Getting Started with Salt

Manage tens of thousands of servers and communicate with each system in seconds

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Contents

What is Salt?

“A configuration management system which provides a high-speed communication working with large number of systems in a highly scalable environment”

- Remote execution engine
- Configuration management system
- Apply defined states
- Enable high-speed communication
- Provisioning and Orchestration
- Easy to extend. Salt Mine
- Python!

Why Salt?

	Salt	Ansible	Chef	Puppet
Initial release	2011	2012	2009	2005
Configuration Language	YAML	YAML	Ruby/DSL	DSL
Template Language	Jinja2	Jinja2	ERB	ERB
Core Language	Python	Python	Ruby	Ruby
Agent-less	Yes	Yes	-	-
Pros/Cons	Execution speed and scalability. Very good Introspection. Strong community. Difficult for new users.	Easy to learn. SSH based. Poor introspection. Performance speed.	Rich collection of recipes. Does not support PUSH. Need to be familiar with Ruby	Mature. Web UI. Ruby is needed. Does not focus on simplicity.

Why Salt?

"We had 10,000 lines of Puppet code and reduced that to roughly 1,000 in Salt" *- Ryan Lane, Lyft*

"We are running around 70,000 minions. When you keep doubling boxes like this, one does not simply scale" *- Thomas Jackson, LinkedIn*

"It is not about configuring Linux or Windows machine or configuring an operations or deployment. It is about development, testing, production and heterogeneity across all that." *- Ross Gardler, Microsoft Azure*

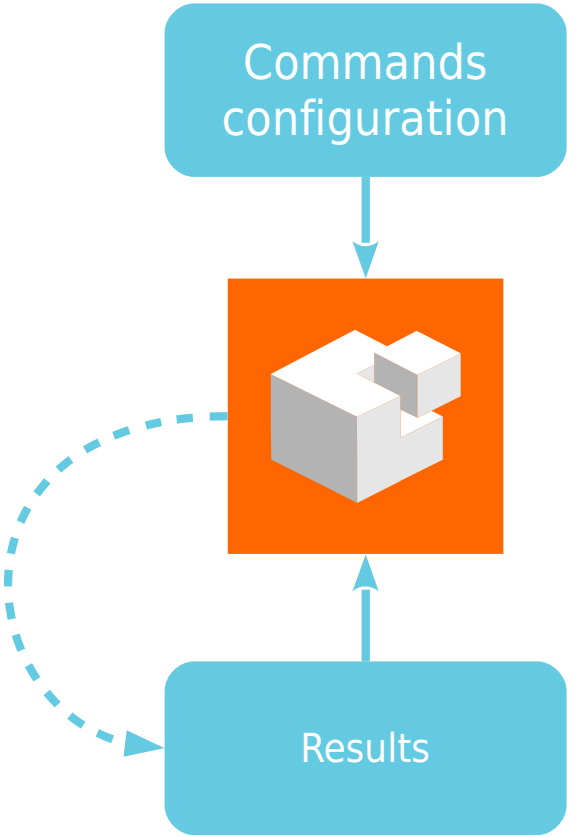
How to run Salt?

- Checkout from GitHub:
https://github.com/saltstack/salt/
(current release 2016.3.3)

- Install from SLE & openSUSE repositories:
(2015.8.7 and 2016.3.2)

- Multiple running environments:

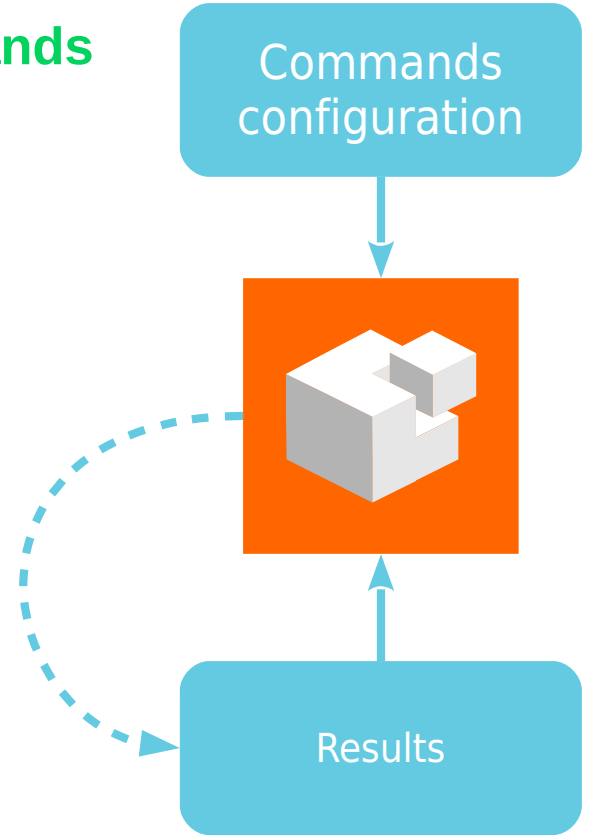
- Master-less configuration
- No agent needed!
- master – minion
- “dumb” devices (salt-proxy)
- Multiple masters (syndic)



