www.dcs.ed.ac.uk/~paul/publications/deployment.pdf

Software Deployment and Configuration

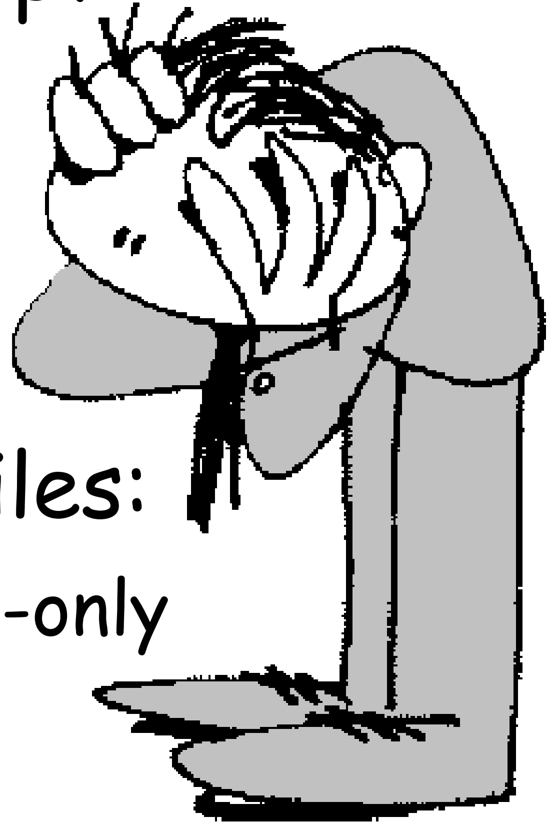
Paul Anderson
Division of Informatics
University of Edinburgh
<paul@dcs.ed.ac.uk

Configuration And Deployment

- Configuration (in this context) is the process of customizing an instance of a software package for:
  - A particular site
  - A particular host
  - A particular user (we will not address this)
- Deployment involves the installation of the software, usually on multiple, remote hosts
- Configuration can occur at different stages:
  - Build (compile) time
  - Deployment (install) time
  - Runtime

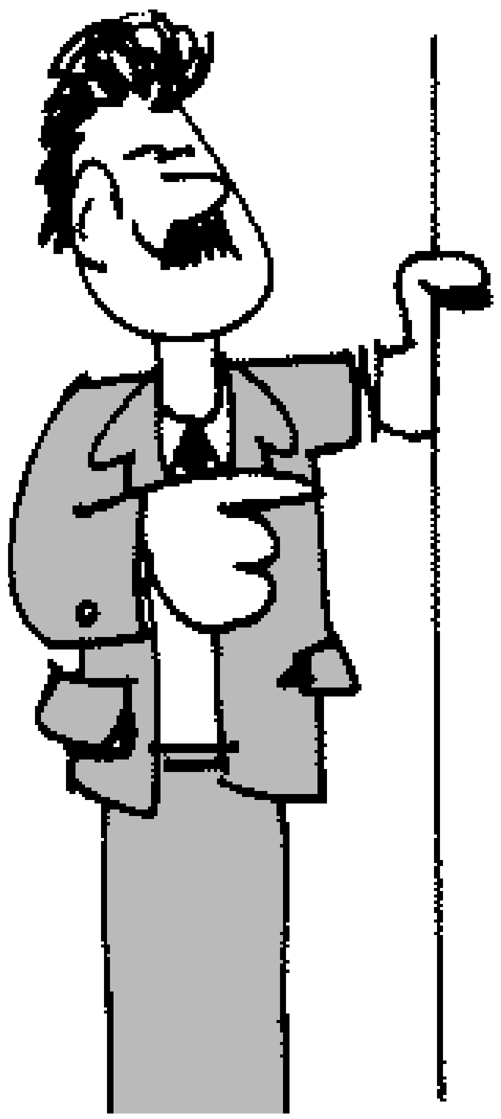
Nightmare.tgz

- The package has an INSTALL script
  - Runs unknown commands as root
  - Expects an interactive dialog
  - Edits inappropriate system files
  - Installs a daemon
- The package attempts to install files:
  - In a directory which is mounted read-only
  - For an inappropriate architecture
  - Into an automount point
- There is no way of identifying what has been installed, and no way or removing it



`~paul/Publications/Workshop_Report.pdf` (1992!)

