects with IBM Power Systems technologies.

This chapter contains the following:
- Overview
- Introduction to typical use-cases with SAP LaMa
- SAP LaMa environment setup
- Execution of SAP system copy in SAP LaMa
- Outlook
2.1 Overview

This section gives an overview about SAP Landscape Management (SAP LaMa) and focuses on key aspects for integration with IBM Power Systems technologies.

SAP LaMa is an application that runs on top of an SAP NetWeaver Application Server (SAP NetWeaver AS) for Java. It provides a centralized, simplified framework for managing SAP and non-SAP solutions and systems, including SAP HANA and SAP S/4HANA systems. Goal of SAP LaMa is to simplify the management of hybrid SAP landscapes which are deployed either on-premise bare-metal or virtualized servers or in the cloud. On one hand, SAP LaMa enables automation of repetitive, day-to-day administration tasks for the SAP basis administrators. This includes complex provisioning operations like copying SAP systems or installing SAP application servers. On the other hand, by way of SAP LaMa and its frontend, the SAP basis administrators get a simplified access to the infrastructure elements that are required for fulfilling their tasks.

SAP LaMa recently got a lot of extensions as standard solution for managing and operating of SAP HANA powered landscapes: Advanced SAP HANA operations like performing system replication setup, takeovers, failbacks, system copies, system refreshes and minimizing business downtime during SAP HANA maintenance activities can be managed with SAP LaMa (LaMa4HANA).

SAP LaMa relies on the SAP Hostagent and SAP Adaptive Extensions for monitoring and management of the operating system. Those components need to be installed on each host that shall be managed by SAP Landscape Management. The SAP Hostagent package includes all required elements for centrally monitoring and managing any kind of operating systems covered in the SAP NetWeaver support matrix – see the SAP Product Availability Matrix (PAM) for details (https://support.sap.com/en/release-upgrade-maintenance.html). The SAP Hostagent is complemented by the SAP Adaptive Extensions. By way of those methods, SAP LaMa performs various operations on the host, for example:

- Perform operations on SAP HANA systems and tenant databases
- Discover SAP HANA systems
- Provision SAP HANA tenant databases
- Monitor SAP HANA systems and tenant databases
- Reexport NFS (Network File System)
- Manage virtual hostnames and IBM storage by way of SAP Adaptive Extensions (SAPACOSPrep) for IBM Power Linux platform

Three main integration points for SAP Partner Technologies are available for SAP LaMa:

- Virtualization and Cloud Management
- Storage Management
- Orchestration

IBM provides adapters for Virtualization Management and Storage Management that are directly integrated and are shipped with the SAP LaMa software. These adapters translate the generic SAP LaMa calls to platform-specific commands which are then executed by the appropriate infrastructure component. The integration with IBM PowerVC allow virtualization monitoring and management of IBM Power Systems servers and logical partitions, including the provisioning of new LPARs. Having the virtualization data available by way of IBM PowerVC, all the dependencies how the SAP Systems are installed and on which physical server they are running can be identified and visualized. When using IBM backend storage that is SAN-attached to the LPAR by way of NPIV and managed by IBM PowerVC, then adaptively installed SAP Systems can be relocated between different LPARs, and “Storage-based” System Copy/Clone can be executed.
For Orchestration, SAP Landscape Management provides a REST API that allows to get/update information from/in SAP LaMa or to trigger actions in SAP LaMa from remote - This is a generic interface, there is currently no IBM-specific extension available. Clients can define their own custom operations/ processes and trigger them externally.

Table 2-1 lists the communication layers between SAP LaMa and the managed components (SAP instances and infrastructure).

**Table 2-1 Communication layers for SAP LaMa and managed components**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Function Call (RFC)</td>
<td>SAP LaMa triggers RFCs in the SAP System for executing SAP basis system management tasks (for example, Post Copy Automation task lists).</td>
</tr>
<tr>
<td>SAP Instance Agent (sapstartsrv)</td>
<td>Start-, Stop and get status of the SAP Instance.</td>
</tr>
<tr>
<td>SAP Hostagent (saphostexec), Adaptive Extensions</td>
<td>Execute commands on operating system level: mount or unmount file systems, acquire or Release IP addresses, custom defined commands. Perform database actions and monitoring (sapdbcrl).</td>
</tr>
<tr>
<td>Virtualization Adapter (IBM PowerVC)</td>
<td>Full visiblity across server and virtualization, map with SAP application topology. Automated provisioning of LPARs, triggering live migrations from one system to another, power-off/ power-on LPARs, gather information about hosts and operating systems status and details.</td>
</tr>
<tr>
<td>Storage Adapter (IBM PowerVC)</td>
<td>Gather details about the storage volumes of the SAP system/ instances, perform storage mapping (attach/ detach storage volumes to/ from a host) and to manage consistency groups and snapshots for the volumes required for SAP System Copy/ Clone scenarios.</td>
</tr>
</tbody>
</table>
Figure 2-1 illustrates the different communication paths.

Figure 2-1   Communication between SAP LaMa and the managed components

SAP LaMa capabilities like Custom Provisioning and Custom Hooks/Operations allow to extend standard workflows and/or create specific customer actions. SAP LaMa offers a custom cloning capability that allows to create a system clone/system copy by integrating storage cloning procedures already existing at the clients' environment. Such an approach can be integrated into SAP LaMa: Pre-defined sub-steps in the standard workflow for the pre-clone, clone, and post-clone phases are replaced by custom defined scripts or web service calls: Those get then executed on the source and target systems during the custom provisioning flow.