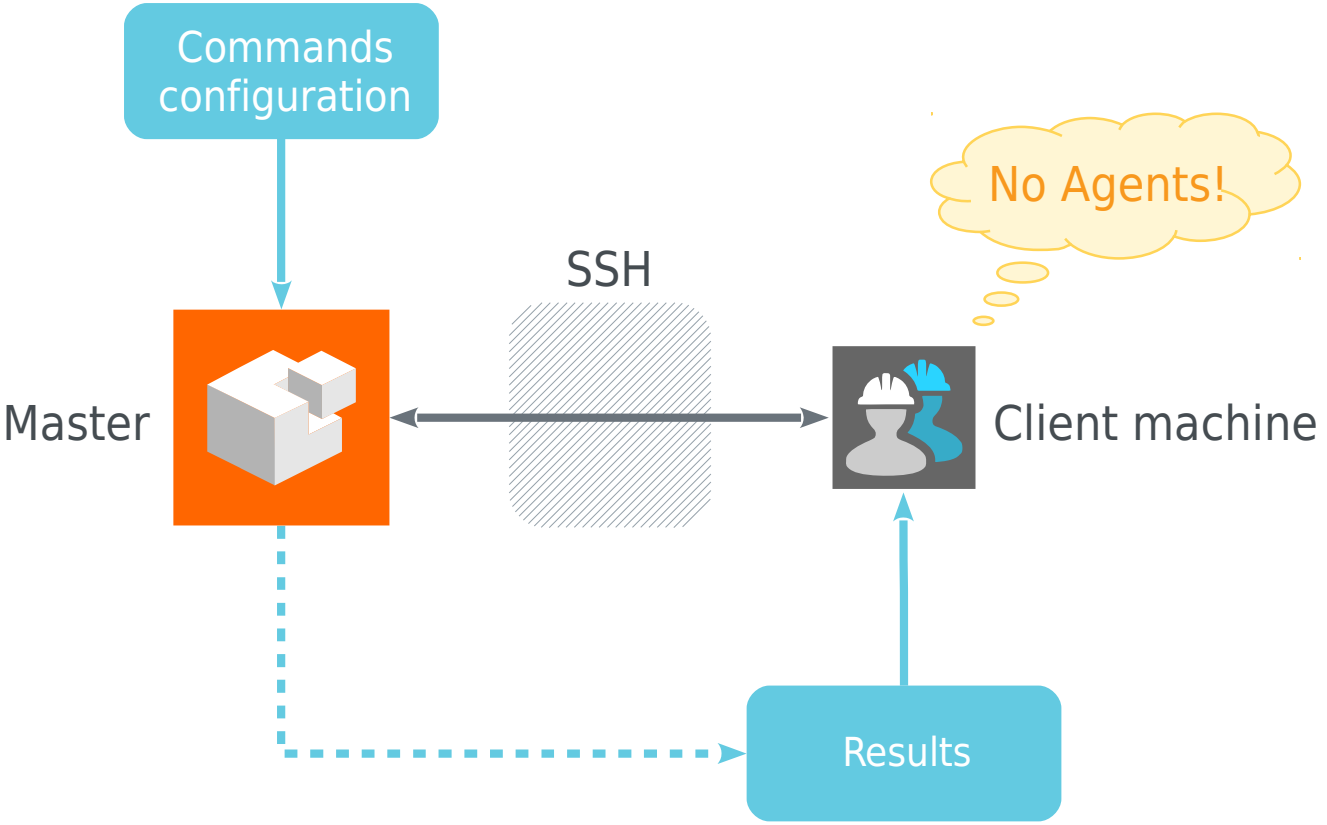
Using Salt without a master server (master-less)

“We can use Salt locally to execute commands and configurations”

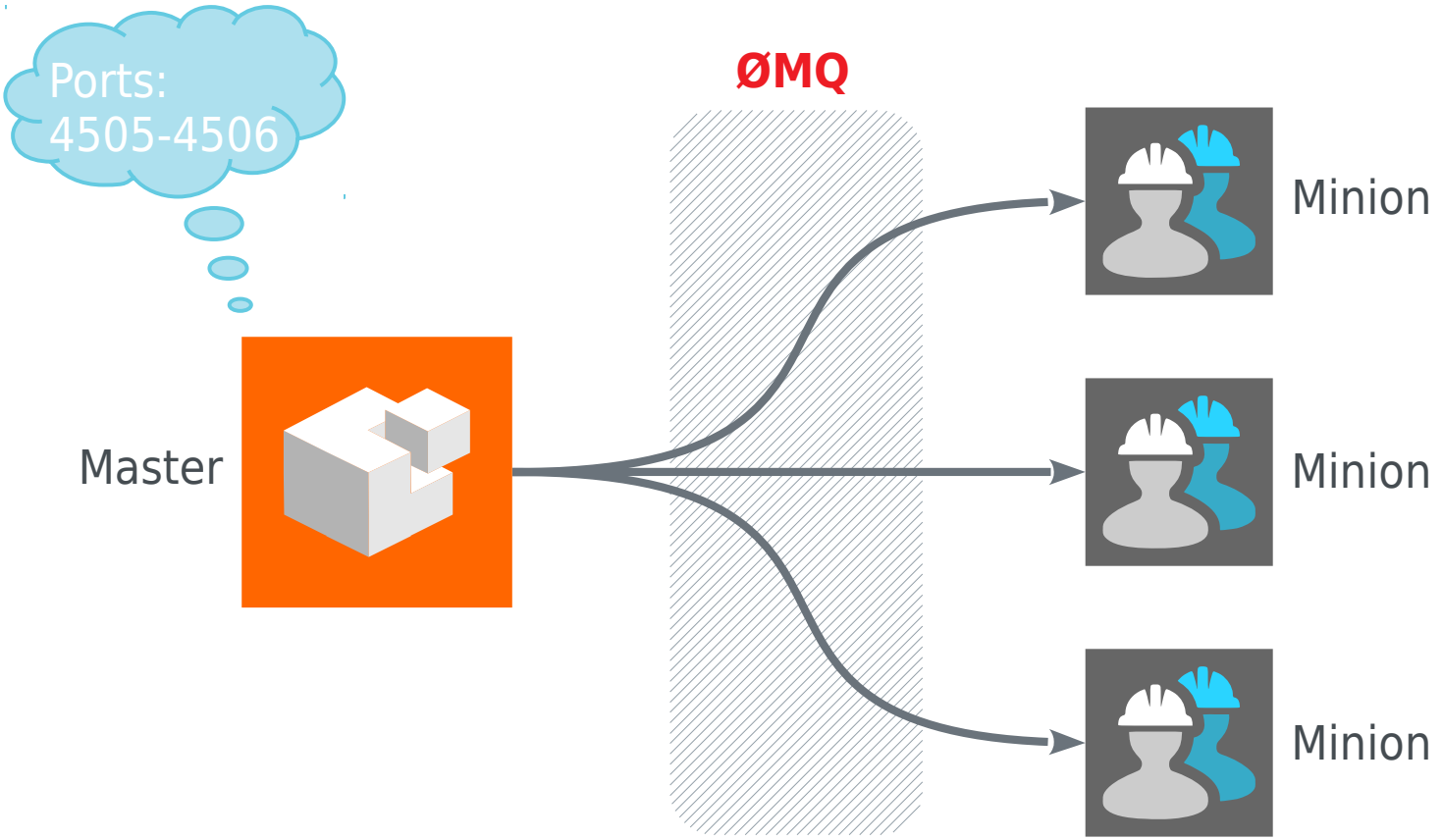
```
# salt-call --local test.ping
# salt-call --local pkg.install apache2
# salt-call --local service.enable apache2
# salt-call --local state.apply mystate
```



