



the Next Generation

Paul Anderson
Division of Informatics
University of Edinburgh
<paul@dcs.ed.ac.uk>

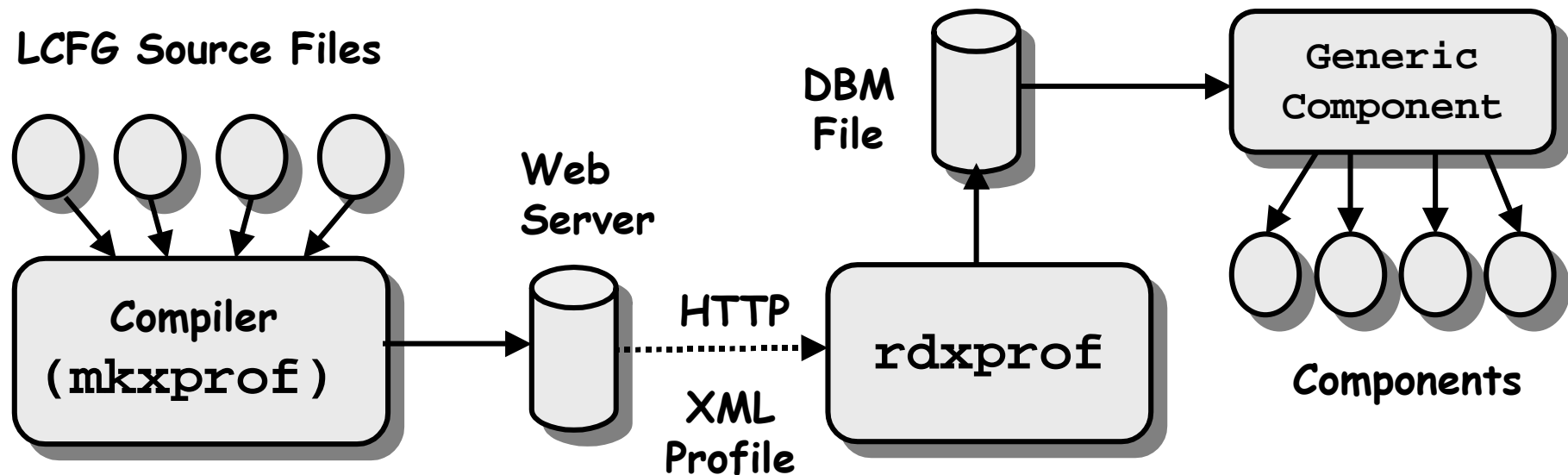
What is LCFG?

- A system for automatically installing and maintaining the configuration of large numbers of Unix systems.
- Supports very diverse configurations - from laptops to servers.
- Supports the tracking of rapidly changing configurations.
- Supports devolved management of different aspects of the configuration.
- Modular, extensible architecture.

Some History

- Originally developed under Solaris for internal use in the Computer Science Department at Edinburgh (~1993).
- Considerably reworked for the port to Linux. Now the primary (only) platform (~1998).
- More upgrading for use on the testbeds of the European DataGRID (~2001).
- Current being expanded for use in the Informatics Division at Edinburgh (750 machines).
- Currently being packaged for wider use.

LCFG Architecture



- Source files are compiled into per-machine "profiles".
- The profile is transmitted to the clients over HTTP.
- "Components" on the client create the local configuration files according to the profile.

Summary

- The LCFG Profile
- The Client Side
 - Retrieving the profile.
 - LCFG components.
 - Updating software.
 - Booting & Installing.
- The Server Side
 - Specifying configurations.
 - Languages and compilers.
- General Issues

