standardize complex IT with ansible e.g.
SAP HANA

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What is SAP HANA & Requirements

SAP HANA is
- an in-memory database
- critical performance and unusual setup requirements
- no native rpm install method
- requirements documented in SAP Notes

SAP Notes:
- SAP define all setup guidelines for all their platform in SAP Notes
- SAP Notes give MANUAL steps
- SAP Notes are crucial to follow, if you want to have support
- Important Information is spread across many notes
- Easy to miss or misinterpret one or the other Note
Supported Kernel versions and patches to use with certified Hardware for SAP HANA on RHEL 7

You can use all official RHEL 7 Linux Kernels and packages shipped by Red Hat for the RHEL 7 minor releases supported by SAP HANA, including security and bug fixes provided via “Extended Update Support” for the supported RHEL 7 minor releases. Using updated Linux Kernels and packages from RHEL 7 minor releases not listed in SAP Note 2292690 is not supported and will break the certification.

To ensure that systems do not get accidentally updated, all RHEL 7 servers running SAP HANA must be subscribed to the "Extended Update Support" channels for "RHEL 7.x for SAP HANA" (where x stands for the respective minor version of RHEL 7) or the “E4S” channels when using "Red Hat Enterprise Linux for SAP Solutions" (RHEL for SAP Solutions).

Please refer to the following Red Hat knowledge base articles for instructions on how to configure your system accordingly:
- Red Hat Enterprise Linux for SAP HANA - system updates and supportability (Red Hat customer portal login required)
- How to subscribe RHEL 7 for SAP HANA systems to Extended Update Support (EUS) channel? (Red Hat customer portal login required)
- How to subscribe SAP HANA systems to the Update Services for SAP Solutions (Red Hat customer portal login required)

RHEL 7.2 specific package requirements
- kernel-3.10.0-327.62.4.el7 or newer

RHEL 7.3 specific package requirements
- kernel-3.10.0-514.36.5.el7 or newer
- glibc-2.17-157.48_3.5 or newer
- tuned-profiles-sap-hana-2.7.1-3.el7_3.3 or newer

RHEL 7.4 specific package requirements
- kernel-3.10.0-693.11.6 or newer
- tuned-profiles-sap-hana-2.8.0.5.el7_4.2 or newer

Additional 3rd-party kernel modules

If additional 3rd party kernel modules are loaded that complicate support for both SAP and the OS vendor (Red Hat), then the following SAP Note applies:
- 764359 - SAP support terms and 3rd-party Linux kernel drivers

Configure tuned to use profile "sap-hana"

The tuned profile "sap-hana", which is provided by Red Hat as part of RHEL 7 for SAP HANA, contains many of the settings mentioned below and configures some additional settings. Therefore the "sap-hana" tuned profile must be activated on all systems running SAP HANA.

```
# yum install tuned-profiles-sap-hana
# systemctl start tuned
# systemctl enable tuned
# tuned-adm profile sap-hana
```

On RHEL 7.4 when using versions of the tuned-profiles-sap-hana package older than 2.8.0.5.el7_4.2 or on RHEL 7.3 when using versions of the tuned-profiles-sap-hana package older than 2.7.1-3.el7_3.3, the "sap-hana" tuned profile must be modified as follows before it can be activated:
Overview of required Notes just for RHEL 7

To install SAP HANA on RHEL 7 OS, you need to follow these notes:

- 2235581 - SAP HANA: Supported Operating Systems
- 2009879 - SAP HANA Guidelines for Red Hat Enterprise Linux (RHEL) Operating System
- 2055470 - HANA on POWER Planning and Installation Specifics
- 2292690 - SAP HANA DB: Recommended OS settings for RHEL 7
- 2455582 - Linux: Running SAP applications compiled with GCC 6.x
- 2382421 - Optimizing the Network Configuration on HANA- and OS-Level

Many more apply to hardware or virtualization, you also need to take into consideration
SAP HANA standard installation process