No agent: salt-ssh



Salt Master and Minions



The Salt Transport: ØMQ

Salt uses ZeroMQ as default transport protocol:

PUB channel (4505 tcp):

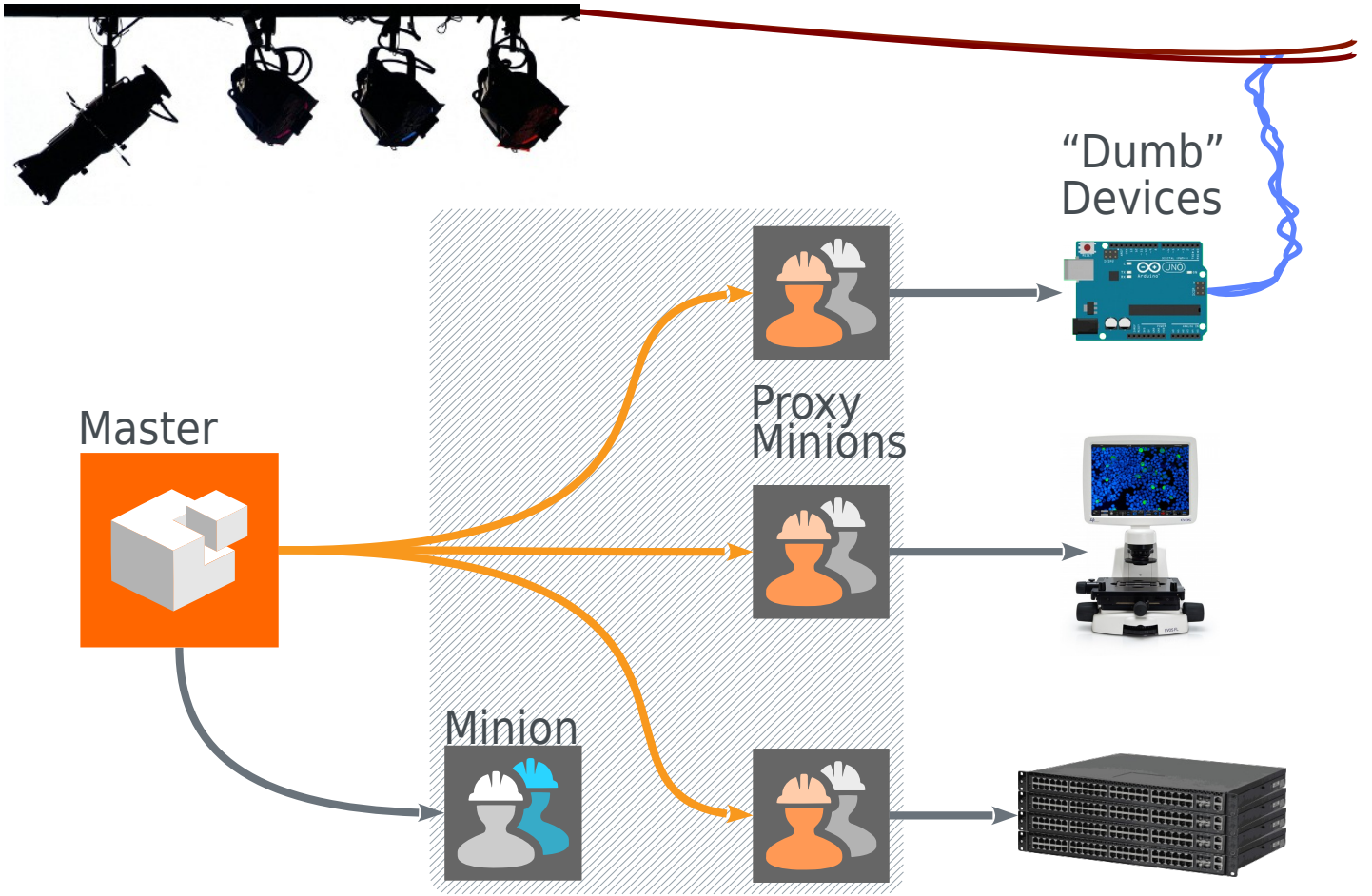
- Implements a pub/sub socket. Encrypted payload is published by master which includes minion targeting

- REQ channel (4506 tcp):
  - Implements a req/rep sockets. Fetching files and returning jobs from minions to master.

