Toward Broad-Spectrum Autonomic Management

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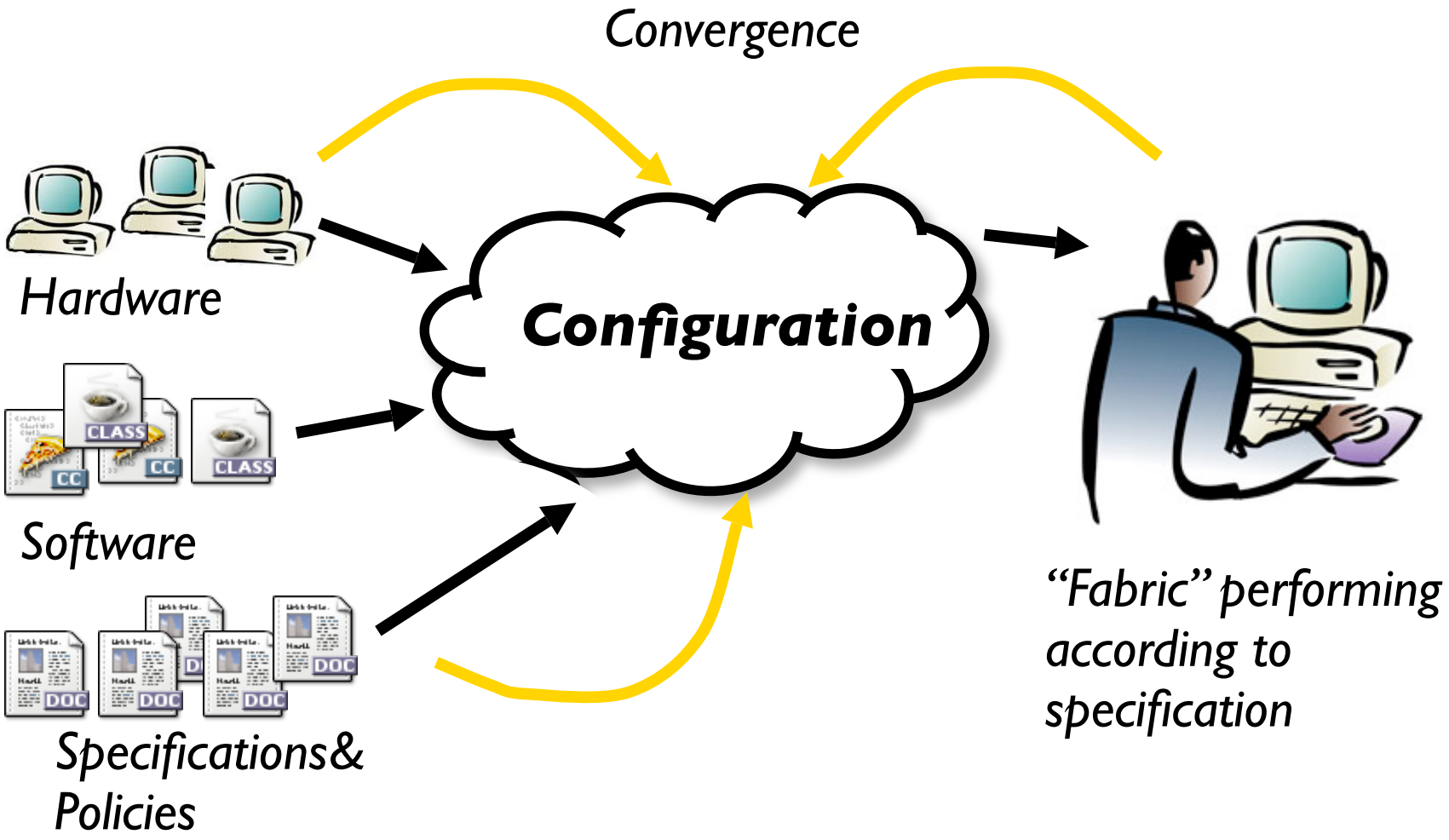
Overview

- Background
  - *"system configuration" & "autonomics"*
  - *a comparison & a practical illustration*
- The problem
  - *most practical "fabrics" require elements of both*
  - *this means that there is usually no clear declarative specification for the fabric configuration*
- *A proposed approach*
  - *a integrated multi-resolution framework*
  - *further research*

System Configuration



System Configuration

- Starting with:
  - *several hundred new machines with empty disks*
  - *a repository of all the necessary software packages*
  - *a specification of the required service*
- Load the software and configure the machines to provide the service
- This involves many internal services:
  - *DNS, LDAP, DHCP, NFS, NIS, SMTP, Web …*
  - *the relationships are most important*
- Maintain the specification when things change
  - *either the requirements, or the system (failures)*

Autonomics

- Autonomic computer systems are ones which:

  "Maintain and adjust their operation in the face of changing workloads, demands, and external conditions, and in the face of hardware or software failures of innocent, or malicious origin."

