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Efficient and Scalable OS Provisioning with Kadeploy3

Emmanuel Jeanvoine, Luc Sarzyniec and Lucas Nussbaum

Key features

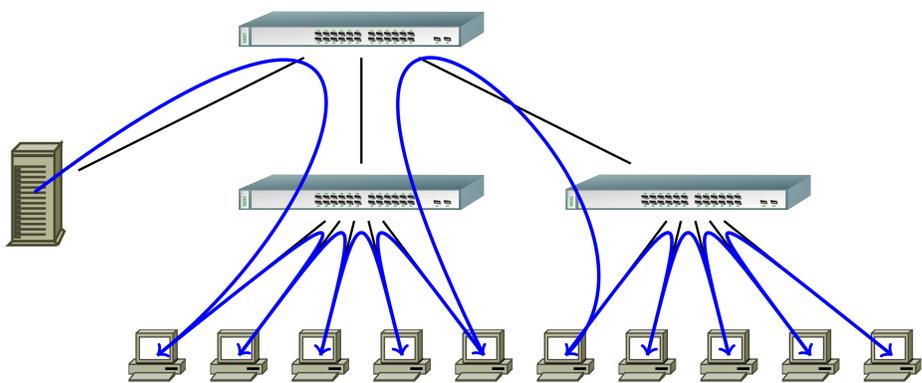
- ▶ **Install and configure a large number of nodes**
 - ▶ Install several cluster in one shot
 - ▶ Support for concurrent deployments
 - ▶ Control several clusters from a single client
- ▶ **Manage a library of pre-configured system images**
 - ▶ User-provided images
 - ▶ Visibility of images (shared, private)
- ▶ **Reliability of the installation process**
 - ▶ Customizable workflow engine
 - ▶ Windowed operations
 - ▶ Escalation of low-level remote commands
- ▶ **Hardware compatibility**
 - ▶ Built on top of PXE, DHCP, TFTP/HTTP
 - ▶ Remote operations based on SSH
 - ▶ Customizable remote low-level operations (IPMI, ...)
- ▶ **Software compatibility**
 - ▶ Support any operating system (Linux, *BSD, Windows, ...)
 - ▶ Integration with batch scheduler and network isolation tools
 - ▶ Remote control API

Scalability

System image broadcast

Goal: Send a big file on thousands of nodes
Challenge: Avoid network bottlenecks, saturation of links

- ▶ **Several alternatives available**
 - ▶ Chain, Tree, Bittorrent, ...



- ▶ Default alternative: **Topology-aware chain broadcast**
 - ▶ Parallel tree-based initialization of the chain
 - ▶ **Saturation of full-duplex** network in both directions
 - ▶ Efficient on networks composed of **hierarchy of switches**

Parallel operations

Goal: Executing commands on thousands of nodes
Challenge: Avoid client overloading, gather commands outputs

- ▶ Based on **TakTuk** (<http://taktuk.gforge.inria.fr>)
- ▶ **Hierarchical connections** between nodes
- ▶ Adaptive work-stealing algorithm
- ▶ **Auto-propagation** mechanism

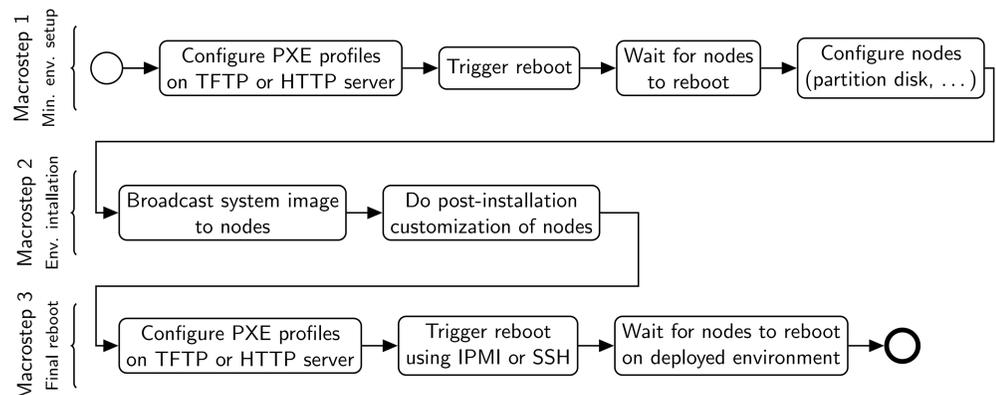
Reliability

Reliable workflow engine

Goal: Manage the installation process

Challenge: Handle hardware & network failures, customization

- ▶ Engine based on **event automata**
- ▶ **Fallback methods** in case of failure
- ▶ Timeouts and retries at every step
- ▶ A typical workflow example:



Reliable reboot and power operations

Goal: Trigger remote reboot and power on/off on nodes

Challenge: Reliability, compatibility

- ▶ **Compatibility** with remote hardware managements protocols
- ▶ **Escalation** of several level of administrator defined commands
- ▶ Managing groups of nodes (e.g. PDU reboots)
- ▶ **Windowed operations** (DHCP flood, electrical hazards, ...)

Evaluation

- ▶ Key software on Grid'5000 **since 2009**
 - ▶ **25 clusters on 10 sites**
 - ▶ 620 users, **170 000 deployments**
 - ▶ about **10 mins** to deploy 130 nodes
- ▶ Virtualized infrastructure
 - ▶ **4000 VMs** dispatched on **635 physical nodes**
 - ▶ **3838 nodes** successful in a single shot in **less than 1 hour**

Software suite

- ▶ **Management of images**
 - ▶ User custom images
- ▶ **Rights management**
 - ▶ Compatibility with batch scheduler
- ▶ **Statistics collection**
 - ▶ Identify hardware issues, ...
- ▶ **Frontends to low-level tools**
 - ▶ Reboot and power on/off operations, serial consoles
- ▶ **DEB** and **RPM** packages
- ▶ Actively developed since 2009

<http://kadeploy3.gforge.inria.fr/>