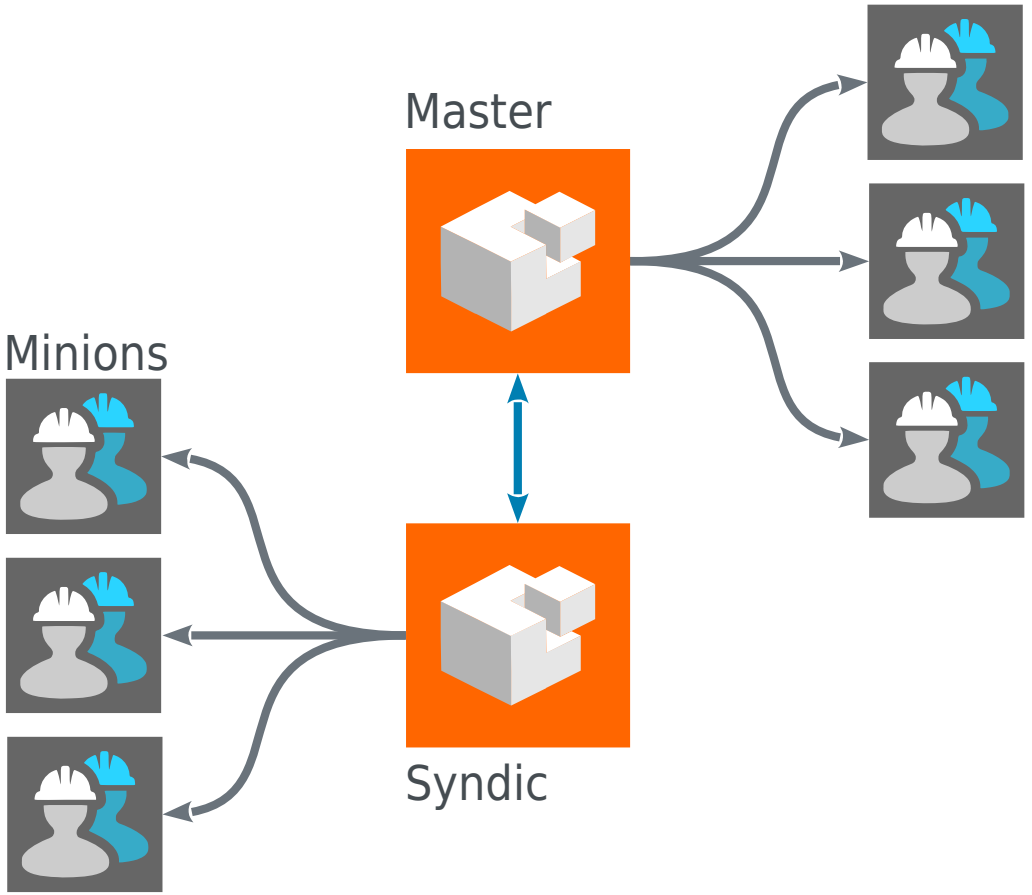
Also supports:

- TCP transport
- RAET transport

Salt in “dumb” devices (salt-proxy)



Salt with multiple masters (salt-syndic)



Master

Salt Master

The main daemon for managing the bus and components.

Installation:

zypper install salt-master

Configuration:

/etc/salt/master

/etc/salt/master.d/*.conf

Salt Master

Useful settings:

log_level: warning|debug

state_output: full|mixed

Files:

/var/cache/salt/master/*

/var/log/salt/master

/run/salt/master

Setting up a Salt Master

- /etc/salt/master

(single environment)

```
# Files and state roots
file_roots:
  base:
    - /srv/salt

# Pillar data roots
pillar_roots:
  base:
    - /srv/pillar
```

(multiple environments)

```
file_roots:
  dev:
    - /srv/salt/dev/
  prod:
    - /srv/salt/prod/
  qa:
    - /srv/salt/qa/

pillar_roots:
  base:
    - /srv/pillar
  prod:
    - /srv/pillar/prod
  dev:
    - /srv/pillar/dev
```

Minion

Salt Minion

The agent running on each host.

Installation:

zypper install salt-minion

Configuration:

/etc/salt/minion

/etc/salt/minion.d/*.conf

/etc/salt/minion_id

Salt Minion

Useful settings:

log_level: warning|debug

master: salt

Files:

/var/cache/salt/minion/*

/var/log/salt/minion

/run/salt/minion

Salt Minion

A minion is not part of the Salt cluster until the master accepts its key.

