Languages for Large Scale System Configuration

John Hawkins

Laboratory for the Foundations of Computer Science
University of Edinburgh

System Configuration

- Need to configure large groups of machines

- Traditionally done using scripts or disk imaging

- Tools such as Cfengine useful but problematic

- Move towards use of declarative languages for specification of configuration

- Current declarative languages still have drawbacks

LCFG

- Developed by Paul Anderson, University of Edinburgh 1994
- Central configuration repository
- Configurations compiled from 'header files' into profile
- Profiles shipped to hosts
- Hosts run set of 'components' which manage configuration
- Language relatively basic
- Use of C Preprocessor for file inclusion and override macros
- Data represented as key-value pairs

Requirements for Future Languages

- Increased scalability (over 1000 nodes)

- Removal of dependence on central server

- Looser specification, particularly with use of constraints

- Improved support for devolved management teams

- Reduced ambiguity in source syntax

- Better understood language semantics

- Improved support for dynamic reconfiguration, to cope with rapidly changing requirements and failure recovery

- Increased ease of adoption

A Language Based on Partially Ordered Maps

- Propose to base language around unified data structure
- Pomap – pair consisting of set of tag, value pairs and set of constraints
- Tag can map to a value, or another pomap
- Basic types – scalars, records, partially ordered sets
- User defined types may be added
- Three phases to compilation
  - Translation of source to pomap representation
  - Composition of pomap fragments
  - Evaluation to produce final values
- Currently working on static configuration problem, but will extend to dynamic configuration

Grid Configuration

- Important to ensure correct low-level configuration of nodes
- Dynamic reconfiguration of nodes to meet specific requirements of individual jobs
- For example, job depends on particular version of gcc
- Higher-level configuration tasks, eg configuring web/Grid services
- Some work at Edinburgh on Grid configuration