- HARDWARE  ►  LINUX (OS)  ►  SAP HANA  ►  VALIDATION  ►  MAINTENANCE
  - On Site construction
  - Installation & Configuration
  - Installation & Configuration
  - Validation & Customization
  - Maintenance & Updates

Individually for each server and environment!
Why automate complex applications

First requirement by pressure
- Complex hardware environment
- Short time limit

Excellent results
- Successfully verified deployments

First development: quick and dirty with puppet
<table>
<thead>
<tr>
<th>Interface</th>
<th>Hostname</th>
<th>IP</th>
<th>Subnet</th>
<th>Gateway</th>
<th>DNS</th>
<th>DNS Domain</th>
<th>SAP SID</th>
<th>SAP Label Frontend</th>
<th>IP Frontend</th>
<th>IP Internode</th>
<th>IP Label Frontend</th>
<th>IP Label Inter</th>
<th>IP Label System</th>
<th>IP Label System Rx</th>
<th>IP Label System Rx</th>
</tr>
</thead>
</table>
SAP HANA optimized installation process

HARDWARE ➤ LINUX (OS), SAP HANA, VALIDATION ➤ MAINTENANCE

- On Site construction
- Installation & Configuration
- Installation & Configuration
- Validation & Customization
- Maintenance & Updates

Automation for the whole environment
Migration from Puppet to Ansible

- Why?
  - complex first puppet setup (Client/Server environment)
  - easy and fast starting process with ansible

- Migration Tools (puppet to ansible)?
  - Not really useful

- Manual migration
  - three days (easy first steps)
  - Ununderstandable for others ;)
  - But worked!
Example: SAP HANA deployment with Puppet

```bash
systemctl stop numad
systemctl disable numad
systemctl status numad
```

```yaml
service { 'numad':
  enable => true,
  ensure => 'running',
}
```
Example: SAP HANA deployment with Ansible

```bash
systemctl stop numad
systemctl disable numad
systemctl status numad
```

- name: disable numad
  service: name=numad state=stopped enabled=no
yum install @base xfsprogs libaio net-tools bind-utils gtk2 libicu xulrunner tcsh sudo libssh2 expect cairo graphviz iptraf-ng krb5-workstation krb5-libs libpng12 ntp ntpdate nfs-utils lm_sensors rsyslog openssl098e openssl PackageKit-gtk3-module libcanberra-gtk2 libtool-ltdl xorg-x11-xauth numactl

Package { ensure => 'installed' }

$enhancers = [ 'chrony',
  'xfsprogs',
  'libaio',
  'net-tools',
  'bind-utils',
  ...,
  'numactl',
  'tuned-profiles-sap' ]

package { $enhancers: }
}
yum install @base xfsprogs libaio net-tools bind-utils gtk2 libicu xulrunner tcsh
sudo libssh2 expect cairo graphviz iptraf-ng krb5-workstation krb5-libs librpng12
ntp ntpdate nfs-utils lm_sensors rsyslog openssl098e openssl
PackageKit-gtk3-module libcanberra-gtk2 libtool-ltdl xorg-x11-xauth numactl

- name: install required packages
  yum: state=latest name={{ item }}
  with_items:
    - chrony
    - xfsprogs
    - libaio
    - net-tools
    - bind-utils
    ...
    - numactl
    - tuned-profiles-sap-hana
How we have started with Ansible

- We picked ready-to-use roles from Red Hat where appropriate/ready
  - https://access.redhat.com/articles/3050101
  - https://galaxy.ansible.com/linux-system-roles

- We created a few roles adding all steps we needed to deploy HANA according to the SAP Notes
  - followed the generic Styleguide
    https://docs.ansible.com/ansible/latest/user_guide/playbooks_best_practices.html
  - These followed manual instructions
  - made changes where it was required
  - reused previous bash script snippets
  - **no well defined structure**
  - no proper testing