Useful commands (to run in Master):

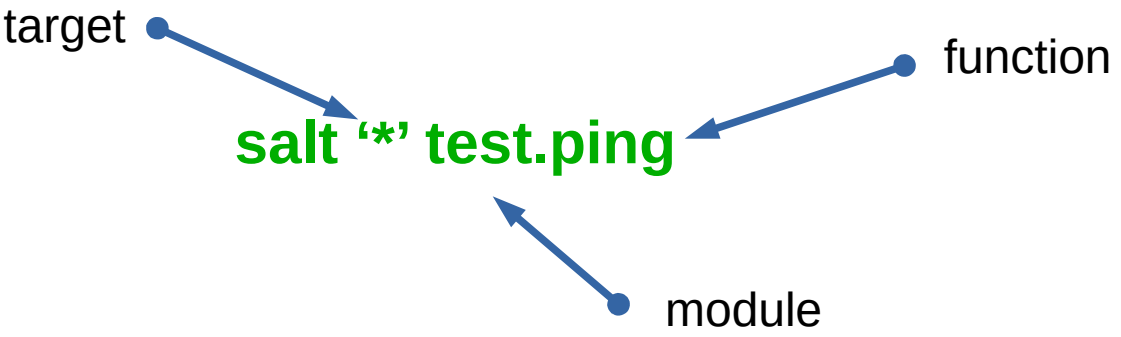
salt-key -A

salt-key -A -y

salt-key -L

```
# salt-key -L
Accepted Keys:
minion0
minion1
Denied Keys:
Unaccepted Keys:
minion2
Rejected Keys:
```

Starting playing with Salt



Useful commands:

salt '*' test.ping

salt '*' cmd.run “date +%s.%N”

salt-run jobs.active

salt '*' saltutil.kill_job <jid>

salt-run manage.up

salt-run state.event pretty=True

```
# salt ‘*’ test.ping
minion0:
    True
minion1:
    True
```

Grains

Salt Grains

Data provided by the minion. Static for the life of the minion.

Commands

```
salt 'node1*' grains.items
salt 'node1*' grains.get kernelrelease
```

State file

```
{% set kernel = grains['kernelrelease'] | replace('-default', '')  %}
kernel:
  cmd.run:
    - name: “echo Kernel is {{ kernel }}”
```

Salt Grains

Custom grains can override core grains.

Precedence:

/etc/salt/grains

/etc/salt/minion

/srv/salt/_grains

Caveats

- Not immediately available, salt '*' saltutil.sync_grains

Pillar

Salt Pillar

Pillar files are essentially YAML files with an sls extension. Centralized configuration data filtered to each minion by the master.

Location

- /srv/pillar
- /srv/pillar/top.sls
- Subdirectories do not affect data structure

/srv/pillar/ceph/cluster/node1.domain.sls

```
cluster: ceph
roles:
- master
```

Salt Pillar

Display all pillar data for a specific minion.

Commands

```
salt 'node1*' pillar.items
    node1.domain:
        ----------
        cluster:
            ceph
        roles:
            - master
```

Salt Pillar

Using pillar data.

Commands

salt 'node1*' pillar.get roles

State file

tgt: {{ pillar.get('master_minion') }}

tgt: {{ salt['pillar.get']('master_minion') }}

{% set FAIL_ON_WARNING = salt['pillar.get']('FAIL_ON_WARNING', 'True') %}

{% for role in salt['pillar.get']('rgw_configurations', ['rgw']) %}

mon_initial_members = {{ salt['pillar.get']('mon_initial_members') | join(', ') }}

Salt Pillar

Pillar data is not automatically available.

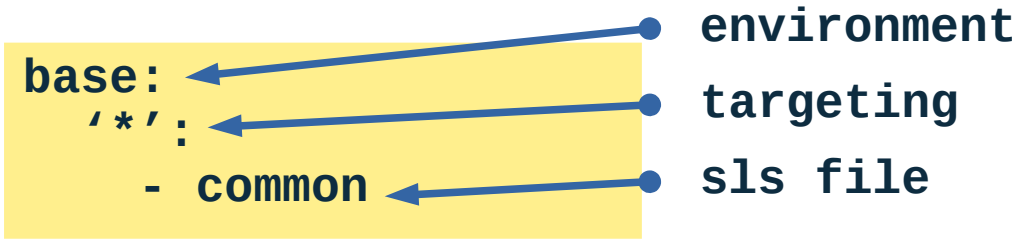
Commands

```
salt 'node1*' saltutil.pillar_refresh
    node1.domain:
        True

salt 'node1*' saltutil.refresh_pillar
    node1.domain:
        True
```

The Pillar “top.sls” file

- /srv/pillar/top.sls



- /srv/pillar/common.sls

```
vim:
  pkg.installed

/etc/hosts:
  file.managed:
    -source: salt://hosts
```

- /srv/pillar/common.sls

```
foo: bar

{% if grains['os_family'] == "Suse" %}
suseToken: token-only-in-suse-minions
{% endif %}
```

“SLS files are JINJA2 templates rendering YAML output. We can render output using pillars, grains or even salt functions”

States

Salt States

States are synonymous with the Salt state file. The extension is sls.

