Adding SAP IT Operations Analytics (ITOA) to a Lenovo SAP HANA Solution

SAPPHIRE 2017 Demonstration

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Introduction

Lenovo is pleased to present this whitepaper in collaboration with our strategic partners SAP and SUSE Linux describing the steps associated with adding SAP IT Operations Analytics (ITOA) to the Lenovo SAP HANA Solution. SAP ITOA leverages SAP HANA to provide a holistic, real-time view of all events, conditions, and issues in your datacenter landscape.

SAP ITOA provides functional capabilities to:

- Resolve and respond to IT incidents in real time
- Reduce the effort needed to analyze multiple data sets
- Predict failures before they happen

Lenovo additionally provides a license for Lenovo XClarity® Administrator with each server purchase and a copy of SAP IT Operations Analytics on each Lenovo SAP HANA Solution with limited license rights.

Overview

The SAP ITOA application is distinguished by its ability to correlate events in real-time from multiple data sources to give you a comprehensive view of your environment. The principal components of ITOA are shown on the following diagram:

- A data source
Lenovo is perfectly positioned with its XClarity System Management application to provide a comprehensive ITOA implementation. XClarity has the capability to forward syslog information from managed endpoints to the ITOA adapter. It is especially interesting when the managed endpoint is also a SAP HANA server – SAP ITOA can correlate SAP Host Agent event information with the hardware and OS data in real time.

In our demonstration, there are multiple sources for the input data – Lenovo XClarity instances and SAP HANA Host Agents. The SAP ITOA Adapter runs on an independent server and uses a SAP HANA database as a persistent data store. The web browser is the display shown at our booth at the SAPPHIRE 2017 show.

In our demonstration, SAP HANA is implemented on a clustered pair of SAP HANA servers running SAP System Replication and SUSE Linux HA Extension for very robust reliability and availability. We additionally have an implementation of SUSE Enterprise Storage as the SAP HANA Data backup location.

The following diagram shows the major SAP ITOA components and their relationships for the Lenovo SAP ITOA demonstration:

Pre-requisite SAP HANA Installation Requirement

Lenovo offers customers complete SAP HANA Solutions for various sizings. The ITOA demonstration is based on a pair of x3850X6 (Machine type 6241) servers with:
Four (4) E7-8880v2 2.50GHz processors, (15) cores each,
- 512GB DDR3 RAM,
- ServeRAID M5210 RAID Controller,
- 6 x 1.2TB SAS HDD, 2 x 400GB SATA SSD, XFS Filesystem with Bcache Acceleration,
- 4 x 10Gb port Ethernet (Mellanox), 4 x 1Gb port Ethernet (Intel),
- SUSE Linux Enterprise Server 12 SP1 for SAP,
- SAP HANA 2.00.000.00

The following diagram shows the hardware used for the demonstration:

The HANA servers were identically installed and configured by Lenovo Professional Services consultants using the latest code levels and procedures using the following steps:

1. Prepare server by setting tuning parameters in UEFI to HANA specifications.
2. Install SUSE Linux Enterprise for SAP Applications SP1 using AutoYast and the Lenovo Solution package.
3. Configure passwords, network, and verify OS settings.
4. Use Lenovo solution scripting to: generate ssh keys, create raid devices, configure the storage for an XFS filesystem with bcache acceleration, and install Lenovo-specific tools and services for SAP HANA.

5. Install and configure SAP HANA instances.

Consider SUSE Linux High Availability Implementation

For many customers, a HANA instance can be the life blood of their organization. So, a highly available implementation is very desirable. For this demonstration, Lenovo has implemented SAP System Replication and SLES High Availability to illustrate our approach to minimizing RPO and RTO.

**RPO – Recovery Point Objective** – maximum targeted period in which data might be lost from an IT service due to a major incident. (Wikipedia)

**RTO – Recovery Time Objective** - targeted duration of time and a service level within which a business process must be restored after a disaster (or disruption) in order to avoid unacceptable consequences associated with a break in business continuity. (Wikipedia)

SAP System Replication ensures that the HANA database is available and synchronized with a secondary server at all times. System Replication serves to minimize (or even reduce to zero) RPO. It further provides methods for failing over (takeover) between the primary server and secondary server. There are additionally three (3) supported methods of replication:

- Sync – Synchronous replication. Primary system waits until secondary system has received data and persisted it to disk.
  - Full Sync - Additionally the synchronous replication mode (SYNC) can be run with “full sync” enabled. In full sync operation, transaction processing on the primary site blocks, when the secondary is currently not connected and newly created log buffers cannot be shipped to the secondary site.