The web services/scripts need to be registered as a Provider Implementation Definition and references the script/web services execution triggered by the SAP Host Agent on the source or target system during the workflow step. The provider implementation definition references the location of the script or command to be executed on the LPAR, including all the parameters/arguments which will be transferred from SAP LaMa to the script. See also the SAP Note 1465491 - Provider Implementation Definition at the following website:

https://launchpad.support.sap.com/%23/notes/1465491

and the SAP Landscape Management 3.0, Enterprise Edition documentation for details at the following website:


A custom provisioning process can then be created: In the custom provisioning process, a standard process step then can be replaced with the step referenced in the provider implementations. It is specified when or under which circumstances the custom step gets executed in an SAP LaMa operation.

Provider implementation definitions can be used in the context of custom hooks or custom operations too. Custom hooks allow to add additional pre-, post-, or error processing steps to the standard workflows defined in SAP LaMa. Custom operations allow triggering of user-defined activities directly from the SAP LaMa GUI or as part of mass operations. For
example, the SAP basis administrators can run certain custom-defined scripts with privileged permissions on the hosts without granting him root access in general.

2.2 Introduction to typical use-cases with SAP LaMa

This chapter describes typical use cases that clients implement for the management of their SAP Systems. The examples focus on SAP systems deployed to an IBM Power Systems environment with LINUX operating system:

1. Management of complex SAP landscapes composed of several SAP systems which are running on premise or in different public clouds.
2. SAP HANA landscape management.
4. SAP System Clone, SAP System Copy, SAP System Refresh (including refreshes of DB Server-only).
5. Virtualization monitoring of IBM Power Systems servers and logical partitions (LPARs).
6. Virtualization management of IBM Power Systems servers and logical partitions (LPARs).
7. OS Provisioning and OS image handling.
8. Provisioning of SAP Application Servers.
9. Extensibility with user defined operations and workflows.

The following section contains a short description of these use-cases. The sections further on describe specific requirements for the implementation of use cases 3, 4, 5, 6 and 7. All other use cases are not specific to an IBM Power Systems environment and are described in the SAP LaMa documentation in detail.

2.2.1 Use case 1 – Management of complex and distributed SAP landscapes

A SAP Landscape is composed of several SAP systems which are running on premise and/or in different public clouds. SAP LaMa centralizes management of different entities of the landscape within one user interface. The provided management view includes on premise and cloud landscapes, physical hosts, virtual machines (LPARs), operating systems (hosts), SAP systems and SAP instances. SAP LaMa provides functionalities to execute basic operations (like start or stop) on SAP systems and SAP instances. These operations can be triggered also on groups of elements (mass operations).

2.2.2 Use case 2 – SAP HANA landscape management

SAP LaMa provides several options for management of SAP HANA landscapes:

- New SAP HANA tenant move with near-zero downtime maintenance
- Support for SAP HANA system and tenant rename
- End-to-end automation for SAP HANA system replication setup
- End-to-end automation for SAP HANA takeover and failback procedures
- Support SAP HANA multitarget replication
- Near zero downtime maintenance for SAP HANA primary and secondary sites (such as SAP HANA upgrades, OS upgrades or Hardware maintenance)
Figure 2-2 illustrates new HA/DR options with SAP HANA 2.0: Those can be managed with SAP LaMa.

2.2.3 Use case 3 – Relocation of adaptively installed SAP Systems

SAP LaMa provides functionality to move entire SAP system or one of its instances from one host to another host. The SAP system/instance needs to be stopped on the source host before, and then gets restarted on the target host this will cause a short downtime. The relocation is a combination of a detach task (unprepare) followed by an attach task (prepare) on the host – detach/attach tasks invoke the IBM PowerVC storage adapter, and so all the SAP system storage needs to be managed by PowerVC. For this use case PowerVC is configured as storage adapter in SAP LaMa. Mass operations allow to relocate multiple SAP systems or instances immediately.

The end-to-end process invokes and automates the following steps:

1. Stop the SAP system or SAP instance
2. Unprepare SAP system or SAP instance on the source host. During the so-called Unprepare action:
   - The SAP instance agent is stopped and de-registered from the host
   - File systems (defined in the mount config) of the system/instance are unmounted
   - The virtual IP addresses of the system/instance are released from the network adapter on the source host
   - Storage volumes reflecting the file systems are unmapped from the source host by way of IBM PowerVC
3. Prepare SAP instance or system on the target LPAR. The Prepare action is inverse to the Unprepare:
   – Storage volumes reflecting the file systems are mapped to the target host by way of IBM PowerVC
   – All file systems (defined in the mount config) of the system or instance are mounted
   – The virtual IP addresses of the system or instance are acquired in the network adapter of the target host
   – The SAP instance agent is registered on the host and started

4. Start the SAP system or instance(s) on the target LPAR

For this use-case, the SAP systems or instances need to be adaptively installed. This means:
   ▶ Virtual IP addresses are required to decouple the SAP instance from the host. Name resolution (forward and backward) for the virtual IP address and the associated virtual host name must be ensured on all involved hosts (source and target LPAR) and on the SAP LaMa system.
   ▶ The SAP instance requires an adaptive storage layout, so that all required storage entities (volumes, file systems) of the SAP instance can be accessed on both the source and target LPAR. Access to the volumes in the storage system need to be based on virtual Fibre Channel (NPIV) for both source and target LPAR.
2.2.4 Use case 4 - SAP System Clone, SAP System Copy, SAP System Refresh (including Refresh of DB server)

SAP LaMa provides functionality to copy entire SAP system or the DB instance. The target system either gets newly created (SAP System Clone, SAP System Copy), or an existing SAP system gets refreshed with the actual content from another system. The system runtime environment is either identical to the source system (SAP System Clone), or the runtime is changed to a new hostname, new SAP system ID (SID), or new SAP instance number. Figure 2-3 and Figure 2-4 on page 11 illustrate the difference between SAP System clone, copy and refresh.

![Figure 2-3 SAP System Clone, SAP System Copy and SAP System Refresh](image-url)
All storage volumes which are in scope of the clone/copy process need to reside in one storage system and need to be managed by PowerVC. For this use-case, the SAP systems or instances need to be adaptively installed (see 2.2.3, “Use case 3 – Relocation of adaptively installed SAP Systems” on page 8).

