Cloud Computing Applications and Services

(Aplicações e Serviços de Computação em Nuvem)

System Provisioning

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Provisioning

Provisioning: the action of providing or supplying something for use

- Server provisioning
- Storage provisioning
- Network provisioning
- VM provisioning
- User provisioning

Deployment

Deployment: the process of installing or upgrading an application/service into a server

- Installing or upgrading a web application
- Network service installation or upgrade
- The scope is the **service** or **application**

Provisioning and Deployment is…

Boring (after first iteration)

- Repetitive process
  - So, it's a great target for automation
- May spread across multiple and heterogeneous systems (e.g., with different hardware)
  - Better keep a systems inventory and run tasks sequentially or parallelized
- Will probably require tweaks overtime
  - Well, versioning might be a good idea
- Sometimes a time consuming task
  - Let the machine do it and go do something else

Configuration Management

A way of handling systematic system changes while maintaining integrity throughout its lifecycle

- Express configuration through a common dialect
- Predictable configuration result
- Configuration evolves with the infrastructure
- Infrastructure documentation as a positive side effect
- Full history of changes overtime when used with source code management
- Changes are observable
- Process Automation
- Each unit of work is expressed as a recipe

Recipes

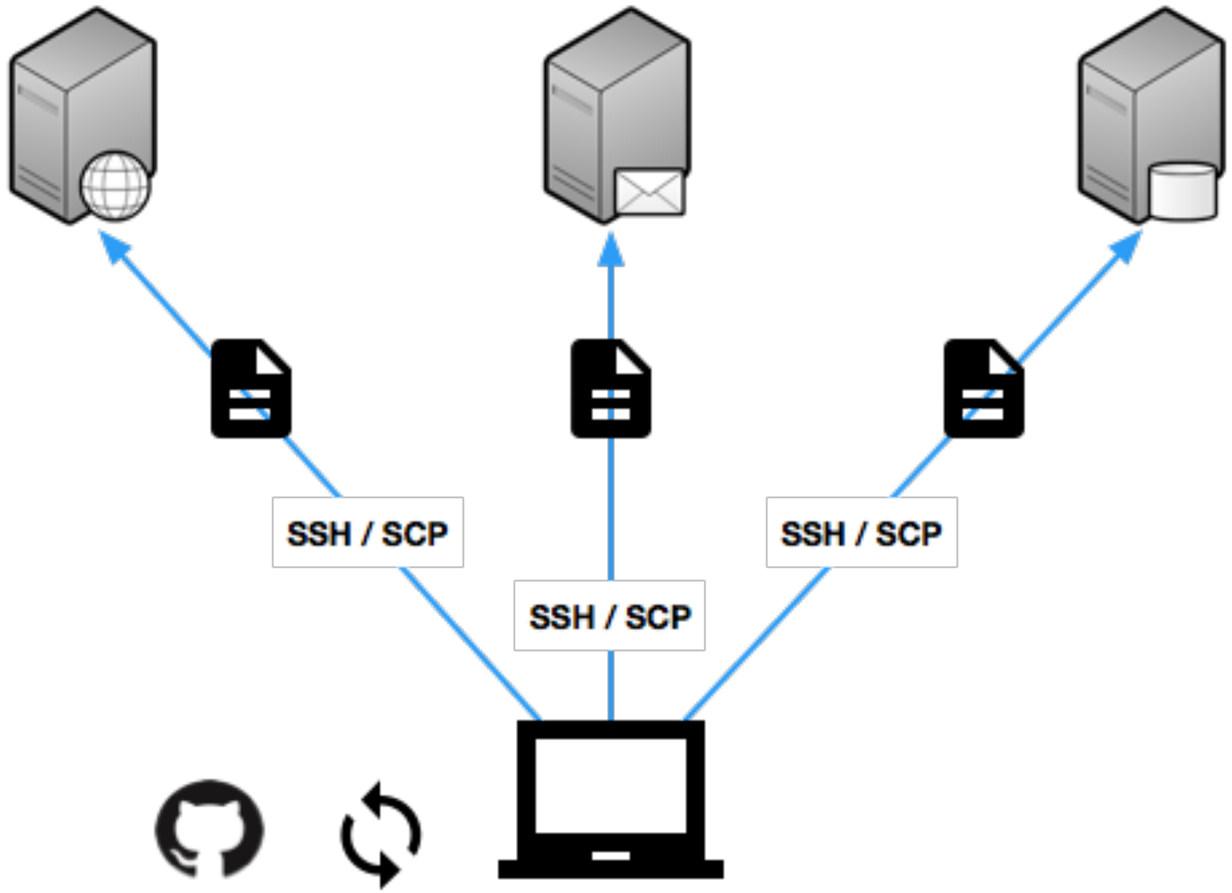
Define task automation via a set of directives expressed in a given language

```
#!/bin/sh
username=deployer
apt-get -y update
apt-get -y upgrade
apt-get -y install vim-nox openntpd sudo whois aptitude
useradd -G sudo -p "password" -s /bin/bash -m $username
mkdir -p /home/$username/.ssh
chmod 700 /home/$username/.ssh
chown $username: /home/$username/.ssh
echo "public_key" >> /home/$username/.ssh/authorized_keys
chmod 600 /home/$username/.ssh/authorized_keys
chown $username: /home/$username/.ssh/authorized_keys
```