- Syncmem – Synchronous in-memory replication. Primary system waits until secondary system has received data.

- Async – Asynchronous replication. Primary system doesn't have to wait for secondary system.

The following steps are required to enable SAP System Replication:

- Perform an initial backup. An initial backup is mandatory but an up-to-date backup is highly recommended.
- Enable the primary system for system replication.
- Establish a connection between secondary and primary system.
Initiate a full replication by starting system replication on secondary – thereafter incremental data replication and continuous log replication occurs (automatic process).

Monitor status of system replication to ensure that both systems are in sync.

Once SAP System Replication is enabled and validated, Linux clustering via **SLES HA Extension** will serve to minimize RTO by automating the SAP failover/takeover process. SUSE describes two (2) models for the implementation in the reference documents listed below – (a) the Performance Optimized model, and (b) the Cost Optimized model. The cost optimized model allows for actively running other instances of SAP HANA on the secondary server while the primary instance is replicating to the secondary server in the background. This allows for the secondary system to be used productively, but also comes with the penalty that the additional secondary instances must be turned off and the primary instance must be loaded into memory at failover, thus extending the RTO. The performance optimized model (used for our demonstration) has the primary instance loaded in memory on the secondary server as it is synchronously replicating with the primary instance.

The steps to enable the SLES HA Extension are summarized as follows:

- Ensure the primary and secondary servers have identical and fully updated firmware, driver, and OS code levels.
- Ensure that SAP System Replication is operational between the servers.
- Ensure networking is fully operational between the servers and a “virtual ip address” is available for the cluster.
- Create “slehasync” database user with “DATA ADMIN” privileges and a password that does not expire. This will be used later by cluster resource manager.
- If a high-speed network is available for system replication, make sure it is configured. Best practice is to have two (2) network communication rings between the servers.
- Install latest version of SLES Pattern “ha_sles” on both servers.
- Install SUSE SAP HANA System Replication agent packages (SAPHanaSR and SAPHanaSR-doc) on both servers.
- Ensure both servers have the same /etc/hosts, group, passwd, shadow files.
- Install and then restart the latest SAP Host agent on both nodes.
- Initialize the cluster on the primary server using the command “ha-cluster-init”.
- If you are using two (2) network communication rings, make sure the second ring is configured under Yast -> Cluster -> Communication Channels.
- Ensure that the /etc/corosync/corosync.conf is copied to the secondary server.
- Add the second node to the cluster using “ha-cluster-join”.
- Stop and then restart the pacemaker service (cluster service) on both nodes.
- Verify cluster status using either cluster resource manager (crm_mon -1 -r) or HAWK (https://<server_ip_address>:7630 login: hacluster/linux). There should be 2 nodes and 0 resources configured.
- Configure a STONITH device. Best practice is sbd, but external shared storage is required. Alternative is IPMI via the server IMM. The server IMM IP Address must be accessible from an OS network connection. Preference is for direct layer 2 connection, rather than a layer 3 route.
- Configure base “bootstrap” settings for crm.
- Configure SAP HANA Topology settings for crm.
- Configure SAP HANA settings for crm.
- Configure the Virtual IP setting for crm.
- Configure constraints for the correct placement of the virtual IP address and the start order between the SAPHana and SAPHanaTopology resources for crm.
- Check the cluster status again using “crm_mon -1 -r”. There should now be 2 nodes configured and (6) or (7) resources configured depending on type of STONITH method chosen.
- Test cluster failover scenarios as needed. (The SLES HA guides referenced below contain excellent guides for this.)

Configuring and testing Linux HA is a challenging task even for seasoned professionals. Please do not hesitate to contact Lenovo Professional Services to help with this task.