Location:

/srv/salt/top.sls

/srv/salt/anything.sls

/srv/salt/project/thing1.sls

/srv/salt/project/thing2/init.sls

Caveat:

- Not all sls files are the same

Salt States

Template

```
/etc/ceph/ceph.client.admin.keyring:
  file.managed:
    - source:
      - salt://ceph/.../ceph.client.admin.keyring
    - user: root
    - group: root
    - mode: 600
```

Package and Service

```
lrbd:
  pkg.installed:
    - pkgs:
      - lrbd

enable lrbd:
  service.running:
    - name: lrbd
    - enable: True
```

Salt States

Includes

```
include:
  - .keyring

start mds:
  service.running:
    - name: ceph-mds@{{ grains['host'] }}
    - enable: True
```

No operation

```
# No pools are created by default

nop:
  test.nop
```

Salt States

/srv/salt/anything.sls:

```
salt '*' state.apply anything
salt '*' state.sls anything
```

/srv/salt/project/thing1.sls:

```
salt '*' state.apply project.thing1
```

/srv/salt/project/thing2/init.sls:

```
salt '*' state.apply project.thing2
```

Salt States

Highstate can be considered a default setting for a salt cluster.

/srv/salt/top.sls:

```
salt '*' state.highstate
```

Layman definitions:

- **Highstate: simply processed, human friendly output**
- **Lowstate: “compiled”, Salt master friendly output**

The States “top.sls” file

- /srv/salt/top.sls

```
base:
  ‘*’:
    - common

  ‘webserver*’:
    - apache
    - webnode

  ‘G@os_family:SUSE’:
    - certs
```

environment

targeting

state

- /srv/salt/common.sls

```
vim:
  pkg.installed

/etc/hosts:
  file.managed:
    -source: salt://hosts
```

- /srv/salt/apache.sls

```
apache:
  pkg.installed: []
  service.running:
    - require:
      - pkg: apache
```

State Modules

State Modules

“Salt State modules allows you to define custom configuration states for almost every component of your system”

```
frank:
  mysql_user.present:
    - host: localhost
    - password: bobcat

server1:
  host.present:
    - ip: 192.168.0.42
    - names:
      - server1
      - florida
```

```
/dev/sda:
  lvm.pv_present

my_vg:
  lvm.vg_present:
    - devices: /dev/sda

lvroot:
  lvm.lv_present:
    - vgname: my_vg
    - size: 10G
    - stripes: 5
    - stripesize: 8K
```

- **alias**
- **apache**
- **archive**
- **bower**
- **cloud**
- **disk**
- **dockerng**
- **file**
- **grafana**
- **htpasswd**
- **iptables**
- **mount**
- **lvm**
- **pkg**
- **mysql_user**
- **network**
- **rsync**
- **selinux**
- **service**
- **snapper**
- **sysctl**
- **supervisord**
- **virt**
- **user**
- **group**
- **...**

Salt State Module Example

/srv/salt/_states/mystatemodule.py

```
def __virtual__():
    return 'fwmod' if 'network.connect' in __salt__
else False

def check(name, port=None, **kwargs):
    ret = {'name': name,
           'result': True,
           'changes': {},
           'comment': ''}

    if 'test' not in kwargs:
        kwargs['test'] = __opts__.get('test', False)

    # check the connection
    if kwargs['test']:
        ret['result'] = True
        ret['comment'] = 'The connection will be tested'
    else:
        results = __salt__['network.connect'](host, port,
**kwargs)
        ret['result'] = results['result']
        ret['comment'] = results['comment']

    return ret
```

Salt State Module Example

Commands

```
salt 'node1*' saltutil.sync_states
salt 'node1*' state.apply testgoogle
```

State file

```
testgoogle:
  fwmod.check:
    - name: 'google.com'
    - port: 80
    - proto: 'tcp'
```

Execution Modules

Salt Execution Modules

“Execution modules allows you to manage and configure almost every component of your system”

```
# salt ‘*’ cmd.run date
minion0:
    Mon Sep  5 12:29:04 UTC 2016
minion1:
    Mon Sep  5 12:29:03 UTC 2016

# salt ‘*’ service.restart apache2
minion0:
    True
minion1:
    False

# salt ‘minion0’ pkg.version vim
minion0:
    7.4.326-2.62
```

- cmd
- iptables
- jenkins
- apache
- network
- disk
- dockerng
- git
- htpasswd
- junos
- kerberos
- ldap3
- lvm
- postfix
- mysql
- parted
- rsync
- selinux
- service
- snapper
- system
- supervisord
- virt
- zypper
- cron
- cp
- ...

Salt Module

Python scripts that return useful values or perform custom actions.

Uses:

- Alter behavior of a state file (e.g. wait or retry)
- Encapsulate logic, simplify Jinja
- Retrieve dynamic information from minions

Commands

- salt 'node1*' keyring.secret
- salt 'node1*' freedisks.list

Salt Module Example

/srv/salt/_modules/keyring.py

```
def secret(filename):
    if os.path.exists(filename):
        with open(filename, 'r') as keyring:
            for line in keyring:
                if 'key' in line and ' = ' in line:
                    key = line.split(' = ')[1].strip()
                    return key

    key = os.urandom(16)
    hdr = struct.pack('<hiih',1,int(time.time()),
                              0,len(key))
    return base64.b64encode(hdr + key)
```

```
def file(component, name=None):
    if component == "osd":
        return "/srv/salt/ceph/osd/cache/bootstrap.keyring"

    if component == "igw":
        return "/srv/salt/ceph/igw/cache/ceph." +  name +
".keyring"

    if component == "mds":
        return "/srv/salt/ceph/mds/cache/" + name +
".keyring"

    if component == "rgw":
        return "/srv/salt/ceph/rgw/cache/" + name +
".keyring"
```

Salt Module Example

Commands

```
salt 'node1*' saltutil.sync_modules
salt 'node1*' keyring.secret
salt 'node1*' keyring.file mds node1
```

State file

```
{% set keyring_file = salt['keyring.file']('mds', grains['host'])  %}
{{ keyring_file}}:
  file.managed:
    - source:
    ...
    - context:
      secret: {{ salt['keyring.secret'](keyring_file) }}
```

Mines

Salt Mine

Cache the output of a module. Complements grains.