During execution of this use case, SAP LaMa calls actions in the Storage System by way of IBM PowerVC to:

- Retrieve information about storage volumes of the SAP system or instances
- Attach or detach storage volumes to and from the hosts in scope
- Create consistency groups and snapshots for the volumes in scope
- Verify the progress of the background copy
- Target host to import the cloned disk image(s) and mount the file systems

Additional preparation steps are required in SAP LaMa to enabled those scenarios:

- Configure PowerVC as storage adapter
- Define infrastructure elements in SAP LaMa configuration Network(s), User Management, Name Server, Assignment (see 2.2.5, “Use case 5 - Virtualization monitoring of IBM Power Systems servers and logical partitions (LPARs)” on page 12)
- Define SWPM repositories for System Copy and System Refresh in SAP LaMa as described in 2.2.5, “Use case 5 - Virtualization monitoring of IBM Power Systems servers and logical partitions (LPARs)” on page 12
- Configure discovered hosts and SAP instances as described in 2.2.7, “Use case 7 - Operating system (OS) provisioning and OS image handling” on page 12 and 2.2.8, “Use case 8: Provisioning of SAP Application Servers” on page 13 (for example, enter RFC Users, configure network fencing exceptions, and so on)
Activate System Clone, System Copy and System Refresh in SAP LaMa configuration for SAP system as allowed use case (refer to 2.2.8, “Use case 8: Provisioning of SAP Application Servers” on page 13)

2.2.5 Use case 5 - Virtualization monitoring of IBM Power Systems servers and logical partitions (LPARs)

During the execution of this use case, SAP LaMa communicates with the virtualization manager and IBM PowerVC Adapter to retrieve monitoring data of IBM Power Systems physical servers and logical partitions. SAP LaMa extends the landscape picture with information about underlying IT infrastructure. SAP LaMa users see:
- Which physical server a particular SAP system is running
- Which SAP systems are running on the same physical server
- How many CPU and Memory resources are available and how they are utilized (outside view from hypervisor)

2.2.6 Use case 6 - Virtualization management of IBM Power Systems servers and logical partitions (LPARs)

SAP LaMa triggers operations on IBM PowerVC to activate or deactivate a logical partition or to shutdown the operating system on it. SAP LaMa can also trigger an online relocation to another system using Live Partition Mobility. For all these tasks, SAP LaMa monitors the execution process of the triggered operation and finally refreshes monitoring data. For this use case, PowerVC is configured as the virtualization adapter in SAP LaMa. SAP LaMa users can perform the following:
- Activate an inactive LPAR
- Deactivate an active LPAR
- Shut down the operating system on an active LPAR
- Relocate an active LPAR to another IBM Power System

2.2.7 Use case 7 - Operating system (OS) provisioning and OS image handling

SAP LaMa triggers operations on IBM PowerVC (which is configured as virtualization adapter) to provision a new operating system from an image available in the IBM PowerVC repository. The IBM Power System where the new LPAR is created can be explicitly specified or is evaluated at runtime due to the placement policy in IBM PowerVC. Further characteristics are defined by way of a provisioning template chosen during the deployment process.

Additional preparation steps are required as follows:
- Prepare image templates in IBM PowerVC
  - Install golden image on an LPAR for capture (or capture an existing LPAR that meets the prerequisites)
  - Capture golden images in IBM PowerVC
  - Define compute templates in IBM PowerVC
- LPAR deployment
  - Request IP addresses and hostnames for the new LPARs
  - Create DNS entries for the hostnames of the new LPARs
– Deploy new LPAR (Provision virtual host in SAP LaMa)

Define content for golden Image for managed SAP Systems

In general, follow SAP Note 2369910 - SAP Software on Linux: General information and the references mentioned there. From an SAP LaMa perspective, a few additional items need to be considered for the Linux operating system:

During an SAP System Copy, SAP LaMa uses the TCP/IP filtering capabilities bundled with the operating system to isolate the target SAP system: To avoid impacting any other system or interface, outbound communication is blocked during a system copy, and is released only after the PostCopy Automation tasks are completed. On Linux, those TCP/IP filters are included in the «iptables» packages – iptables need to be part of the image built.

SAP LaMa uses the SAP Hostagent on the operating system to gather monitoring data and execute actions on the host. Some specific actions are not included in the base SAP Hostagent package but are part of the SAP Adaptive Extensions package. Both SAP Hostagent and SAP Adaptive Extensions need to be installed in the image. Download SAP Hostagent/ SAP Adaptive Extensions for the OS from the SAP Software Download Center (https://support.sap.com/en/my-support/software-downloads.html), and see the following SAP notes for installation details:

> Note 1031096 - Installing Package SAPHOSTAGENT
> Note 1759181 - Installation of SAPACEXT.SAR

**Note:** These packages either need to be installed within the golden image before it is captured in PowerVC - or a pre-installation script needs to be created.

2.2.8 Use case 8: Provisioning of SAP Application Servers

SAP LaMa has the functionality of installing SAP NetWeaver Application Servers to an existing system: In such a case, SAP LaMa will trigger the SAP Software Provisioning Manager on an LPAR to invoke the SAP application server installation.

As a prerequisite the installation media (SWPM, InstMaster, SAP Kernel, Database Client) need to be extracted to a directory that can be attached to the LPAR (for example, by way of NFS). Create a root directory for the repository, and copy the installation content to individual subdirectories. In the Infrastructure Repositories, add a configurations for the SWPM Configuration for Application Server Installation reflecting that content.

The profiles and global directories (/sapmnt/<SID>) of the SAP system need to be available on the LPAR where the application server will be installed.