Summary



- Choosing pathnames
- Compile-time configuration
- Packaging
  - Package management tools
  - Creating RPMs
  - Install-time configuration
- Deployment
- Runtime configuration
  - LCFG

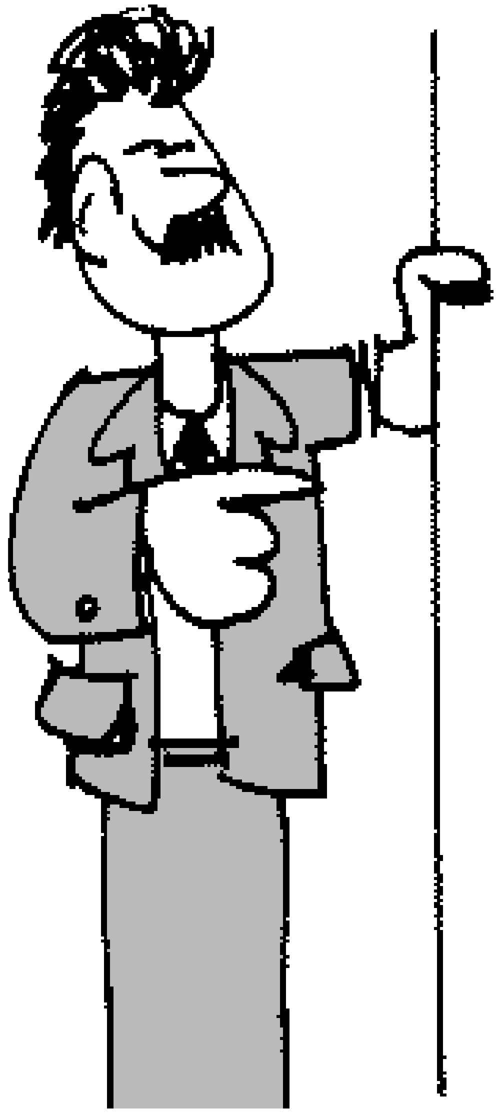
Choosing Pathnames

- Different areas of the filesystem have different properties:
  - Local or network mounted (or an automount point)
  - Single or shared architecture
  - Read-only or read-write
  - Small or large filesystem
- Different pathnames will belong to different areas at different sites
- Pathnames used at install time might not be the same as the pathnames used at runtime!
  - When installing onto a read-only network drive
  - When building RPMS (we don't have root access)

Pathname Standards

- Filesystem Hierarchy Standard:
  - Specifies guiding principles for each area of the filesystem
  - Specifies the minimum files and directories required
  - Enumerates exceptions to the principles
  - Enumerates specific cases where there has been historical conflict
- **`http://www.pathname.com/fhs/`**
- Individual sites or projects may have their own standards

Summary



- ✓ Choosing pathnames
- Compile-time configuration
- Packaging
  - Package management tools
  - Creating RPMs
  - Install-time configuration
- Deployment
- Runtime configuration
  - LCFG