Few steps:

- Write a module
- Synchronize to minions
- Configure minions

Commands

```
salt 'node1*' freedisks.list
salt-call mine.get 'node1*' freedisks.list
salt 'node1*' mine.get 'node*' freedisks.list
```

Salt Mine Example

/srv/salt/_modules/freedisks.py

```
def list():
    drives = []
    for path in glob('/sys/block/*/device'):
        base = os.path.dirname(path)
        device = os.path.basename(base)
        # Skip partitioned drives
        partitions = glob(base + "/" + device + "*")
        if partitions:
            continue
        # Skip removable media
        removable = open(base +
"/removable").read().rstrip('\n')
        if (removable == "1"):
            continue
        rotational = open(base +
"/queue/rotational").read().rstrip('\n')

        hardware =_hwinfo(device)
        hardware['device'] = device
        hardware['rotational'] = rotational

        drives.append(hardware)
    return drives
```

Salt Mine Example

```
def _hwinfo(device):
    results = {}
    cmd = "/usr/sbin/hwinfo --disk --only /dev/
{}".format(device)
    proc = Popen(cmd, stdout=PIPE, stderr=PIPE,
shell=True)
    for line in proc.stdout:
        m = re.match("  ([^:]+): (.*)", line)
        if m:
            if (m.group(1) == "Capacity"):
                c = re.match("(\d+ \w+) \((\d+) bytes\)",
m.group(2))
                if c:
                    results[m.group(1)] = c.group(1)
                    results['Bytes'] = c.group(2)
            else:
                # Remove double quotes
                results[m.group(1)] = re.sub(r"", '', m.group(2))
    return results
```

Salt Mine Example

```
24: IDE 200.0: 10600 Disk
  [Created at block.245]
  ...
  Model: "HGST HTS721010A9"
  Vendor: "HGST"
  Device: "HTS721010A9"
  Revision: "A3J0"
  Serial ID: "JR100X6P2PWRME"
  Device File: /dev/sdc
  ...
  Size: 1953525168 sectors a 512 bytes
  Capacity: 931 GB (1000204886016 bytes)
  Config Status: cfg=new, avail=yes, need=no, active=unknown
  Attached to: #14 (SATA controller)
```

Salt Mine Example

/srv/salt/_modules/freedisks.py

Sync'ing:

- salt '*' saltutil.sync_module
- salt '*' saltutil.sync_all

State file

```
load modules:
  module.run:
    - name: saltutil.sync_all
    - refresh: True
```

Salt Mine Example

/srv/salt/.../mine_functions/init.sls:

```
configure_mine_functions:
  file.managed:
    - name: /etc/salt/minion.d/mine_functions.conf
    - source: salt://ceph/mine_functions/files/mine_functions.conf

manage_salt_minion_for_mine_functions:
  service.running:
    - name: salt-minion
    - watch:
      - file: configure_mine_functions
```

Salt Mine Example

/etc/salt/minion.d/mine_functions.conf

```
mine_functions:
  freedisks.list: [ ]
```

Runners

Salt Runner

A runner is conceptually similar to a stand-alone script. Unlike state files or modules, the runner executes on the master.

Uses:

- Query salt state

  salt-run jobs.active

  salt-run manage.up
- Updating external systems

  salt-run queue.insert myqueue abc

  salt-run network.wol 52:54:00:1D:62:F7

Salt Runner

Uses Continued:

- Coordinate complex states across groups of minions

  salt-run state.orchestrate orch.gateways

- Custom runners

  salt-run filequeue.add queue=master complete

  salt-run validate.pillar

- Jinja conditionals

  {% if salt['saltutil.runner']('filequeue.check', name='complete', queue='master') == True %}

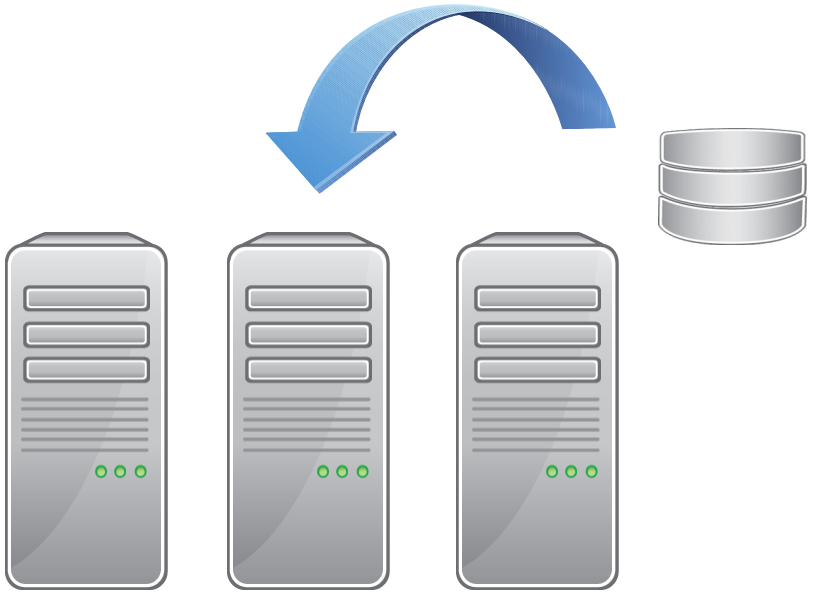
Salt Runner: state.orchestrate

The state.orchestrate runner has a different sls file format that allows targeting of minions.

```
installation:
  salt.state:
    - tgt: 'I@roles:gateways'
    - tgt_type: compound
    - sls: gateways.packages
```