2.2.9 Use case 9: Extensibility with user defined operations and workflows

SAP LaMa can be considered as a framework for landscape management. In addition to predefined functionalities, SAP LaMa provides a possibility to extend the management software with user defined operations, workflows and tailor it to specific needs. SAP LaMa provides the following extension points:

> Custom Tabs – Define your own tabs in the SAP LaMa GUI to launch additional tools
> Custom Services – Detect, manage and integrate additional applications
> Custom Operations – Define your own action buttons in the SAP LaMa GUI
> Custom Hooks – Extend the functionality of predefined activities (Pre-, Post, Error handling)
2.3 SAP LaMa environment setup

At first, the SAP systems in scope need to be enabled. To enable the environment for all the use cases, certain prerequisites need to be fulfilled for the managed environment. The managed environment consists out of the following components:

- SAP LaMa Management System
- IBM PowerVC Server

Figure 2-5 illustrates the steps required for the setup of the environment.

2.3.1 Enablement of SAP systems

This section describes the steps to enable SAP systems.

Preparations on the managed hosts

On each LPAR that will be integrated into and managed with SAP LaMa, preparation steps on the operating system level need to be executed:

- Installation of SAP Hostagent and SAP adaptive extensions
- Prepare firewall fencing for target hosts

Install SAP HostAgent and SAP Adaptive Extensions on all LPARs

Check or install the SAP Host Agent and the SAP Adaptive Extensions on all LPARs part of the environment:


**Check version of the SAP Host Agent**

As user root:

```bash
cd /usr/sap/hostctrl/exe
./saphostexec --version
```

The latest available version at the moment is **SAP HOST AGENT 7.21 SP40**.

In case an update is required:

1. Download the latest patch of SAPHOSTAGENT.SAR for the OS platform (IBM AIX, Linux on Power little endian, Linux on Power big endian) from SAP Support Software Download Portal at the following website:

   https://support.sap.com/swdc → Support Packages and Patches → By Categoriy → SAP Technology Components → SAP Host Agent 7.21

2. Choose the appropriate OS platform:

As user root, copy the downloaded SAPHOSTAGENT<SP-version>.SAR archive to a temporary directory, then execute the SAP Host Agent **upgrade** command:

```
/usr/sap/hostctrl/saphostexec -upgrade -archive <path to downloaded SAPHOSTAGENT<SP-version>.SAR>
```

**Check the version of the SAP Adaptive Extensions**

SAP Note 1808793: SAP Adaptive Extension Improvements and Fixes at the following website:

https://launchpad.support.sap.com/%23/notes/1808793

In addition to the SAP Hostagent, the IBM libraries and scripts for integrating the IBM components into the SAP LaMa are required. The libraries are delivered as part of the SAPACEXT package. The package contains the following parts:

- IBM AIX or Linux platform library (libsaposprep.o or libsapacosprep.so). The library includes OS specific functions for activating and deactivating of virtual IP addresses and for handling of IPSec and IPtables firewalls
- IBM storage library (libsapacosprep_ibm.o or libsapacosprep_ibm.so). The library includes OS specific functions for mounting and unmounting file systems

To install, upgrade, or downgrade SAP Adaptive Extensions, see also SAP Help Portal at the following website:


According to the platforms, download the appropriate packages: Linux on Power LE (SLES12) as shown in Figure 2-6.

![SAP Software download for Adaptive Extensions](image)

The libraries are extracted to the directory `/usr/hostctrl/exe`. Additional files are extracted to directory structure `/usr/hostctrl/exe/operations.d` and `/usr/hostctrl/exe/operations.d/IBM`. Create an additional directory for the trace and log files of the scripts in all the systems. The default location for the trace and log files is
/usr/sap/hostctrl/exe/operations.d/IBM/traces. Ensure that the files under operations.d belong to the root user and are only writeable by the root user.

**Check and create trace directory**
Create a directory for the trace and log files of the scripts in all the systems. The default location for the trace and log files is /usr/sap/hostctrl/exe/operations.d/IBM/traces.

**Check iptables packages on the target LPARs**
SAP LaMa uses the TCP/IP filtering capabilities bundled with the operating system to isolate the target SAP system after the system copy (unless the PostCopy Automation is completed). On Linux, the TCP/IP filters are included in the « iptables» packages. Those package needs to be installed in the OS for the target LPARs.

**SAP system preparation**
The SAP NetWeaver Systems need to be adaptively installed. An adaptively installed SAP NetWeaver system has following attributes:

- Installed with a suitable file system layout, that
- Decouples the SAP instance from the server
- Allows to independently relocate the different instances (database, central services, primary application server) to different target LPARs
- Installed using virtual IP addresses
- SAP related OS users and groups have UIDs and GIDs that are identical and unique across the entire landscape

**Suitable file system layout**
Figure 2-7 on page 17 illustrates an example file system layout for a central SAP S/4HANA system.

The root file system / and the file system /usr/sap belong to the host, and are not part of any relocation or SAP System Clone/copy scenario. The SAP Hostagent and SAP Adaptive extensions are installed in directories under the /usr/sap file system tree. /usr/sap is either a file system / directory within the system disk, or eventually is deployed to an additional volume. However, the file system /usr/sap always belong to the host.

The SAP NetWeaver AS ABAP has the components SAP Central Services, and SAP primary application server. Those components are installed in the directory trees under /usr/sap/<SAPSID>, and require the SAPMOUNT share /sapmnt/<SAPSID>.

The SAP HANA database is installed in /hana/shared, and having the data volumes in /hana/data, log volumes in /hana/log, and a backup directory /hana/backup. For recovery reasons, it is good practice to separate the different areas on different disk volumes.
For an SAP System Copy and SAP System Refresh scenario, it is important that
/usr/sap/<HANASID> is a directory, and not a file system.

![File system layout for SAP HANA, suitable for SAP System Copy](image)

**Virtual IP addresses**

Ensure that SAP instances are installed using their own virtual hostnames. The SAP instance(s) need to be decoupled from the hostname of the operating system they are running on. All virtual IP addresses need to be resolvable by way of DNS for SAP LaMa and all participating hosts. There must be a unique relationship between (virtual) hostname and its IP address: Do not use a DNS alias, but assign an unique virtual hostname with an own IP address.