References:

“How to Perform System Replication for SAP HANA“ -
https://www.sap.com/documents/2013/10/26c02b58-5a7c-0010-82c7-eda71af511fa.html

“SAP HANA SR Performance Optimized Scenario” – (for SLES 12 SP1 HA Extension)

“SAP HANA SR Cost Optimized Scenario” – (for SLES 12 SP1 HA Extension)
https://www.suse.com/docrep/documents/crfn7g3wji/sap_hana_sr_cost_optimized_scenario_12_sp1.pdf

Consider SAP HANA Backup Storage Location

It is always best practice to configure a backup location and schedule for your HANA database that is physically independent from the primary storage for your HANA database. Configuring
the backup location and schedule is a relatively simple task using either the SAP HANA Studio or hdbsql command line interface from the server operating system.

SUSE and Lenovo jointly developed a reference architecture for SUSE Enterprise Storage (SES) that meets SAP Key Performance Indicators (KPIs) for SAP HANA systems. The architecture shown in the diagram below is for a SAP HANA filesystem implementation:

![Architecture Diagram]

Figure 1: Architecture Overview

We have configured a proof of concept SUSE Enterprise Storage (SES) implementation to be used for database backup for the SAP ITOA demonstration system. The reference architecture shown above would call for physical servers and storage expansions for SES according to the following diagram:
Since we do not have the full hardware required for the reference architecture, we implemented this function on our ITOA Adapter server (hana-x6-node03) using KVM Virtual Machines and local storage according to the following diagram:
SUSE Enterprise Storage (SES) is based on the open-source CEPH storage architecture. It is both high-performance and high-availability with user-selectable redundancy factor. It may be presented to servers as block, file, or object storage. For the demonstration, we mount the SES storage as file storage presented to both of the HANA database servers.

Since the implementation does not follow the recommended reference architecture, we will not summarize the implementation steps here. We will, however, refer you to the best practices guide described below for full details of a reference architecture implementation.
Reference:

“Best Practice Guide for Lenovo Storage Solution - Based on SUSE Enterprise Storage (SES)” -

Request login credentials at sapsolutions@lenovo.com and provide the requested information.

“Administration and Deployment Guide – SUSE Enterprise Storage 4” –
https://www.suse.com/documentation/ses-4/

Pre-requisite Lenovo XClarity Administrator Installation

Lenovo XClarity Administrator (XClarity) is a centralized resource management solution for Lenovo server solutions and systems. XClarity is an agent-free solution, which reduces complexity and resource requirements on managed endpoints. XClarity further offers a mobile app for Android and iOS devices. The app enables you to securely monitor physical systems, get real-time status alerts and notifications, and take action on common system level tasks.

Lenovo XClarity Administrator dashboard (see below) provides easily accessible functions:

- Discovery
- Inventory
- Monitoring
- Firmware Updates
- Firmware Compliance
- Configuration Management
- Deployment of operating systems and hypervisors to bare metal servers
For our demonstration, the local XClarity instance is installed as a KVM Virtual Machine on HANAX6NODE03. Please see http://flexsystem.lenovofiles.com/help/index.jsp?topic=%2Fcom.lenovo.lxca.doc%2Fsetup_esxi
for instructions to perform the VM installation. (VMWare installation described, KVM installation similar) Our local XClarity instance manages the three (3) ITOA demonstration servers:

The local XClarity instance, as well as, a remote XClarity instance forward events to the ITOA Adapter server. For this purpose, completing the menu item Monitoring -> Event Forwarding is required.

The following dialogs indicate the proper settings for forwarding events to the ITOA Adapter server:
Click ‘Create’ to save the New Recipient settings. You should see events begin to populate ITOA after restarting the XClarity server:
SAP ITOA Adapter Installation

The following is taken from Chapter 2 – Installation and Getting Started from “SAP IT Operations Analytics 2.0 Support Pack 03: Administrator's and User's Guide” referenced at the end of this section.

Installation Summary Context

The recommended installation method is to install all components (the core, the plugins, and the adapter) from the adapter host. The individual steps of this method are presented in the “SAP IT Operations Analytics 2.0 Support Pack 03: Administrator's and User's Guide” referenced at the end of this section.

The installer requires you to specify a number of different settings. In summary, these are:

- You specify that you want to install the delivery units for the core and plugins along with the adapter.
- You define where the adapter should be installed.
- You create an operating system user that will be used later on to start and stop the adapter.
- You provide the information that is required to install the core and plugins on the target SAP HANA system as well as to set up the connections between the adapter and the SAP HANA host: the SAP HANA client location on the adapter host, the listening port for administrative information on the adapter, as well as the fully qualified SAP HANA host name and instance number.