Tools of the Trade

Tool	Language	Agent	Agentless	SSH
Ansible	YAML	No	Yes	Yes
Chef	Ruby	Yes	Supported	Yes
Puppet	Puppet's Dec. Lang.	Yes	Supported	Yes
SaltStack	YAML	Yes	Supported	Yes

Provisioning and Deployment Workflow



Ansible is an open-source automation tool used for configuration management, application deployment, intra-service orchestration, and provisioning

Vocabulary

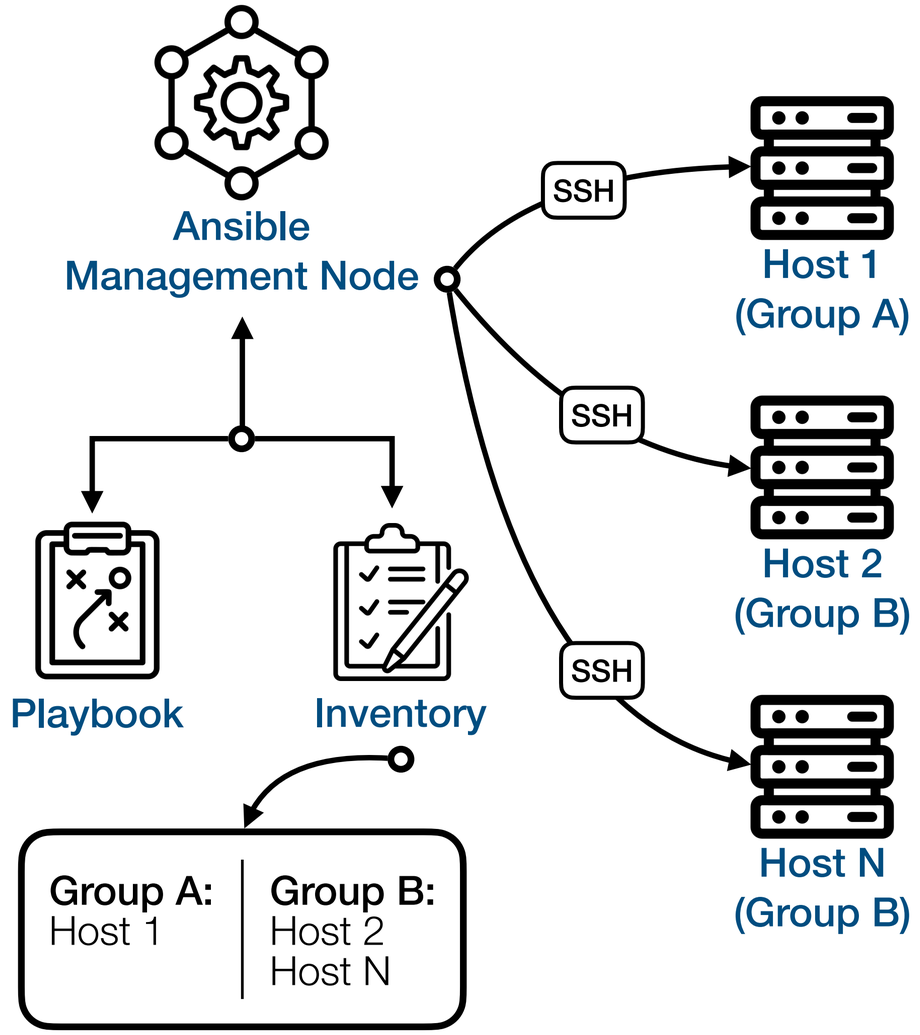
- **Inventory**
  - Grouped deployment targets (hosts)
- **Module**
  - Reusable work unit distributed with Ansible or developed for it
- **Task**
  - Combination of a module and given arguments in order to create an action
- **Handlers**
  - Special kind of task that responds to a notification
- **Templates**
  - Enable the creation of dynamic configuration (leverages Jinja2, the Python template engine)
- **Role**
  - Reusable component that encapsulates variables, templates, tasks, handlers… (configurable)
- **Playbook**
  - Describe policies for remote systems to enforce (set of roles / tasks)