=> This ended up in spaghetti code that no one could understand, hence not improve
Now look on the HANA process

1. Basic environmental setup → Configure Subscription Mgmt. → Configure RHEL & 3rd party software repositories

2. Basic OS Setup → Network/DNS → NTP → Monitoring, Backup → Application Storage Configuration

3. HANA installation and configuration → OS preconfigure → HANA deployment → HANA HSR setup → Pacemaker Cluster Setup
Define the roles for each step

HANA installation and configuration

OS preconfigure

HANA deployment

HANA HSR setup

Pacemaker Cluster Setup

**sap-base-settings**
- configures system locale and hostname and checks DNS according to SAP Note 2369910
- will be required for all SAP Systems!

**sap-hana-preconfigure**
- does all configuration steps according SAP Note 2009879 can be used prior to updates or environment checks as well

**sap-hana-mediacheck**
- checks for sapinstallation media availability (returns version info that can be used by hostagent and deploy role)

**sap-hana-hostagent**
- installs/updates SAP HostAgent (if not done already)

**sap-hana-deploy**
- creates HANA specific users
- kicks off HANA unattended installation for all supported scenarios
sap-hana-preconfigure
- does all configuration steps according SAP Note 2009879
  can be used prior to updates or environment checks as well
This helped to reorganize

- enhanced style guide here: https://docs.adfinis-sygroup.ch/public/ansible-guide/overview.html
  - distinction between installation and configuration
  - clear rules for variables, tags, and where to put information
  - guidelines for documentation

- more granular role definitions
  - separation according SAP Notes, so that User can read
  - optimized work collaboration

- Developed Test-Pipeline in cloud environments
example file with variables

```yaml
- hosts: all
  vars:
    # SAP-BASE-ROLE
    # can use defaults
    # SAP-Media Check
    sap_hana_installdir: "/install/.../

    # SAP HANA Hostagent:
    sap_hana_hostagent_archive: "/install/.../archive"
    sap_uid_sapadm: 20202
    sap_gid_sapsys: 20202
    sap_hana_hostagent_sapadm_pw_clear: "MyS3cret!"
    sap_hana_hostagent_ssl_pw: "MyS3cret!"
    id_groupshm: "20302"

  roles:
    - sap-base-settings
    - sap-hana-preconfigure
    - sap-hana-hostagent
```

Directory structure
Configure tuned to use profile "sap-hana"

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```
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On RHEL 7.4 when using versions of the tuned-profiles-sap-hana package older than 2.8.0-5.el7_4.2 or on RHEL 7.3 when using versions of the tuned-profiles-sap-hana package older than 2.7.1-3.el7_3.3, the "sap-hana" tuned profile must be modified as follows before it can be used. Copy "/usr/lib/tuned/sap-hana/tuned.conf" to "/etc/tuned/sap-hana/tuned.conf" (the /etc/tuned/sap-hana directory must be created if it doesn't exist) and then change the "/etc/tuned/sap-hana/tuned.conf" file as shown here:

```
[cpu]
...
force_latency=70
```

Turn off auto numa balancing
OS RELEASE: RHEL 7
# SAP Note: 2292690
#
# This is the configuration part of the OS
# See ../../vars/RedHat_7.yml for all packages that need to be installed
# The packages are also sorted by SAP Note
#
# Configure tuned to use profile "sap-hana"
# force_latency=70 for older tuned versions, hence the script requires appropriate min releases
# see sap note 2292690

- name: enable tuned
  service: name=tuned state=started enabled=yes

- name: get current tuned profile
  command: cat /etc/tuned-active_profile
  register: current_profile
  changed_when: false

- name: apply tuned profile
  shell: /usr/sbin/tuned-adm profile sap-hana
  when: ansible_virtualization_type != 'vmware' and current_profile.stdout != 'sap-hana'

- name: apply tuned profile on VMware systems
  shell: /usr/sbin/tuned-adm profile sap-hana-vmware
  when: ansible_virtualization_type == 'vmware' and current_profile.stdout != 'sap-hana-vmware'
Example