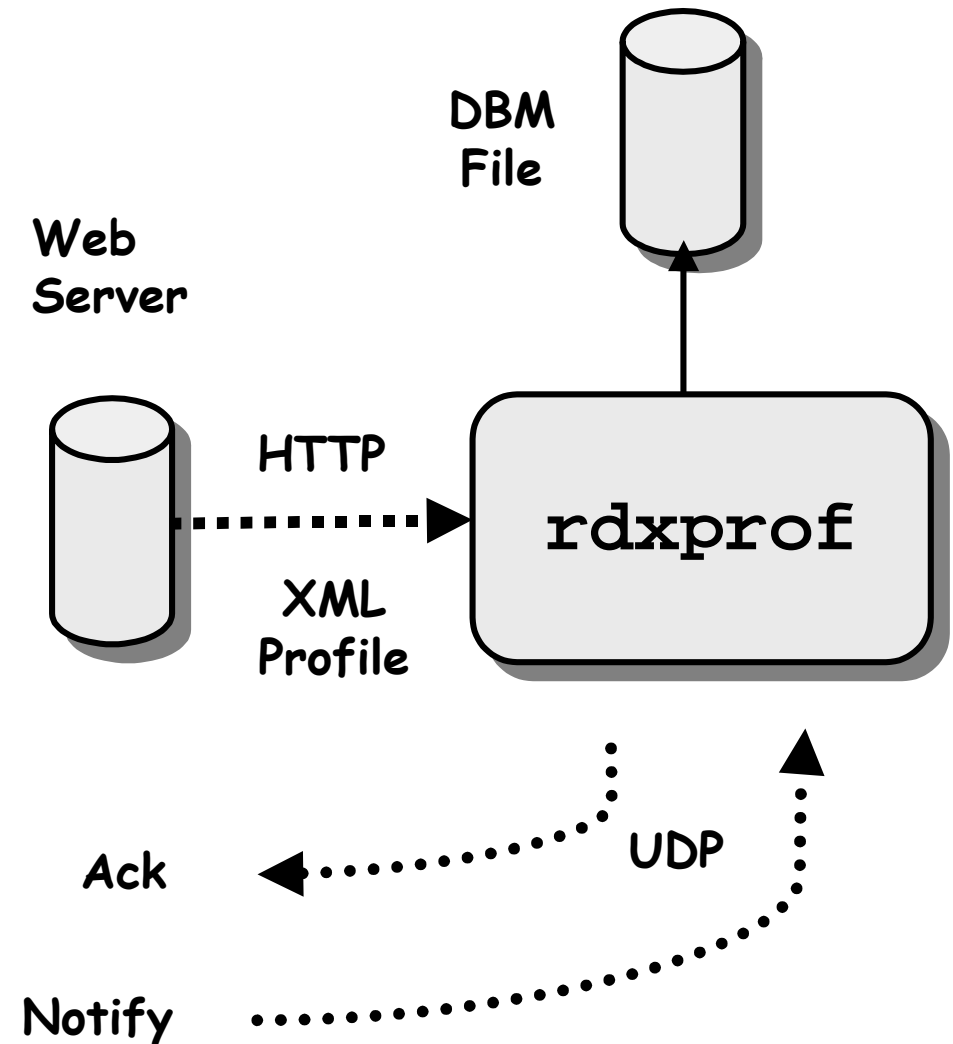
The LCFG Profile

- The profile includes all the information which makes this machine unique.
- Each component has a corresponding section in the profile.
- The meaning of profile elements depends on the component which interprets them.
- New components can be easily added.

```
<profile>
  <mail>
    <relay>
      mailhub@foo.com
    </relay>
    ...
  </mail>
  ...
  <disks>
    <disk1>
      ... partition info ...
    </disk1>
    ...
  </disks>
```

Retrieving the Profile

- The compiler sends a UDP notification when the profile changes.
- The client retrieves the profile from the Web server.
- The client polls for new profiles in case the notification is lost.
- The client sends acknowledgements to the server which can maintain a web page of client states.