**Note**: All hostnames and virtual hostnames must be resolvable uniquely for both SAP LaMa and the LPARs by way of a DNS A record and not by way of a DNS CNAME.

**Central user management**

Ensure that required SAP OS users are (or will become) available and that the OS user IDs and OS group IDs are unique and consistent across the landscape. Possible options can be LDAP or NIS or other customer specific solutions.

**Install SAP LaMa Enterprise Edition License in the source system**

See also SAP Note 1912110 - Install SAP Landscape Management Enterprise Edition License at the following website:

[https://launchpad.support.sap.com/%23/notes/1912110](https://launchpad.support.sap.com/%23/notes/1912110)

Post Copy Automation (PCA) task lists are used to manage all the steps which need to be executed before an SAP system refresh or after an SAP system copy/refresh procedure.

PCA is part of SAP Landscape Management enterprise edition software. The PCA content is shipped within SAP NetWeaver (AS ABAP) software packages and is deactivated per default.
Refer to the ABAP Post-Copy Automation Installation Guide on SAP Help Portal at the following website:


Or use task list SAP_INSTALL_PCAI_ENT to install the add-on PCAI_ENT 1.0. This enables the execution of ABAP PCA task lists.

2.3.2 Install SAP Landscape Management Software

Detailed description of the SAP LaMa installation is out of scope of this publication. Refer to the appropriate documentation from SAP. At first, an SAP System based on SAP NetWeaver AS Java need to be installed. Download the appropriate installation guide and software packages for the target operating system and database platform combination to install the SAP NetWeaver Java System. See also SAP Note 2350235 - SAP Landscape Management 3.0 - Enterprise edition at the following website:

https://launchpad.support.sap.com/%23/notes/2350235

After the SAP NetWeaver AS Java is installed, the SAP LaMa software needs to be deployed: SAP LaMa software is delivered as a set of SCA files containing the Java archives as shown in Table 2-2. Deploy those SCA files by using the SAP Software Update Manager as described in the SAP LaMa Installation Guide.

<table>
<thead>
<tr>
<th>SCA file</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCM</td>
<td>SCA file contains all functional coding and is the main component of SAP LaMa</td>
</tr>
<tr>
<td>VCMCR4E</td>
<td>SCA file contains open source and third-party libraries required to use the search functionality or to generate and display reports in SAP LaMa</td>
</tr>
<tr>
<td>VCMENT</td>
<td>SCA file activates the enterprise functionality within SAP LaMa</td>
</tr>
</tbody>
</table>

After the software is deployed, perform the initial setup using the configuration wizard as described in the post-installation section of the SAP LaMa installation documentation. SAP documentation can be read at the following websites:

  https://help.sap.com/viewer/lama_instguide
- Initial Setup Using the Configuration Wizard
  https://help.sap.com/viewer/lama_help/4e4947eb07c15425e10000000a42189b.html
- Landscape Configuration
  https://help.sap.com/viewer/lama_help/4e57e8322ace4dabe10000000a42189b.html
- Best Practices for System Provisioning
- Landscape Preparation
  https://help.sap.com/viewer/lama_help/ad4e4e34ef54a5d885daf73885c520f.html
2.3.3 Install and configure IBM PowerVC environment

Installation and configuration of IBM PowerVC is out of scope of this publication. The assumption here is that the IBM PowerVC is installed and configured, and all server and storage infrastructure components (HMC, Storage, SAN, and so on) are attached to it. For details how to setup an IBM PowerVC environment, refer to the IBM PowerVC product documentation at the following website:

https://developer.ibm.com/powervc/

You can also referred to the IBM PowerVC Version 1.3.2 Introduction and Configuration, SG24-8199 at the following website:


Create admin user for SAP LaMa on IBM PowerVC

A PowerVC user with Administrator privileges is required as SAP LaMa uses this access to execute monitoring and management tasks in PowerVC.

Create a Project for SAP LaMa in IBM PowerVC

A project, sometimes referred to as a tenant, is a unit of ownership. Most resources in IBM PowerVC, such as virtual machines, volumes, and images, belong to a specific project. Only users with a role assignment for a given project can work with the resources belonging to that project. The ibm-default project is created during installation, but IBM PowerVC supports the creation of additional projects for resource segregation. We recommend to use an own IBM PowerVC project, and add only those resources to that project which are visible in SAP LaMa.

Prepare LPARs and storage volumes in IBM PowerVC after on-boarding

If LPARs and their storage volumes had been created using other tools outside of IBM PowerVC, they need to be imported first. The import is a default procedure which is described in IBM PowerVC documentation. The following post configuration steps are required in addition:

- LPAR: Ensure that LPAR has at least one network adapter and an IP address. The IP address is used for association between operating system data (retrieved by way of SAP Hostagent) and LPAR data gathered by way of IBM PowerVC. Add the IP address to the LPAR configuration in IBM PowerVC UI.
- Storage volume: Ensure that storage volume is assigned to a storage template. This initial assignment is done by way of IBM PowerVC CLI as described in the following website:

https://ibm.co/2IBeELf

2.3.4 Preparing SAP NetWeaver AS Java for communication with IBM PowerVC

This section describes the steps for SAP NetWeaver to communicate with IBM PowerVC.