Overview

- Agentless recipe execution via SSH or locally
  - Target hosts are defined in the inventory
- Recipes are expressed in YAML
  - Recipes are created via module and task directives
  - Recipes are organized into roles and playbooks
- Tasks only run if the target differs from the expected result (idempotency)

How Ansible works

- Ansible is operated from a Management Node, where you write and execute your Ansible playbooks and commands.
- The list of hosts to be managed by Ansible is specified in the Inventory file.
- Ansible connects to remote hosts using SSH and executes the set of tasks defined in a Playbook.

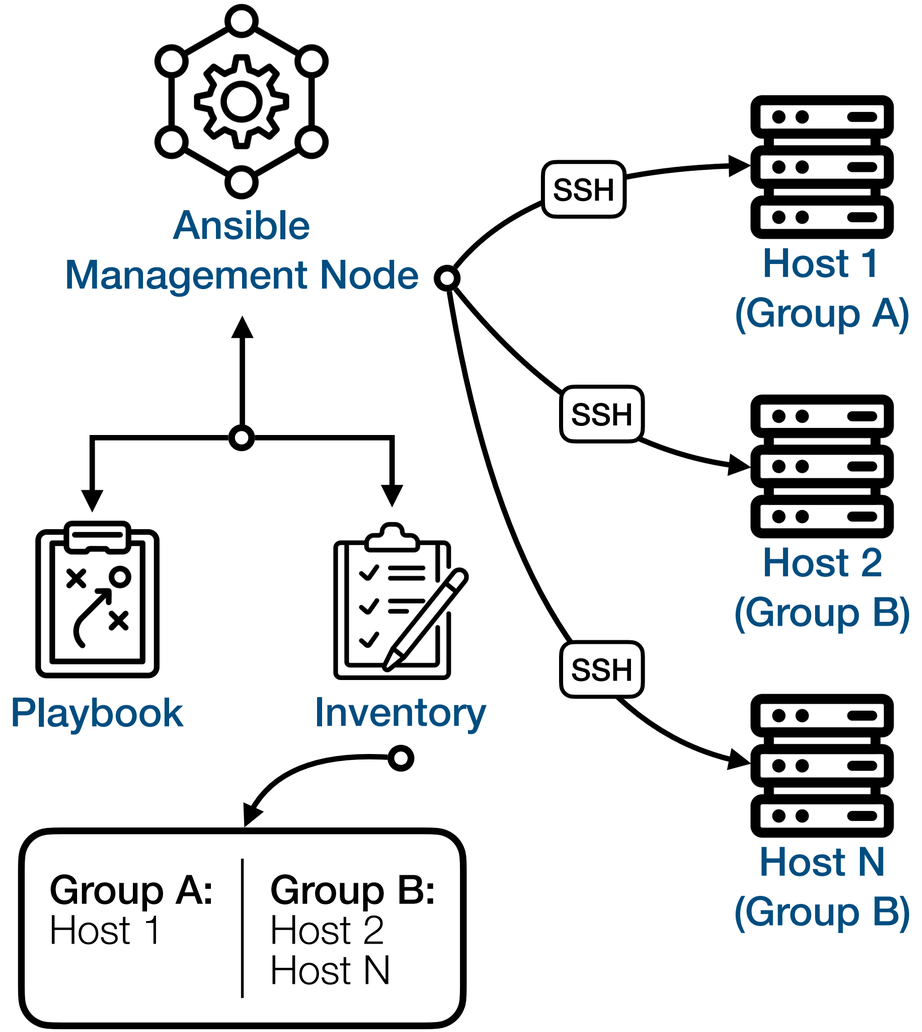


Inventory File

hosts.inv:

```
[webservers]
host-[01:99].example.com

[database]
db-01.example.com
Staging.example.com
```



Simple Playbook

```
- hosts: all
  vars:
    username: someuser
    shell: /bin/bash
  tasks:
    - name: create unprivileged user
      user:
        name: '{{username}}'
        password: 'secretpasswordhash'
        shell: '{{shell}}'
    - name: Set SSH authorized_key
      authorized_key:
        user: '{{username}}'
        state: present
        key: "{{ lookup('file', '/home/' + someuser + '/.ssh/id_rsa.pub') }}"
```