An LCFG Component

- An LCFG component accepts "method" arguments similar to a System V init script.
- The "config" method is called when the profile changes.
- If the configuration is changed while the component is running, it is not always obvious what action to take.

```
start:  
  configure  
  init.d/daemon start  
  
stop:  
  init.d/daemon stop  
  
configure:  
  read profile  
  create config files  
  restart daemon  
  (if necessary)
```

Component Support

- LCFG includes support for components in shell script, or Perl.
- In each case, a “generic component” provides a superclass with defaults for all methods, and supporting functions.
- An underlying Perl library provides access to the profile and other common functions.
- Template handling functions allow configuration files to be generated very easily from resources in the profile.

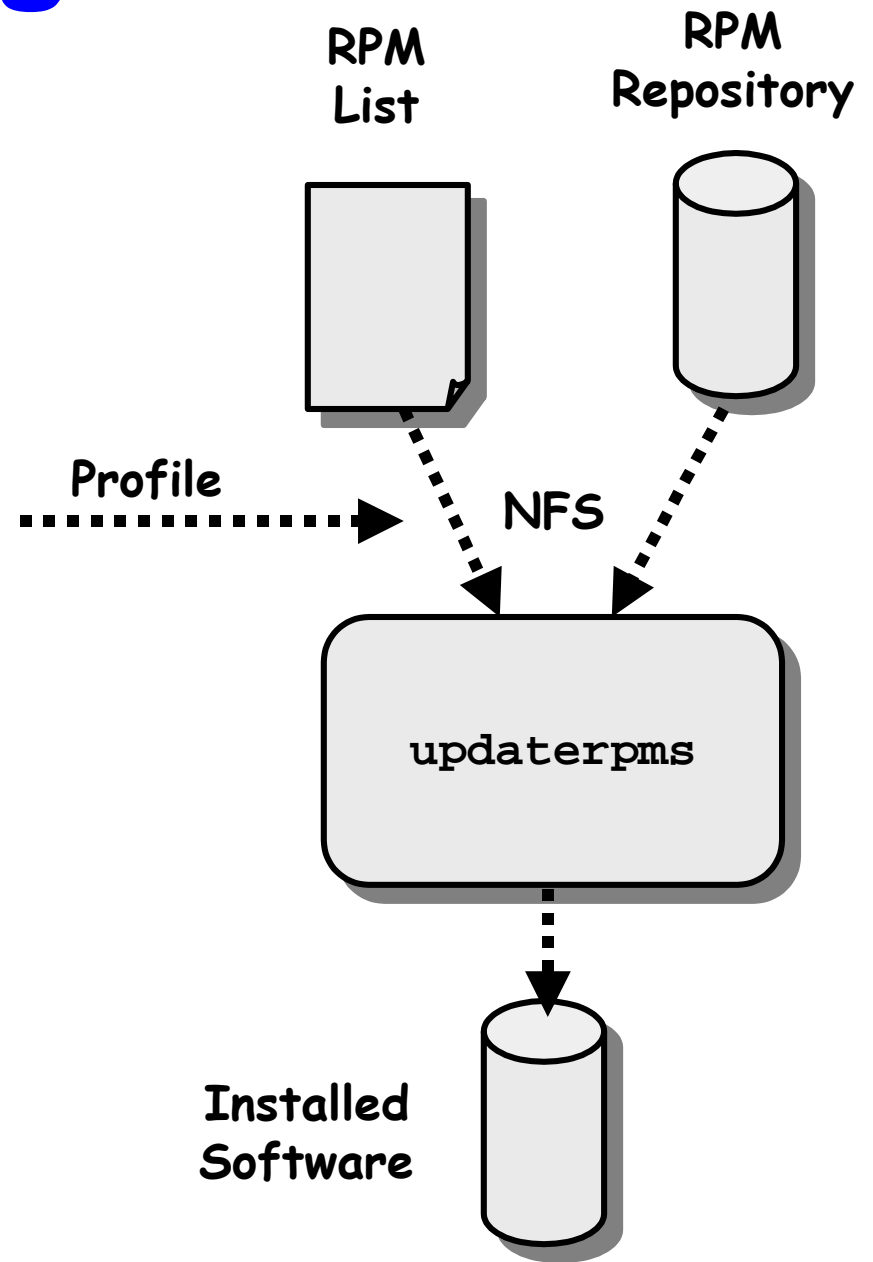
Some Components

- Mailng - sendmail
- Xntp - time service
- Vmware - vmware
- DNS - DNS configuration
- Lpd - printer
- Apache - web service
- Postgres - database

..... Around 50 components on our systems ...