Check and update of SSL library within NW Java server

IBM PowerVC requires the usage of secure communication protocols TLS v1.1 or TLS v1.2 for any external communication. Older protocol versions have security exposures, hence are no longer supported and have been disabled. Check that the SAP NetWeaver Application Server Java engine where the SAP LaMa code is running supports those required TLS versions.
For details, see SAP Note 2284059: Update of SSL library within NW Java server and SAP Note 2569156 - How to get and validate SSLContext.properties file at the following website:

https://launchpad.support.sap.com/%23/notes/2284059

Change the SSLEngine in the SAP NetWeaver engine. Add the cipher suites to property file SSLConfig.properties as described in SAP Note 2284059. Add the following lines:

cipherSuite=TLS_DHE_RSA_WITH_AES_128_GCM_SHA256
cipherSuite=TLS_DHE_RSA_WITH_AES_128_CBC_SHA256

**Import the IBM PowerVC certificate into a truststore of SAP NetWeaver AS Java**

A communication setup using server certificates provides the most secure level for communication between SAP LaMa and IBM PowerVC. In this case, the IBM PowerVC certificate is used, and the hostname contained in the certificate is verified against the hostname of the public key (which is stored in the SAP NetWeaver AS Java keystore), and which is defined within the SAP LaMa virtualization manager definition.

The *IBM PowerVC server certificate* needs to be imported first into the keystore of the underlying SAP NetWeaver AS Java engine. Follow the SAP Netweaver documentation *Using the AS Java Key Storage* for more information about how-to importing the public key of the self-signed IBM PowerVC into the keystore (https://bit.ly/33nxXzP). Check that the hostname in the certificate is valid and matches the hostname of the IBM PowerVC server. The hostname referenced in the SAP LaMa virtualization adapter configuration also needs to correspond to the hostname in the certificate. Remember the name of the certificate store view of the SAP NetWeaver AS Java as this name is required during the IBM PowerVC adapter definition in SAP LaMa.

By default, IBM PowerVC uses a self-signed X.509 certificate to secure its web interface and REST APIs. Self-signed certificates are not signed by an independent certificate authority (CA). If there are enhanced security requirements, then the default self-signed certificate can be replaced with a new CA-signed certificate – procedures for that are described in the IBM PowerVC documentation in the chapter Providing new certificates for IBM PowerVC access at the following website:


You can refer to the Securing PowerVC web interface with self-signed or CA signed certificates as the following website:

https://ibm.co/2B07ifX

Export the certificate file /etc/pki/tls/certs/powervc.crt from the IBM PowerVC server, and import it into the keystore of the SAP NetWeaver AS Java by way of the Netweaver Administrator (nwa) tool. See Figure 2-8 on page 21 and Figure 2-9 on page 21 for details.
To import the public key:
Login to nwa → Navigate to Configuration → Certificates and Keys.

![NetWeaver Administrator: Certificates and Views](image)

Select the appropriate Keystore, for example TrustedCAs as shown in Figure 2-9.

![TrustedCA view](image)

- This keystore view name will later be entered in the Virtualization Manager/Storage Manager definition.

Import the PublicKey previously exported from the IBM PowerVC Server into the KeyStore (Figure 2-10).

![SAP NWA: Details of TrustedCA view](image)
2.3.5 Configuration steps in SAP LaMa

First, a set of configuration steps need to be run in SAP LaMa before the use cases can be executed as follows:

- All network configurations need to be described in SAP LaMa configuration
- Handling of OS user management settings are required
- The assignment for which operating system has to be chosen
- A SWPM repository for System Rename execution needs to be defined
- PowerVC needs to be defined as storage manager/virtualization manager

In the following section, these steps are described in more detail.

Networks

The properties for all networks, which are used by virtual or physical hostnames by managed SAP systems need to be defined in the SAP LaMa configuration (Figure 2-11). Network base properties include a network name, the network subnet mask, and the broadcast address for the network.

Advanced configuration settings include the IP address of the Gateway server, the DNS zone name, and eventually an IP range in case SAP LaMa assigns IP addresses and update DNS entries for virtual hostnames during an SAP System Clone/Copy action. In that case, select the Auto Assign IP Address option in the System Copy roadmap (Figure 2-29 on page 36). During System Copy execution, SAP LaMa selects an available IP address out of the predefined IP range.

The range is defined by way of the Update IP range field of the network configuration:

- IP addresses are expected in dotted quad notation
- The lower and upper parts of a range must be present in each range and are separated by ":" or ":."
- Multiple IP ranges can be separated by ":;"

See also SAP Note 1572841 - Setup of name server update of SAP LVM, which describes the DNS name server integration with SAP LaMa at the following website:

https://launchpad.support.sap.com/#/notes/1572841
User management
This step specifies how OS users and group handling for the SAP systems is managed. OS users, that are required, but do not exist on the target system are automatically created by SAP LaMa on the target system during a system copy/clone operation. SAP LaMa provides functionalities for management of users and groups by way of LDAP or NIS. These settings need to be configured.

Communication with LDAP or NIS software is realized by way of the SAP Hostagent. Configuration of LDAP and NIS in LaMa is not part of this publication, as it is described in the SAP LaMa Landscape Configuration documentation in the following website:
https://help.sap.com/viewer/lama_help/4e57e8322ace4dabe10000000a42189b.html

Name server
SAP LaMa provides functionalities for automatic management of DNS entries by way of a DNS update. You can setup the DNS management connection here. The communication is realized by way of the SAP Hostagent. This configuration is not the part of this publication, and is described in SAP LaMa Landscape Configuration documentation at the following website:
https://help.sap.com/viewer/lama_help/4e57e8322ace4dabe10000000a42189b.html

Another option is to ensure that DNS entries for used IP addresses and hostnames already exist.

Assignment
After network, user management and name server handling are configured, associate these configurations. SAP LaMa will then take the appropriate actions according to the different network.

Define SWPM repositories (AIX, LINUX_PPC64_LE) in SAP LaMa
In use cases based on SAP copy and SAP refresh, SAP Software Provisioning Manager (SWPM) is required. SWPM is used to rename copied SAP system sources.

Ensure that the required SWPM software version is either locally available on the target system, or can be mounted by way of NFS from a central repository.
In this step the required SWPM versions, according to the OS flavours and NetWeaver releases are specified (Figure 2-12).