  J Kephart

Autonomics

- Autonomic operations can occur at any level in the configuration "stack" -
  - *recreate a corrupt configuration file on one host*
  - *restart a failed daemon on one host*
  - *redeploy a service to another host when a host fails*
  - *configure extra hosts into a cluster when the overall load increases*
- Autonomics can be thought of as the automation of the entire system configuration process

A comparison

- The fields of *Autonomics* and *System Configuration* have evolved in separate communities with a different emphasis -
  - *System configuration* provides ways of specifying and managing the configuration of an infrastructure, and "low-level" autonomics
  - *Autonomics* provide solutions to "high-level" automation, such as service migration
- Current practical installations use elements of both

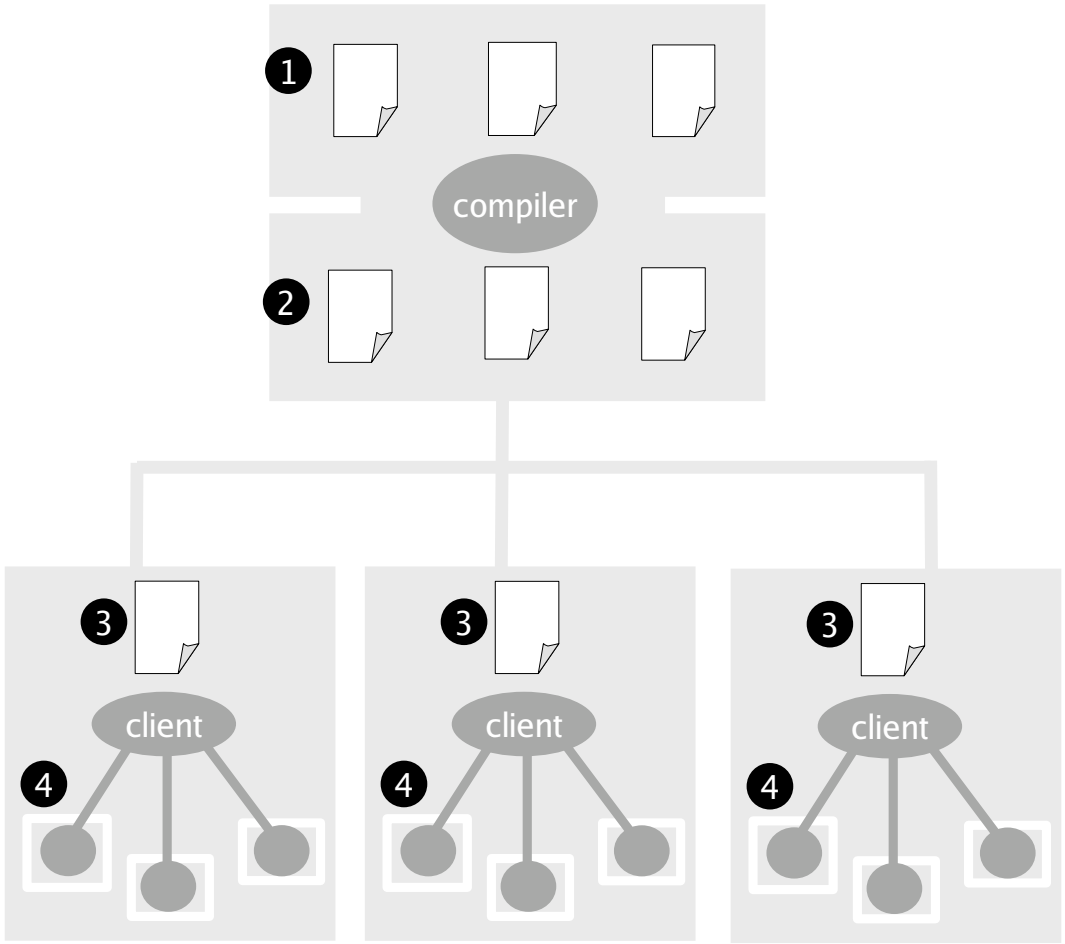
An example

- A high-level autonomic process may determine which nodes are to be used to provide the elements of a web-service - web front-end, database etc.
  - *this will handle service migration and reconfiguration in response to load or failures*
- Lower-level system configuration tools support (re-)configuration of the underlying infrastructure
  - *DNS, Kerberos, firewall holes, backups, etc.*

