EPHEMERAL DEVOPS: ADVENTURES IN MANAGING SHORT-LIVED SYSTEMS

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Who am I?

- DevOps Engineer at Unity Technologies
- Security Enthusiast
- Enormous fan of config management

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WHAT ARE EPHEMERAL SYSTEMS
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- Dynamically destroyed
- Usually heterogeneous
What did I build?

- Create and destroy about 600~1,000 heavyweight virtual machines an hour
  - Most of those run extremely CPU and disk intensive operations
- Updating existing and new VM configurations takes seconds
- Upgrades can be rolled out or rolled back in production extremely quickly
- Small team (three people) maintains it
- Bootstrapped with vSphere + Puppet
WHY EPHEMERAL SYSTEMS?
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- Non-containerized applications
  - Desktop apps
  - Legacy apps
  - Complex VMs

But why?
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  - Multiple OSes
  - Multiple configurations
  - Multiple patch targets
  - Lots of iterative testing
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- Existing infrastructure
  - New flexibility without breaking anything
  - Doesn’t require buying new hardware
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- Testing
  - Rapid, immediate feedback with new code
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- Experimenting
  - Rapidly deploy on-the-fly changes
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- **Simulating**
  - Fully leverage dynamic environment configuration management tools
  - r10k (Puppet)
  - grinder (Salt)
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- **Parallelization**
  - Building
  - Testing
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- Don’t have budget for new data centers or administrators
Why Ephemeral Systems in Security?

Exploit Development

- Write a revision, grab a target from multiple different pools of targets, destroy when done!
- Make a pool for every target
- Hook the grab, use, and destroy VM loop for every test script
Why Ephemeral Systems in Security?

Clean Slate Experimentation

- Rapidly deploy on-the-fly changes
- Simply call the API to destroy a machine at the conclusion of every test
- New machines for every run
- No more restore from snapshot
Why Ephemeral Systems in Security?

Dynamic Behavior

- Simulate changes in active installations
- Simply commit a change to a Hiera data file, run Puppet
- Need something even more dynamic? Make a Puppet Environment branch, deploy, and run the same machine against both branches
- No need to manually modify machines, all are still built from the same template
Why Ephemeral Systems in Security?

Narrowed Attack Window

- Non-containerized applications tend to stick around a long time
- Complex VM requirements
  - Non-Linux OSes
  - Specific patch levels
  - Custom software installations
- Treat these VMs as containers
  - Create, use, destroy, loop, all via API
Why Ephemeral Systems in Security?

Information Isolation

- No more wiping machines or rolling back to snapshots and hoping nothing is left on disk
- Grab a VM, use it, and dump it
- When the old one is destroyed it takes its environment with it, ensuring no disk recovery within the VM
TOOLS
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- vSphere
  - VMs
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- Redis
- BIND
- ISC-DHCP-Server
- *Dynamic DNS Updates from DHCP Server*
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- Coffee
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- Self configuration
  - Puppet
  - Hiera
  - VMware GuestInfo Variables (hostname, pool, DNS, etc)
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- Cleanup scripts
Build: Flow
Puppet

- Autosigner

- Certificate cleanup
  - Remove old & dead node certs, reinventory

- Nodes cleaning script
  - Reports, facts, nodes
Build: Support

- **Puppet**
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- **VmPooler**
  - Logrotate for vmpooler.log
  - Install provided init script
Puppet
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Nodes cleaning script
- Reports, facts, nodes

VmPooler
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vSphere
- Ramdisk cleaner
Build: Monitoring

- Pools empty
- PuppetServer, PuppetDB down
  - Full disk
  - Too many files in a dir to remove
  - Certificates
- BIND/DHCP issues
  - Logging can get massive
- Weird vSphere things
  - Ramdisk fills up from creating/destroying VMs
PERFORMANCE
Performance

- PuppetServer holds up well
  - 4 Cores, 16GB RAM, Linux
  - Around 600~1,000 VMs per hour
  - Load avg: 3.0 ~ 5.0
  - Creating certs, deleting certs, signing certs, compiling catalogs
Performance

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  - vSphere VM itself may fall over, taking the API with it
  - Needs restarting every six to nine months, YMMV
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- **DHCP/BIND holds up okay...mostly**
  - Once a year or so stops adding/removing, just restart
Usage: General

- Get a box
  - `curl -d --url vmpooler.somewhere.com:4567/api/v1/vm/[vm-type]`
  - Checks out a box, [box hostname]