**Figure 2-12  SAP LaMa Repository definition**

**Define IBM PowerVC as a virtualization adapter in SAP LaMa**
Log into the SAP LaMa system, and navigate to Infrastructure → Virtualization managers (Figure 2-13).

**Figure 2-13  SAP LaMa Navigate to Virtualization manager**

Select Add to add a new virtualization manager.
Choose *IBM PowerVC Adapter* (Figure 2-14) and click Next.

![Figure 2-14  Select IBM PowerVC Adapter](image)

*Figure 2-14  Select IBM PowerVC Adapter*
In the next panel, enter the configuration details (Figure 2-15).

**Figure 2-15  PowerVC Virtualization Manager Properties**

Click Test Configuration, and click Save.
IBM PowerVC Storage Manager Definition
The configuration of the IBM storage manager adapter (IBM PowerVC Storage Adapter) is done similarly to the Virtualization Manager Definition described in “Define IBM PowerVC as a virtualization adapter in SAP LaMa” on page 24 (Figure 2-16).

![IBM PowerVC Storage Manager Definition](image)

**Figure 2-16  IBM PowerVC Storage Manager Definition**

### 2.3.6 Discovery of managed systems and hosts in SAP LaMa

All SAP systems, their instances and all the corresponding hosts need to be discovered in SAP LaMa. One possibility is running a discovery using communication of SAP LaMa with SAP Hostagents running on these hosts. For the communication 'sapadm' user credentials are used. The discovered entities (SAP systems, SAP instances and OS hosts) can be logically grouped.
In order to start the discovery, navigate to Configuration → Systems and choose *Retrieve new Instances and Hosts*. In the dialog (see Figure 2-17) specify the detection method (for example, using SAP Hostagent) and the entity types to discover (for example, both, instances and hosts). Depending on the landscape, eventually trigger detection of *special* entities (for example, shadow or stand-alone DBs or SAP diagnostic agents).

![Figure 2-17   SAP LaMa Discovery](image)
Specify the list of OS hosts which will be scanned (by host name or IP address), SAP Hostagent port used in the landscape and credentials for communication with SAP Hostagent, SAP instance agents and with SAP DB. After clicking Next, the discovery process runs (Figure 2-18).

---

**Figure 2-18   Discovery - Details**

---

Specifying the list of OS hosts, SAP Hostagent port, and credentials for communication with SAP Hostagent, SAP instance agents, and SAP DB. After clicking Next, the discovery process runs.
As result, a list of discovered SAP instances and hosts are shown. Assign the instances to SAP systems (for example, by clicking Auto Assign) and group the found hosts to SAP LaMa pools (refer to Figure 2-19 and to Figure 2-20). After click save and the entities become managed by SAP LaMa.
2.3.7 Configuration of SAP hosts in SAP LaMa for copy use cases

For SAP clone, copy and refresh use cases, additional configuration of host entities is required (see 2.3.1, “Enablement of SAP systems” on page 14). Edit the configuration of SAP hosts and ensure the following settings (Figure 2-21):

- SAP hosts are AC enabled
- A SAP host acting as a target for SAP System Clone/Copy is Isolation ready
- Retrieve network interfaces used by SAP systems running on these hosts and assign them to the networks configured in SAP LaMa
- Retrieve Host-Specific Storage Properties
- Save the configuration

![Figure 2-21 Host properties](image)

2.3.8 Configuration of SAP systems in SAP LaMa for copy use cases

For SAP clone, copy and refresh use cases, additional configuration of SAP instances and SAP system are required (see 2.3.1, “Enablement of SAP systems” on page 14). Edit the configuration of each SAP instance and check the following settings (Figure 2-22 on page 32, Figure 2-23 on page 33, Figure 2-24 on page 33):

- SAP DB communication credentials are complete and valid (relevant for SAP DB instance only)
- Each SAP instance is AC-Enabled
- The Required Host Type is correct
- Deactivate OS Managed Mounts (Automounter) and click Retrieve Mount List. Check the list contains only SAP instance related mount points. Remove all the other retrieved mount points.

Figure 2-22  SAP Instance settings – Basic Configuration
Edit the configuration of the SAP system and check the following:

- The SAP system can be used for cloning, copying, renaming or other use cases depending on a relevant scenario
- For copying, renaming and refreshing scenarios SAP Post Copy Automation is triggered. So complete the RFC configuration for these cases (Figure 2-25 on page 34).
2.4 Execution of SAP system copy in SAP LaMa

This section describes how to copy an SAP system in SAP LaMa. Another use cases (SAP clone, SAP refresh) are executed in similar way. The only difference is the requested configuration input in process dialogs.

To initiate an SAP system copy process navigate to Provisioning → Choose SAP source system → click Copy System (Figure 2-26).
1. Specify data for SAP target (SAP target SID, SAP target DB SID, SAP LaMa pool for target system). Provide also credentials for communication with the system (Figure 2-27).

Figure 2-27  SAP System Copy roadmap – Basic Data
2. Choose the host for SAP target (Figure 2-28). This SAP host must be managed by SAP LaMa and configured as AC Enabled and Isolation ready. See also 2.3.1, “Enablement of SAP systems” on page 14 for other requirements.

![Figure 2-28 SAP System Copy roadmap – select target hosts](image)

3. Specify virtual hostnames for SAP target instances (Figure 2-29). Virtual hostnames can be shared between the instances of the same system (in case they are located on the same host).

![Figure 2-29 SAP System Copy roadmap – Define virtual hostnames](image)
4. Define the instance numbers for the instances (Figure 2-30).

![Figure 2-30 SAP System Copy roadmap – Define SAP Instance numbers](image-url)
5. Check the storage configuration (Figure 2-31). You can change proposed names for OS volume groups and OS logical volumes.

![Figure 2-31 SAP System Copy roadmap – Storage definitions](image)
6. Specify the database consistency for the SAP source system (online or stop the SAP source system first). In case it is possible to define an execution time when the snapshot is triggered (Figure 2-32).

