Introducing Configuration Management Capabilities into CloudLab Experiments

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Computer and Network Experimental Research Using Testbeds, CNERT’16
This Talk Covers

• Testbeds
• Experiments
• Configuration Management
• Demo
• Discussion
Long History of Testbed Research at Utah
Testbeds: Provide Isolated and Recreatable Environments
Experiments: Require Building Software Environments ...
... on Many Nodes
... with Many Components

Examples:
- Compiler
- MPI library
- Scheduler
- Network File System
- Numerical Libraries
- Benchmarks

Examples:
- Application Output
- Power Traces
- System Logs
- Node Information
Common Workflows

**Snapshot-based:**
- Configure Experiment
- *Recreate* Identical Experiments
  *byte-for-byte*
- Snapshot Nodes

**Script-based:**
- Develop Scripts
- Use Scripts On New Experiments
- *Rebuild* Desired Configurations
Goal: Build Computing Clusters using Experiment Nodes

2 x 3 x 2 x ... x 4

configurations
for controller and compute nodes

compiler versions
• GCC 4.8.2
• GCC 5.2
• GCC 5.3

library versions
• OpenMPI 1.8
• OpenMPI 1.10

architectures
• ARMv8 at Utah
• Haswell at Wisconsin
• Ivy Bridge at Clemson
• Sandy Bridge on Apt
Goal: Build Computing Clusters using Experiment Nodes

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configurations
for controller and compute nodes

compiler versions
• GCC 4.8.2
• GCC 5.2
• GCC 5.3

library versions
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new versions become available often

architectures
• ARMv8 at Utah
• Haswell at Wisconsin
• Ivy Bridge at Clemson
• Sandy Bridge on Apt

new machines are installed

new components are added
Goal: Build Computing Clusters using Experiment Nodes

Problem: Explosion of Configurations!

(snapshot- and simple script-based approaches don’t scale)
Proposed Strategies

• DevOps: treat infrastructure as code

• Develop modular, reusable infrastructure code

• Explore interactions between components

• Change perspective: from “bags of scripts” to “hierarchies of roles”

• Find balance between simplicity and flexibility

• Transparently support different hardware
Implementation

- Used Chef, a configuration management system (CMS)

- On CloudLab, built a profile that turns an experiment into a Chef “cluster”
  - https://www.cloudlab.us/p/utahstud/ChefCluster

- Enabled easy integration of public and private infrastructure code
  - Chef Supermarket and emulab/chef-repo on GitHub

- Developed *recipes*, *cookbooks*, and *roles* for building computing clusters
Configuration Management System: Enables “Orchestration”

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Operating System

Software

Results

Dynamic Configuration

CloudLab
Demo

CloudLab, Chef, Supermarket
Putting Things Together

More information: hands-on tutorial at [http://cloudlab.us/chef](http://cloudlab.us/chef)  
(presented at the GENI Regional Workshop at ASU in March 2016)
Thank you!

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