- You specify the SAP HANA user that will be used to install the core application, plugins, and adapter as well as to create the technical SAP HANA users and the schemas for SAP ITOA (SAP_DCI and SAP_ITOA). In a multiple-container system, this is a user in the SAP HANA tenant database. For multiple-container mode, you are still required to specify a system database user first as this user is required to add the scriptserver service to the tenant database system.

- You create three technical users, all of which will be used to perform tasks that cannot be done directly by the ITOA administrator or the end users: database access, job execution, and communication between SAP HANA and the adapter.

- You can opt to secure the connections between SAP HANA and the adapter (both directions) so that you do not have to secure these connections manually later on.

Reference:

SAP ITOA Content Package for Lenovo XClarity Administrator

In the following sections, LXCA is an abbreviation for Lenovo XClarity Administrator.

To ease the integration of SAP ITOA and Lenovo XClarity Administrator (LXCA), a prebuilt content package containing mappings of XClarity syslog data to database fields is available for installation as an SAP HANA Delivery Unit.

- A prebuilt Syslog parsing rule that allows extracting semantical attributes from syslog messages forwarded by LXCA.

- A set of prebuilt dashboards for visualizing and analyzing common problem patterns identifiable via LXCA.

- Dashboards for visualizing and analyzing data received via the SAP Host Agent.

- Alert definitions for common alert-worthy situations identifiable via LXCA.
This delivery unit can be imported to the SAP HANA system hosting the SAP ITOA application via standard SAP HANA Lifecycle Management means: http://<host>:<port>/sap/hana/xs/lm.

**SAP ITOA Configuration**

When entering SAP ITOA for the first time after a new installation, you are being prompted to initialize the installation. As part of the initialization, please create a "bucket". Buckets will hold data streamed or pulled from the connected data, e.g. Lenovo XClarity. The bucket to be created first, is the bucket for receiving the Syslog messages forwarded from the Lenovo XClarity instance(s).

Begin by navigating to the Bucket tab in the left-hand side navigation, then click the ‘+’ button on the right-hand side of the screen.
Create Data Bucket

Bucket Name *

- XClarity

- Enable Retention
  - Retention Period
    - 
  - Advanced Settings
    - Retention Period for Attributes
      - 
    - Retention Period for Messages
      - 

- Show Setting

Plugins

- ITOA Core Plugin
- ITOA Regex Tokenizer
- ITOA Syslog Socket Input
- ITOA SAP Host Agent
- ITOA Attribute Editor
- ITOA Alerting and Notification

Rules

- sap.dci.parsermodel:core
- sap.dci.parsermodel:core
- sap.dci.parsermodel:sapagent
- sap.dci.parsermodel:sapagent
- sap.dci.parsermodel:syslog3164
- sap.dci.parsermodel:syslog3164

- sap.dci.parsermodel:syslog3164
- sap.dci.parsermodel:syslog3164
- sap.dci.parsermodel:syslog3164
- sap.dci.parsermodel:syslog3164
- sap.dci.parsermodel:syslog3164
- sap.dci.parsermodel:syslog3164

- Additional rules at bottom of scroll area

Back  Finish  Cancel
Bucket Name: XClarity

Enable the following Plugins: ITOA Syslog Socket Input, ITOA Attribute Editor

Enable the following Rule: sap.dci.parser.model::syslog3164

These settings allow the bucket to receive Syslog messages, to parse the incoming syslog messages (rules to be defined via the Attribute Editor) and a standard rule for the standard Syslog envelope is already applied.

As you can have multiple adapters in a distributed environment, you need to configure the bucket by specifying via which adapters it should receive the syslog messages from XClarity. In order to do so, navigate to the newly created bucket and then select “Edit Bucket Configuration”. Within the “Syslog Server” configuration, select the adapter of your choice, define the port number and protocol, and start the syslog server. It will now start to receive the syslog messages sent to this adapter and its port as initially defined in your XClarity setup step.