![Figure 2-32 SAP System Copy roadmap – Consistency](image-url)
7. Define the OS users required for the SAP target system. Here, the users are created by LDAP. Adapt the configuration of users and groups (Figure 2-33).

Figure 2-33   SAP System Copy roadmap – OS users and groups
8. Display the SAP software provisioning manager (SWPM) settings. SWPM is started during the copy process and renames the SAP system to a new SID (Figure 2-34).

![Figure 2-34 SAP System Copy roadmap – System Rename settings](image)

During the copy process, the target SAP system must be isolated to ensure SAP landscape consistency. For the isolation, SAP LaMa uses iptables on the SAP target host.

9. Define allowed outgoing connections, which will not be blocked, but remain open during the isolation process (for example, RMC port used for communication with HMC). See Figure 2-35.

![Figure 2-35 SAP System Copy roadmap – Fencing](image)
To ensure SAP landscape consistency, the copied SAP system must become *clean*. This includes certain tasks on the OS level that are done by SAP SWPM (configured in step 8) and tasks in the SAP system itself executed by the SAP Post Copy Automation.

10. Specify a PCA task lists for the various SAP clients (Figure 2-36).

![Figure 2-36 SAP System Copy roadmap – PCA settings](image)

11. Start the SAP system copy directly, or create a blueprint and start the configured process later, or get an URL to trigger the process remotely (Figure 2-37).

![Figure 2-37 SAP System Copy roadmap – Summary](image)

After starting the SAP system, copy navigate to Monitoring → Activities to monitor the progress. Check process status of each single step of this activity, click the step name to provide detailed logging information (refer to Figure 2-38 on page 43 and Figure 2-39 on page 44).
### Figure 2-38  Monitoring view - steps

<table>
<thead>
<tr>
<th>ID</th>
<th>Successor IDs</th>
<th>Predecessor IDs</th>
<th>Hook for ID</th>
<th>Status</th>
<th>Step Time</th>
<th>Duration</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>Completed</td>
<td>0:00</td>
<td>0:06</td>
<td>Create Target System</td>
</tr>
<tr>
<td>2</td>
<td>3.5.7.8</td>
<td>1</td>
<td></td>
<td>Completed</td>
<td>0:00</td>
<td>0:35</td>
<td>Prepare Clone Volumes</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>2</td>
<td></td>
<td>Completed</td>
<td>0:36</td>
<td>0:46</td>
<td>Stop</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>3</td>
<td></td>
<td>Completed</td>
<td>1:22</td>
<td>1:26</td>
<td>Stop</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>2.4</td>
<td></td>
<td>Completed</td>
<td>2:48</td>
<td>0:25</td>
<td>Prepare DR copy</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>5</td>
<td></td>
<td>Completed</td>
<td>3:14</td>
<td>0:34</td>
<td>Finalize Source DR</td>
</tr>
<tr>
<td>7</td>
<td>13, 16, 19, 21, 28, 30, 31, 32, 33, 34, 35, 8, 9</td>
<td>2.6</td>
<td></td>
<td>Completed</td>
<td>3:48</td>
<td>0:26</td>
<td>Clone Volumes</td>
</tr>
<tr>
<td>8</td>
<td>10, 11, 13, 15, 19, 21, 28, 30, 31, 32, 33, 34, 35</td>
<td>2.7</td>
<td></td>
<td>Completed</td>
<td>4:17</td>
<td>0:55</td>
<td>Post Clone Volumes</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>7</td>
<td></td>
<td>Completed</td>
<td>4:17</td>
<td>1:22</td>
<td>Start</td>
</tr>
<tr>
<td>10</td>
<td>13</td>
<td>8</td>
<td></td>
<td>Completed</td>
<td>5:14</td>
<td>0:40</td>
<td>Update Mount Configuration</td>
</tr>
</tbody>
</table>

**Completed**
2.5 Outlook

SAP and IBM continuously develop additional features such as container support, HANA and operational enhancements to reduce planned downtime. This section gives a first idea on additional use cases of LaMa on IBM Power Systems server with or without IBM System Storage.

2.5.1 SAP containerized applications

SAP is committed to the strategic trend of containerization. Containers are becoming a fundamental building block for modern application development. For example, SAP HANA express edition, a streamlined version of the SAP HANA platform, is available as a docker container image for the Linux and Intel platform and allows to build and deploy modern applications that use up to 32 GB memory. This enables developers to jump-start application development on their personal computers or in the cloud.

However, typically SAP NetWeaver Systems and SAP HANA databases get installed in bare-metal servers or virtual machines. These virtual machines will remain in the data centers for many years, and need to be managed and maintained by IT administrators.

This is one of IBM Cloud key differentiators as the IBM Cloud leverages Kubernetes to orchestrate container deployments, but IBM Cloud can also provision VMs for multicloud...
environments by way of IBM Cloud Automation Manager (CAM). CAM is a part of the IBM Cloud and can manage various cloud endpoints, including IBM PowerVC.

### 2.5.2 SAP HANA management

SAP and IBM introduced the support of HANA scale-up copy/clone refresh and further basic management in 2018. Since then the integration of SAP HANA has progressed and downtime minimizing features have been general available in April 2019.
Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this paper.

IBM Redbooks

The following IBM Redbooks publications provide additional information about the topic in this document. Note that some publications referenced in this list might be available in softcopy only.

- *IBM PowerVC Version 1.3.2 Introduction and Configuration, SG24-8199*

You can search for, view, download or order these documents and other Redbooks, Redpapers, Web Docs, draft and additional materials, at the following website:

[ibm.com/redbooks](https://ibm.com/redbooks)

Online resources

These websites are also relevant as further information sources:

- SAP Landscape Management 3.0, Enterprise Edition
- SAP Support Software download portal
  [https://support.sap.com/swdc](https://support.sap.com/swdc)
- IBM PowerVC documentation

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