Software Updating

- The “updaterpms” component installs and deletes RPMs from the machine to make the installed RPMs match the required configuration.
- Currently, the list of required RPMs is contained in a separate file, referenced from the profile.
- Currently the RPMs themselves are retrieved over NFS.



Booting & Installation

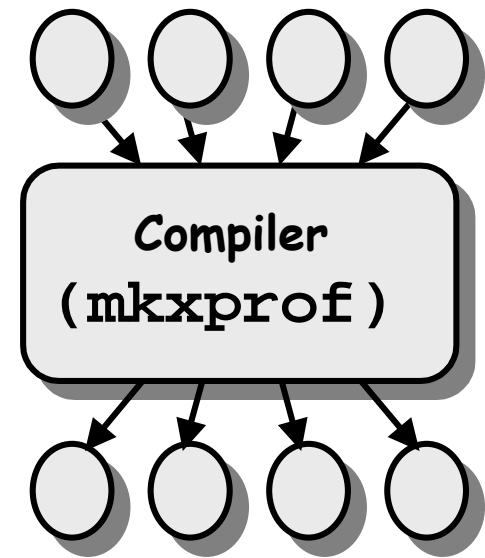
- The “boot” component runs from the init system to start/stop all other components.
- A new machine is installed by booting a simple “installroot” filesystem from a floppy, CD, or network. This:
 - Fetches the profile.
 - Calls a special “install” method on some components to perform install-specific functions (partition disk).
 - Calls “updaterpms” in the normal way to load the required software.
 - Reboots the machine.

Specifying Configurations

- The configuration for each machine is specified in a source file.
- Source files normally include other source files specifying different "aspects":
 - "student machine"
 - "laptop"
 - "web server"
- The compiler combines the different aspects to create an explicit profile.
- Different aspects can be managed by different people.

(on the server)

LCFG Source Files



Profiles

Compilers

- Languages for specifying configurations and aspect combining are an interesting research area.
- The current production LCFG compiler is based around the use of Perl regular expressions to "mutate" values when combining aspects. (The C preprocessor is used for file inclusion).
- The EDG compiler is a prototype compiler based on a purpose-designed language.

LCFG Source Files

```
hardware.keyboard pc101
```

```
boot.services inet auth mailng .....
```

```
#include "toshiba4300.h"  
#include "redhat62.h"  
#include "staff-machine.h"  
#include "portable.h"
```

```
EXTRA(boot.services) kdm
```

```
OVERRIDE(hardware.keyboard) happy
```

Some Properties of LCFG

- Unattended installation
 - Including re-installs on new hardware with no loss of configuration.
- Guaranteed up-to-date configurations
 - Important for security.
- Ability to add new components easily
- “Explicit” representations of the configuration
 - Allows configuration parameters to be validated before application.
 - Allows configurations to be generated automatically from different languages.
- Aspects
 - Support devolved management.

Some Other Issues

- Contexts

Allow rapid switching between different variants of a configuration.

- Dynamic Parameters

May need to be incorporated from information which is not available in the profile.

- Security

Profile transport can be secured by TLS.
UDP is more difficult.

Some Future Issues

- Monitoring

To monitor the actual state of a configuration.

- "Intrusion Levels"

To delay certain configuration changes until an appropriate time.

- ACLs

Per-resource ACLs are a language feature that would be very useful, allowing different people to modify only certain aspects of a machine's configuration.

Availability

- The LCFG web site is currently under construction.
- This contains most software and documentation, but it is likely to be about the end of March before it contains a coherent version of the software that can be easily extracted and installed at a remote site:

<http://www.lcfg.org>