- Use that box

- All done? Dump the box
  - `curl -X DELETE --url vmpooler.somewhere.com:4567/api/v1/vm/[box hostname]`

- Loop
Usage: Parallel Testing Batches

- Array of tests
- Get boxes
  - Loop over retrieval for array of boxes
  - `curl -d --url vmpooler.somewhere.com:4567/api/v1/vm/[vm-type]`
- Run block of tests against array of boxes
- All done? Dump the boxes
  - Loop over array of boxes
  - `curl -X DELETE --url vmpooler.somewhere.com:4567/api/v1/vm/[box hostname]`
- Loop
Usage: Dynamic Environments

- New Puppet branch, need to test
- Get a box
  - `curl -d --url vmpooler.somewhere.com:4567/api/v1/vm/[vm-type]`
  - Checks out a box, [box hostname]
- SSH to that box
- Let’s config that box
  - Normal mode: `puppet agent --test`
  - New feature: `puppet agent --test --environment [featurebranch]`
- All done? Dump the box
  - `curl -X DELETE --url vmpooler.somewhere.com:4567/api/v1/vm/[box hostname]`
- Loop
- Merge Puppet branch
Usage: Dynamic App Behavior

- Make a new Puppet environment, [newbehavior]
  - Users, configs, whatever needs to be simulated in Hiera and Manifests
  - Deploy with r10k

- Get a box
  - `curl -d --url vmpooler.somewhere.com:4567/api/v1/vm/[vm-type]`

- SSH to that box, alter the app behavior
  - Normal behavior: `puppet agent --test`
  - New behavior: `puppet agent --test --environment [newbehavior]`

- Test

- All done? Dump the box and branch
  - `curl -X DELETE --url vmpooler.somewhere.com:4567/api/v1/vm/[box hostname]`
  - `git push origin :[newbehavior]`
MAINTENANCE
Maintenance

- These examples are using Puppet
- These sorts of concerns will affect ANY tool doing config management
  - Salt, Chef, CFengine, Puppet, all have the same concerns
  - They all expect nodes to live a long time
- Maintenance is...different
- Ephemeral VMs die all the time, that’s okay
- If any component dies, the pools drain
- Drained pools are bad
- Bad pools are sad pools
Maintenance

- vmpooler.log
  - Size, rotation, needs monitoring
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- vSphere stops responding
EXTENDING
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- TerraForm + Packer
  - TerraForm for management hosts
  - Packer for management hosts & Ephemeral VMs
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  - Calls to VmPooler API
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- Containers for management components
  
  VmPooler has a container, but it includes Redis (heavy)
  Redis containers exist
  Puppet containers aren’t 100% supported (but work!)
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- TerraForm + Packer
  - TerraForm for management hosts
  - Packer for management hosts & Ephemeral VMs
- ChatOps
  - Calls to VmPooler API
- Containers for management components
  - VmPooler has a container, but it includes Redis (heavy)
  - Redis containers exist
  - Puppet containers aren’t 100% supported (but work!)
- Removing PuppetDB
  - If you aren’t using the data or collections, it can only fail here
  - Lose speed on compilation, YMMV
Extending

- One more wild idea
Extending

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- Remove PuppetServer from Ephemeral VM loop
  - Go full standalone
  - Use “puppet apply” to self-configure
  - Use Packer scripts to prebuild only parts from Hiera and Codebase relevant to an Ephemeral VM type
  - Lose flexibility for testing quickly
  - Gain reliability on the server side
  - No more certificate cleanup
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- Puppet is awesome!
- Dynamic DNS + DHCP is awesome!
- Dynamic pools are awesome!
- Everything is awesome!
Apply What You Have Learned Today

- Deploy toolchain VMs
  - Vmpooler, DHCP + Bind, PuppetServer + PuppetDB
- Reconfigure BIND for Dynamic DNS Updates
- Create pool templates
  - OSes, patch levels, installed software, desired targets
- Experiment!
  - Exploit Development (Usage: General | Parallel Testing Batches)
  - Clean Slate Experimentation (Usage: General | Dynamic Environment)
  - Dynamic Behavior (Usage: Dynamic App Behavior)
  - Narrowed Attack Windows (Usage: General | Dynamic App Behavior)
  - Information Isolation (Usage: General | Dynamic Environment)
QUESTIONS