The problem

- Modern system configuration tools allow the fabric configuration to be maintained from an explicit declarative specification.
- This is important -
  - *we can reason about the configuration - eg. for security verification*
  - *we can compose multiple aspects*
- If the configuration is manipulated by a separate autonomic layer, then the overall declarative specification is usually lost

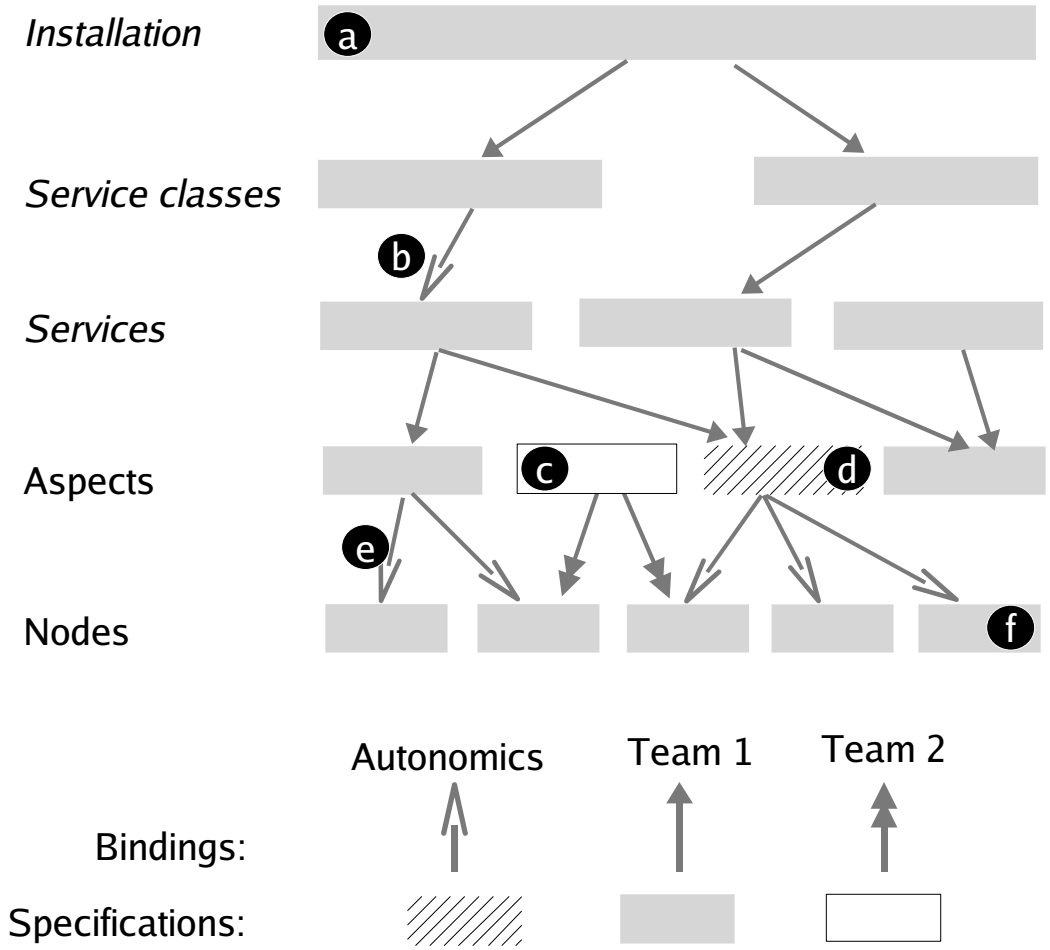
An example - LCFG



What do we need?

- A model which supports a uniform configuration process at all levels
- Manual and autonomic elements of the specification must be integrated so that it is possible to reason across the whole system
  - *for example, about authorisation*
- Autonomic components must generate configurations which are governed by declarative constraints
  - *"loose" specifications*

A multi-resolution framework



Further research

- Specification languages -
  - constraints (mcfg)
  - aspect composition (mcfg)
  - authorisation (cfgas)
  - multi-resolution specifications
- Deployment
  - distributed evaluation
  - deployment sequencing

Some Links

- Slides:
  http://homepages.inf.ed.ac.uk/dcspaul/publications/icn2007-slides.pdf
- Paper:
  http://homepages.inf.ed.ac.uk/dcspaul/publications/icn2007.pdf
- Paul Anderson
  http://homepages.inf.ed.ac.uk/dcspaul
  <*dcspaul@inf.ed.ac.uk*>
- LISA, Large installation System Administration Conference
  November 11th-16th 2007, Dallas
  http://www.usenix.org/events/lisa07/