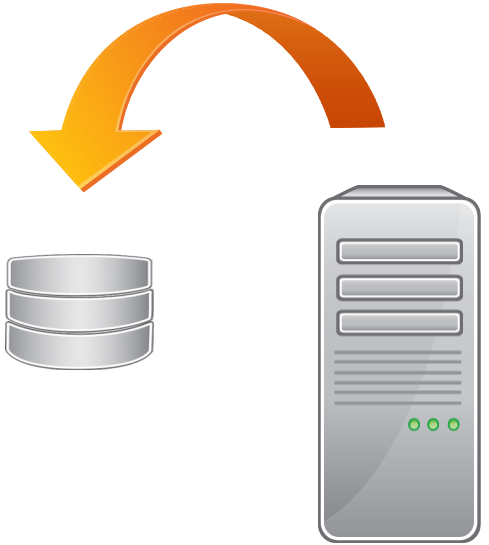
Salt Runner: state.orchestrate

Imagine a redundant gateway setup where the application retrieves the configuration from an external source.



Salt Runner: state.orchestrate

The dilemma is the configuration only needs to be stored once for all gateways. The import command is only available after package installation.



Salt Runner: state.orchestrate

The manual steps are

- Install packages on each gateway
  zypper in mypackage
- Initialize the external source
  Import configuration
- Start application on each gateway
  systemctl enable myservice
  systemctl start myservice

Salt Runner: state.orchestrate

The salt states are

- **Install packages**
  zypper in mypackage
- Configure packages
  Import configuration
- Start application
  systemctl enable myservice
  systemctl start myservice

/srv/salt/gateways/package/init.sls

```
installation:
  pkg.installed:
    - pkgs:
      - mypackage
```

Salt Runner: state.orchestrate

The salt states are

- Install packages
  zypper in mypackage
- **Configure packages**
  Import configuration
- Start application
  systemctl enable myservice
  systemctl start myservice

/srv/salt/gateways/import/init.sls

```
configure:
  cmd.run:
    - name: "client-cli {{ salt['pillar.get']
('mysettings') }}"
    - shell: /bin/bash
```

Salt Runner: state.orchestrate

The salt states are

- Install packages
  zypper in mypackage
- Configure packages
  Import configuration
- **Start application**
  systemctl enable myservice
  systemctl start myservice

/srv/salt/gateways/start/init.sls

```
enable:
  service.running:
    - name: myservice
    - enable: True

restart:
  module.run:
    - name: service.restart
    - m_name: myservice
```

Salt Runner: state.orchestrate

/srv/salt/orch/gateways.sls:

```
installation:
  salt.state:
    - tgt: "I@roles:gateways"
    - tgt_type: compound
    - sls: gateways.package
configure:
  salt.state:
    - tgt: "{{ salt.saltutil.runner('select.one_minion', roles='gateways') }}"
    - sls: gateways.import
start:
  salt.state:
    - tgt: "I@roles:gateways"
    - tgt_type: compound
    - sls: gateways.start
```

Salt Runner: state.orchestrate

To execute the orchestration runner

```
salt-run state.orchestrate orch.gateways
salt-run state.orch orch.gateways
```

Reactor

Salt Reactor

Listens for salt events and triggers an action

Examples:

- Putting all minions into highstate
- Coordinating actions with reboots

Salt Reactor

Reactor is part of the salt master. The configuration only allows simple globbing.

/etc/salt/master.d/reactor.conf

```
reactor:
  - 'salt/minion/*/start':
    - /srv/salt/reactor/highstate.sls
```

Salt Reactor

Reactor sls files are different.

/srv/salt/reactor/highstate.sls

```
highstate_run:
  cmd.state.highstate:
    - tgt: {{ data['id'] }}
```

Salt Reactor

Reactor sls files are different.

/srv/salt/reactor/highstate.sls

```
highstate_run:
  cmd.state.highstate:
    - tgt: {{ data['id'] }}
```

Salt Reactor

Caution:

- No circular dependency checking across events
  - Reactor starts an orchestration which results in firing events that starts an orchestration...
- No synchronization primitives
  - Tasks run by the master are separate processes. Race conditions will happen
- No state machine
  - An error stops the workflow. No automatic retries.

Other Topics

Other Topics

Topics not covered:

- Queues
- Tornado
- Thorium
- Engines
- Beacons
- Salt-api
- Renderers

Salt Projects

SUSE Manager:

- https://www.suse.com/products/suse-manager

SUSE Software Defined Storage:

- Ceph
- DeepSea https://github.com/SUSE/DeepSea

Recommended Sessions

Hear from a Customer:

SUSE Manager 3 & Salt at Tyson Foods (CAS91938) - Weds 3pm & Fri 10:15am

Try a Hands-on Session:

SUSE Manager for Smarties (HO91268) – Tues 2pm & Weds 4:45pm

Advanced Hands-on with SaltStack (HO91449) – Weds 10am & Thurs 2pm

Extending Salt for Fun and Profit (HO92263) – Tues 4:30pm & Thurs 2pm

Learn More:

Managing Configuration Drift and Auditing with Salt (TUT89994) – Weds 2pm

Questions?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