Ansible example:

```
OS RELEASE: RHEL 7
# SAP Note: 2292690
# This is the configuration part of the OS
# Set ../../vers/RedHat_7.yml for all packages that need to be installed
# The packages are also sorted by SAP Note

# Configure tuned to use profile "sap-hana"
# force_latency=70 for older tuned versions, hence the script requires appropriate min releases
# see sap note 2332690

- name: enable tuned
  command: cat /etc/tuned/tuned.conf
  register: tuned_result
  changed: false

- name: apply tuned profile
  command: /usr/sbin/tuned-adm profile sap-hana
  register: tuned_result
  changed: true

- name: apply tuned profile on VMware system
  command: /usr/sbin/tuned-adm profile sap-hana-vmware
  register: tuned_result
  changed: true
```

```
2,1 All
```

SAP HANA DB: Recommended OS settings for RHEL 7
Version 33 from 10.09.2018 in English

- Configure tuned to use profile "sap-hana"

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```
[rpu]
    force_latency=70
```

- Turn off auto-name balancing
Example

Ansible example:

```
# default Kernel Parameters set in SAP Note 238241
sap_hana_preconfigure_kernel_parameters:
  - { name: net.core.somaxconn, value: 4096 }
  - { name: net.ipv4.tcp_max_syn_backlog, value: 8192 }
  - { name: net.ipv4.ip_local_port_range, value: "40000 61000" }
  - { name: net.ipv4.tcp_timestamps, value: 1 }
  - { name: net.ipv4.tcp_tw_recycle, value: 1 }
  - { name: net.ipv4.tcp_slow_start_after_idle, value: 0 }
  - { name: net.ipv4.tcp_syn_retries, value: 8 }

# OS RELEASE: RHEL 7
# SAP Note: 2382421 - Optimizing the Network Configuration on HANA- and OS-Level
# - name: setting kernel tunables as in SAP NOTE 2382421
sysctl:
  sysctl_file: /etc/sysctl.d/sap_hana.conf
  name: "{{ item.name }}"
  value: "{{ item.value }}"
  state: present
  sysctl_set: yes
  reload: yes
with_items: "{{ sap_hana_preconfigure_kernel_parameters }}"
```
Test-Pipelines in cloud environments

- Automate the environments
  - Using Terraform (IaC) for building and destroying everything on demand
  - Fresh installed systems
  - Deploy Ansible playbooks against the new system
  - Check if installation was successful
  - Development pipeline (integration with Jenkins)
Lessons learned

- Use (or create) documentation for automation
- Built up everything from scratch
- Never touch a system for changes directly!
- Version management for changes
- Staging: Dev, QA, Test, Productive

- Customer examples
Current development

- Example SAP HANA Scale-Out with System Replication and Pacemaker
  - Built up completely with Ansible
  - 2 SAP Scale-Out Cluster (with each 4 Nodes)
  - System Replication between both Cluster
  - Own Environment Configurations (NFS, Partitioning, etc.)
Role overview

- public roles
  - sap-base-settings
  - sap-hana-mediacheck
  - sap-hana-preconfigure
  - sap-hana-hostagent
  - sap-hana-deployment
  - saphana-hsr
  - ansible.ha-cluster-pacemaker
  - OndrejHome.pcs-modules-2

- custom roles
  - sva-hosts
  - sva-network
  - sva-local-disk
  - sva-satellite
  - sva-nfs
  - sva-pacemaker
Further Reading

● Ansible Style Guide
  ○ https://docs.ansible.com/ansible/latest/user_guide/playbooks_best_practices.html

● Enhanced Adfinis/Sygroup Style Guide
  ○ https://docs.adfinis-sygroup.ch/public/ansible-guide/overview.html

● Role Repositories on Github
  ○ https://github.com/linux-system-roles
  ○ https://github.com/mk-ansible-roles