Ansible Playbooks: A Detailed Guide

An **Ansible playbook** is a configuration management tool that allows you to automate tasks on one or more machines (or hosts). Playbooks are written in YAML format and consist of one or more **plays**. A play describes the tasks to be executed on a set of hosts, allowing you to define the desired state of your systems. Unlike **ad-hoc commands**, which are good for one-time, quick tasks, **playbooks** are designed for more complex, repeatable automation processes.

In this guide, we'll cover the structure of Ansible playbooks, common use cases, and provide detailed examples.

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1. Playbook Structure

Basic Syntax

A playbook is written in **YAML**, and the basic structure is as follows:

```
---
- name: <description of the play>
  hosts: <target_hosts_or_group>
  become: <true|false>  # Whether to escalate privileges (e.g., via sudo)
  tasks:
    - name: <task_name>
      <module_name>:
        <module_arguments>
```

- **name**: A short description of what the playbook or play does.
- **hosts**: Specifies the group or list of hosts from the inventory file. You can target specific hosts or groups.

- **become**: This specifies whether the tasks in this play should be run with elevated privileges. (e.g., using sudo).

- **tasks**: A list of tasks to execute on the target hosts. Each task uses an Ansible **module** to accomplish a specific goal.

Example Playbook Structure:

```
---
- name: Configure web server
  hosts: webservers
  become: true
  tasks:
    - name: Install Apache HTTP server
      yum:
        name: httpd
        state: present

    - name: Start the Apache service
      service:
        name: httpd
        state: started
        enabled: true

    - name: Copy custom index.html to web server
      copy:
        src: /local/path/index.html
        dest: /var/www/html/index.html
```

---

2. Key Components of Playbooks

2.1 Hosts

The **hosts** section defines the target machines where the playbook will run. This can be:

- A **single host**: hosts: webserver1.example.com
- A **group of hosts**: hosts: webservers
- A **list of hosts**: hosts: ["webserver1", "webserver2"]
- **All hosts**: hosts: all (refers to all hosts in your inventory)

2.2 Tasks

Each task is a single action to be executed on the target hosts. Tasks use **Ansible modules**, which perform specific actions. For example, yum for package management, copy for copying files, service for managing services, and many others.

2.3 Handlers

Handlers are special tasks that are executed only if notified by other tasks. Handlers are typically used to restart a service after making a configuration change. They are triggered when another task uses the notify directive.

Example of a handler:

```
- name: Restart Apache
  service:
    name: httpd
    state: restarted
```

To notify the handler, a task can include:

```
- name: Copy Apache configuration file
  copy:
    src: /path/to/config.conf
    dest: /etc/httpd/conf/httpd.conf
  notify:
    - Restart Apache
```

2.4 Variables

Variables allow you to define values in one place and use them throughout your playbook. They can be defined in the playbook itself or in separate files.

Example:

```
---
- name: Install Apache and configure
  hosts: webservers
  become: true
  vars:
    apache_package: httpd
    service_name: httpd
  tasks:
    - name: Install Apache HTTP server
      yum:
        name: "{{ apache_package }}"
        state: present

    - name: Start Apache service
      service:
        name: "{{ service_name }}"
        state: started
        enabled: true
```

In this example, apache_package and service_name are defined as variables and then used in the tasks.

2.5 Conditionals

You can run tasks conditionally by using the when directive. This allows you to skip tasks based on certain conditions.

Example:

```
- name: Install Apache if not already installed
  hosts: webservers
```

```
  tasks:
    - name: Install Apache HTTP server
      yum:
        name: httpd
        state: present
      when: ansible_facts.packages['httpd'] is not defined
```

This task will only install Apache if it is not already present on the system.

