**Scientific Cluster Deployment & Recovery**

Using puppet to simplify cluster management

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- A cluster deployment and recovery process based on the puppet configuration management engine which allows a part-time FTE to easily deploy and recover entire clusters with minimal effort

**The Problem**

- A university scientist needs to wear an additional system administrator hat.
- This extra duty of maintaining a scientific data analysis cluster (DAC) causes the scientist to be diverted from practicing science.

**The Solution**

A cluster administrator (the scientist) uses a cluster tool to generate a cluster definition that is used for turnkey DAC deployment

- **Cluster Template** a set of cluster node roles defined by service definitions and their relationships
- **Cluster Tool**: a python application that understands the cluster template structure and produces a cluster definition
- **Cluster Definition**: a set of kickstart installation scripts combined with a complete puppet server configuration.

**The Process**

- Puppet is used widely in computing centers for the automatic management of resources.
- A domain expert writes puppet modules.
- Puppet modules that define cluster services are published in a public repository.
- A client designer uses the published puppet modules to design a cluster template.
- A cluster template has a particular directory structure that is understood by a cluster tool.
- Easy-to-follow installation instructions are provided with the cluster template.
- A cluster administrator follows the cluster deployment instructions to deploy the cluster.
- The instructions should consist of setting up a puppet server, installing node operating systems via kickstart installation.
- Node configuration is performed automatically upon system reboot by the puppet daemon.
- A client designer uses the published puppet modules to design a cluster template.
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**The Components**

- A cluster template is created by a cluster designer. It has:
  - configuration parameters
  - templates
  - role and service definitions
  - a role is the function of a cluster node such as HEAD and WORKER nodes in a batch cluster.
  - A service is managed by a puppet module definition.
  - A puppet defines the target state of a node with its declarative language.
  - Puppet modules can be published in a version control systems such as git or SVN.

- A cluster definition is created by a cluster designer. It has:
  - Kickstart install and other configuration scripts
  - Puppet server configuration

**The Actors**

There are several actors in this process from the domain expert who understand the intricacies of the clusters services to the end user who submits analysis jobs on the cluster.

- **Domain Expert**: a domain expert writes puppet modules for configuring and managing services used by data analysis clusters (DAC).
- **Cluster Designer**: a cluster designer creates a cluster template with the puppet modules designed by the domain expert.
- **Cluster Manager**: A cluster manager procures hardware, sets up networking according to the cluster topology and deploys/manages the DAC.
- **Cluster User**: A cluster user logs into the cluster and performs a task. In the case of DAC, a user would run analysis jobs.

**ATLAS Tier 3, an Example**

A simplified ATLAS Tier 3 Analysis cluster. The diagram shows the relationship between node roles and their services.

**Create a Cluster Definition**

ATLAS Tier 3 Cluster tool (at3c) is a set of python commands that facilitates the deployment of ATLAS Tier 3 data analysis clusters. It is a command line tool for creating a cluster definition from a pre-existing cluster template.

**Deploy a Cluster**

Deploying the cluster is a straightforward process for each node. Using the bootable USB stick, the cluster administrator installs the operating system via kickstart installation. After the operating system installation is complete, the system is rebooted and the puppet client configures the system.

**Atlas Tier 3 Cluster**

- Install the cluster tool from [here](http://example.com/at/at3c)
- Get the cluster template from [here](http://example.com/cluster-template)
- Any questions? Val Hendrix, vchendrix@lbl.gov

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**Legend**

- **HEAD**: condor head
- **WORKER**: condor client
- **LDAP**: user authentication
- **NFS**: file server
- **CONDOR**: client of: condor, ldap
- **INTERACTIVE**: condor, ldap, nfs
- **cvmfs**: ATLAS software distribution
- **nfs**: distributed filesystem
- **ip address**, **domain name**: parameters