Now that syslog messages are received via the adapter, it is time to use the parsing rule from the content package. In order to so, navigate to “Activate Content”, search for “Rule” as content type and activate the Rule called “LXCA_Syslog_Rule”. Then, go back to the bucket configuration and add the rule you just activated to the bucket.

Dashboards

In order to use the dashboards (and alerts) that are part of the content package, go to “Activate Content” and search for “Story” as content type. Activate all stories that start with “LXCA...”. “Activate Content” is available from the “Settings” icon on the upper right side of the ITOA browser window.
As a result, you should see these stories when navigating to the “Analytics Builder” from the main menu.

The following dashboards are defined in the content package.

<table>
<thead>
<tr>
<th>Dashboard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LXCA Overview</td>
<td>Provides a consolidated listing for all messages coming from Lenovo XClarity Administrator servers (including events from Lenovo XClarity Administrator-managed resources).</td>
</tr>
<tr>
<td>LXCA Security Logins</td>
<td>Provides statistics on any security related events, such as user logins or failures.</td>
</tr>
<tr>
<td>LXCA Security Changes</td>
<td>Shows any security changes made to the Lenovo XClarity Administrator, such as security policy changes, or changes for individual Lenovo XClarity Administrator users.</td>
</tr>
<tr>
<td>LXCA Provisioning</td>
<td>Shows events related to the provisioning of managed resources.  Lenovo XClarity Administrator can provision changes to managed resources, including updating firmware, pushing configuration changes, and deploying operating system images.</td>
</tr>
<tr>
<td>LXCA Power and Thermal</td>
<td>Graphically depicts power/thermal thresholds. Any time a power or thermal threshold is exceeded, the events associated with that situation is reflected in the graphs.</td>
</tr>
<tr>
<td>LXCA Events Recommending Service</td>
<td>Displays events for resources that require attention by the System Administrator or the Support Center (or events predicting that these types of failures are imminent)</td>
</tr>
<tr>
<td>SAP Host Agent</td>
<td>Analyzes events at the OS and application level</td>
</tr>
</tbody>
</table>

Following is an example of the LXCA Overview:
Alerts

In the course of activating the stories in the section before, four alert definitions were also activated. The content package provides predefined alerts that can be enabled to define what type of notification to generate. For example, an email may be sent to a specified user or that an event notification could be sent to a system administrator.

Alerts are coded to look for specific occurrences in syslog messages. If a syslog is received that contains the occurrence, a notification is generated.

LXCA Alerts for Temperature Thresholds

- This alert will be received whenever Lenovo XClarity Administrator-managed resources report that specified number of temperature thresholds have been exceeded in a specified amount of time.

LXCA Alerts for Power Thresholds
This alert will be received whenever Lenovo XClarity Administrator-managed resources report that specified number of power thresholds have been exceeded in a specified amount of time.

**LXCA Alerts for Serviceable Events**

- This alert will be received when resources managed by Lenovo XClarity Administrator have surfaced a specified number of serviceable events in a specified amount of time. Actions may be required to resolve these issues, potentially by the Support team.

**LXCA Alerts for Predicted Failure Alerts**

- This alert means that resources managed by Lenovo XClarity Administrators have surfaced predicted failure alerts. It is recommended that workload be evacuated from resources surfacing these events.

**Conclusion**

As you can see, SAP ITOA with Lenovo XClarity Administrator and SAP Host Agent information is a very powerful combination for monitoring and managing your Lenovo SAP HANA Solution. This unique combination lets you get and maintain a holistic, real-time overview of complex datacenter landscapes. You can collect, process, and analyze large volumes of data to find the root causes of datacenter issues and resolve them swiftly, or to predict issues and prevent them from happening in the first place.

Lenovo SAP HANA Solutions contain everything you need to get started with SAP ITOA. Lenovo XClarity Administrator licenses are provided for each server purchased. A copy of the SAP ITOA application is included with each Lenovo SAP HANA Solution purchase with limited usage rights. The SAP ITOA Content package for XClarity is available for installation as a Data Unit using the SAP Lifecycle Manager. The SAP ITOA application does not require a large footprint in your environment, but provides a huge benefit to your organization.

Please do not hesitate to contact Lenovo Professional Services to discuss adding a SAP ITOA implementation for your next Lenovo SAP HANA Solution.
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