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3. Example Playbooks

3.1 Basic Playbook to Install a Web Server

This simple playbook installs the Apache web server and starts the service on all web servers.

```
---
- name: Install Apache Web Server
  hosts: webservers
  become: true
  tasks:
    - name: Install httpd package
      yum:
        name: httpd
        state: present

    - name: Start Apache service
      service:
        name: httpd
        state: started
        enabled: true
```

To run this playbook:

```
ansible-playbook -i inventory.ini install_apache.yml
```

3.2 Playbook for Application Deployment

This playbook deploys a basic web application by copying files and ensuring the web server is running.

```
---
- name: Deploy web application
  hosts: webservers
  become: true
  tasks:
    - name: Install required packages
      yum:
        name:
          - httpd
          - git
        state: present

    - name: Clone the application repository
      git:
        repo: 'https://github.com/example/my-web-app.git'
        dest: /var/www/html/my-web-app

    - name: Configure Apache to serve the application
      copy:
        src: /var/www/html/my-web-app/index.html
        dest: /var/www/html/index.html

    - name: Start Apache service
      service:
        name: httpd
        state: started
        enabled: true
```

3.3 Playbook with Handlers and Variables

This example demonstrates using **handlers** and **variables**. It installs a package, makes a configuration change, and then restarts the service if necessary.

```
---
- name: Install and configure Nginx
  hosts: webservers
  become: true
  vars:
    nginx_package: nginx
    nginx_conf_file: /etc/nginx/nginx.conf
    config_file_src: /path/to/nginx.conf
  tasks:
    - name: Install Nginx
      yum:
        name: "{{ nginx_package }}"
        state: present

    - name: Copy Nginx configuration file
      copy:
        src: "{{ config_file_src }}"
        dest: "{{ nginx_conf_file }}"
      notify:
        - Restart Nginx

  handlers:
    - name: Restart Nginx
      service:
        name: nginx
        state: restarted
```

---

4. Advanced Playbook Concepts

4.1 Looping Through Items

You can loop over a list of items using the loop directive. This is useful for running the same task for multiple items.

Example:

```
---
- name: Install multiple packages
  hosts: webservers
  become: true
  tasks:
    - name: Install a list of packages
      yum:
        name: "{{ item }}"
        state: present
      loop:
        - httpd
        - git
        - curl
```

4.2 Tags

Tags allow you to execute only specific parts of the playbook. You can tag tasks and then run only the tagged tasks.

Example:

```
---
- name: Install and configure Nginx
  hosts: webservers
  become: true
  tasks:
    - name: Install Nginx
      yum:
        name: nginx
        state: present
      tags: install

    - name: Start Nginx service
```

```
    service:
      name: nginx
      state: started
      enabled: true
    tags: configure
```

Run a playbook with a specific tag:

ansible-playbook -i inventory.ini install_nginx.yml --tags install

4.3 Roles

Roles in Ansible provide a way to organize tasks, variables, templates, and handlers into reusable units. You can structure your playbook to use predefined roles for things like web servers, databases, etc.

Example directory structure:

```
playbooks/
├── site.yml
├── roles/
│   ├── webserver/
│   │   ├── tasks/
│   │   ├── handlers/
│   │   ├── defaults/
│   │   └── templates/
│   └── database/
```

Using a role in a playbook:

```
---
- name: Configure Web Servers
  hosts: webservers
  become: true
  roles:
    - webserver
```

To create roles, you can use the following command:

ansible-galaxy init <role_name>

---

5. Conclusion

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sible **playbooks** provide a flexible and powerful way to automate configuration management, application deployment, and system administration tasks across multiple servers. Unlike ad-hoc commands, which are typically used for one-off tasks, playbooks allow you to codify complex workflows and ensure consistency and repeatability.

In this guide, we covered:

- The structure and syntax of Ansible playbooks.
- Key components like **tasks**, **handlers**, **variables**, and **conditionals**.
- How to use loops, tags, and roles for more advanced workflows.

By using these features, you can write clear, reusable, and maintainable automation code to manage your infrastructure.

Would you like assistance creating more complex playbooks or help with specific examples?