Module

Using a shell script

```
#!/bin/sh

username=someuser
useradd -G sudo -p "password" -s /bin/bash -m $username
mkdir -p /home/$username/.ssh
chmod 700 /home/$username/.ssh
chown $username: /home/$username/.ssh
echo "public_key" >> /home/$username/.ssh/authorized_keys
chmod 600 /home/$username/.ssh/authorized_keys
chown $username: /home/$username/.ssh/authorized_keys
```

Playbook Structure

hosts.inv
provision.yml
roles
  |
  |- role
      |- files (static files)
      |- templates (Jinja2 templates)
      |- tasks (task definition - main.yml)
      |- handlers (handlers that trigger on notify - main.yml)
      |- vars (role scoped variables - main.yml)
      | … (defaults, meta, etc)

Example:

```
- hosts: webservers
  roles:
    - config
    - users
    - ssh-server
    - ntp-client
    - …
```

See examples at: https://github.com/ansible/ansible-examples

Execution

- **Without ansible.cfg:**

  ansible-playbook playbook.yml -b -i hosts.inv -u someuser -K --private-key=/path/to/private_key

- **With ansible.cfg (ansible.cfg):**

  ansible-playbook playbook.yml -b -K

ansible.cfg:

```
[defaults]
hostfile = hosts.inv
remote_user = someusername
private_key_file = /.../someuser_private_key
```

- **Flags:**
  - -b → become, privilege elevation with sudo command
  - -i → inventory file to use
  - -u → login username
  - -K → ask sudo password

Level Up

Handlers

```
- name: template configuration file
  template:
    src: template.j2
    dest: /etc/nginx/nginx.conf
  notify:
     - restart nginx
```

```
handlers:
    - name: restart nginx
      service:
        name: nginx
        state: restarted
```

Conditionals

```
- name: Common Debian
  include_tasks: debian.yml
  when: ansible_os_family == "Debian"

- name: Common RedHat
  include_tasks: rh.yml
  when: ansible_os_family == "RedHat"
```

```
when:
  - condition
  - condition
```

```
when: condition or condition
```

```
when: somevar | failed
```

```
when: somevar is defined
```

Loops

```
- name: Install Packages
  apt: name="{{ item }}" update_cache=yes state=latest
  loop:
    - vim-nox
    - aptitude

- name: Install Packages
  apt: name="{{ item }}" update_cache=yes state=latest
  loop: "{{ list_variable_with_packages }}"

- name: Copy Files
  copy: src="{{ item.source }}" dest="{{ item.destination }}"
  loop:
    - { source: 'motd', destination: '/etc/motd' }
    - { source: 'sshd', destination: '/etc/ssh/sshd_config'
```

More at:

https://docs.ansible.com/ansible/latest/user_guide/playbooks_loops.html

Host Facts

- Facts can be accessed and used within tasks and templates allowing for more dynamic playbooks

```
{% for host in groups[’webservers'] %}
  {{ hostvars[host]['ansible_all_ipv4_addresses'] | join }}
{% endfor %}
```

```
{{ ansible_distribution }}
{{ ansible_os_family }}
{{ ansible_processor_vcpus }}
```

Vault

- Allows keeping sensitive data such as passwords or keys in encrypted files, rather than as plaintext in playbooks or roles.

More at: https://docs.ansible.com/ansible/2.6/user_guide/vault.html

Provisioning GCP With Ansible

- Ansible can be used to provision different GCP services
  - VMs, Kubernetes, …
- Ansible Modules (examples…)
  - gcp_compute_disk
  - gcp_compute_network
  - gcp_compute_address
  - gcp_compute_firewall
  - gcp_compute_instance
  - gcp_container_cluster

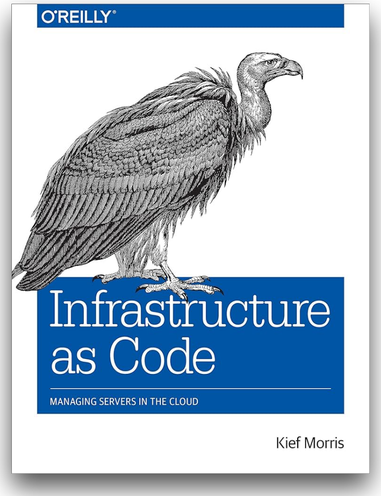
More at:
https://docs.ansible.com/ansible/latest/scenario_guides/guide_gce.html

Dynamic Inventory

- When provision happens dynamically the addresses are unknown
- Problem has two solutions
  - Manually (go into the console and look at the addresses)
  - Automatic (use a dynamic inventory)

Further Reading

- https://docs.ansible.com
- K. Morris. ***Infrastructure as Code: Managing Servers in the Cloud***. O'Reilly, 2016



Questions?