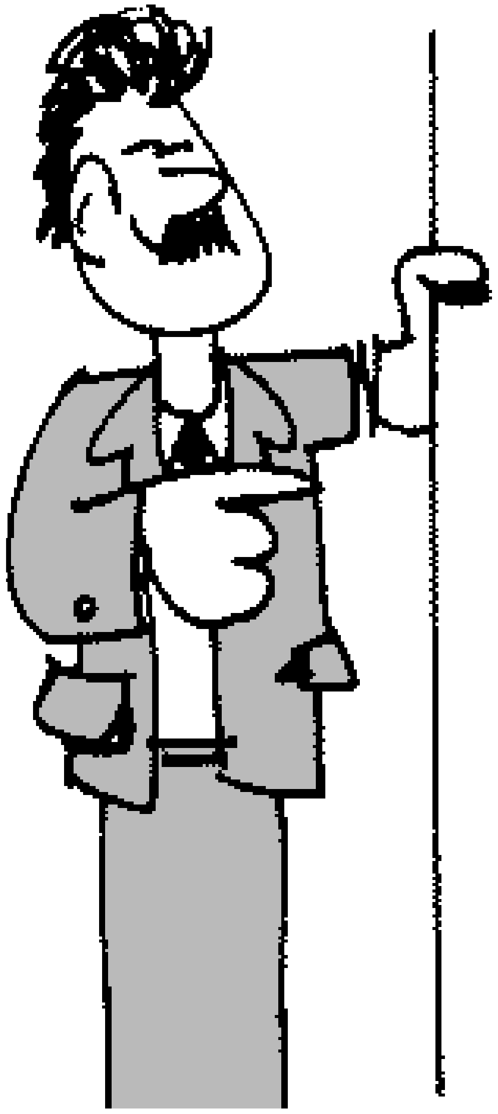
Compile-time Configuration

- It is not always practical to allow everything to be configured dynamically at runtime
  - Eg. Selecting a threading or non-threading library
- Some parameters must be fixed at compile time
- Compile-time configuration leads to multiple (different) versions of the binary package, and care is required to distinguish between these “flavours”.
- Configuration should be part of the standard build process

Compile-time Tools

- In simple, cases, storing configuration information in a single header file may be sufficient.
- In a multi-package project, simple ad-hoc scripts might be used to substitute parameters from a common configuration file
  - **`www.dice.informatics.ed.ac.uk/doc/dice-buildtools.pdf`**
- GNU autoconf is a tool based on an extensible set of m4 macros which can automatically detect many different aspects of the system.
  - Discovered parameters can be used to generate C header files, or substituted in other text files
  - User-supplied parameters can be included
  - **`http://www.gnu.org/software/autoconf/`**

Summary



- ✓ Choosing pathnames
- ✓ Compile-time configuration
- Packaging
  - Package management tools
  - Creating RPMs
  - Install-time configuration
- Deployment
- Runtime configuration
  - LCFG

Packaging

- A (good) packaging tool supports:
  - Bundling of files into an archive format
  - Recording of filenames to enable de-installation
  - Handling of version numbers to support upgrading
  - File conflict detection
  - Dependency management
    - Run-time dependencies
    - Build-time dependencies
    - Install-time dependencies
  - Execution of pre/post install/de-install scripts

Package Management Issues

- Full benefits are only gained if all the software on a system is handled by the same package management system
  - On many platforms, this is not always possible (and required software may be unavailable in the necessary format)
- Support for "flavours" is not well developed and usually involves encoding in the package filename.
- Some or all files in a package may be "relocatable" so that a pathname prefix can be set at install time

Pre/Post Install Scripts

- Pre/Post install scripts are a frequent source of installation problems. They should be avoided if possible. Otherwise:
  - Ensure that actions taken at install time can be (and are) reversed at de-install time
  - Do not modify files belonging to other packages
  - In particular, do not modify system configuration files - /etc/passwd, /etc/inetd.conf, etc..
  - Do not assume the availability of user-interaction, or even a console device
- If some modifications to the system-wide configuration are necessary is is useful to document these, and/or to provide a separate script.

Package Management Tools

- RPM
  - Manages all software packages on Redhat Linux systems
  - **`http://www.rpm.org/`**
- GPT
  - The Globus packaging tool
  - **`http://www-unix.globus.org/packaging/`**
- Solaris pkgadd
  - **`http://sunsite.org.uk/solaris_freeware/pkgadd.html`**
- Conversion between some formats is possible automatically: Eg. GPT => RPM

RPM

- An RPM package is created from:
  - Packed source file (**`foo.tgz`**)
  - Patches (**`foo1.patch`**)
  - Spec file (**`foo.spec`**)
- A single command can build the package:
  - **`rpm -ba foo.spec`**
- This creates a binary RPM with the architecture as a “flavour” in the filename:
  - **`foo-2.35-1.i386.rpm`**
- It also creates a source RPM (SRPM) containing everything necessary to rebuild from the source:
  - **`foo-2.35-1.src.rpm`**

Creating RPMs

- Creating RPMs involves
  - Packaging sources into a tar file
  - Writing a specfile
  - Using rpm -ba
- This process should be integrated with the build process
  - It is useful to be able to reconstruct a whole set of RPMs from a CVS repository.
  - This is possible, if each module supports, for example: "**`make rpm`**"
- Building multiple package formats for the same package may be necessary to support multiple platforms

A Skeleton Specfile

```
Summary: .. description
Name: foo
Version: 2.35
Release: 2
Source: foo-2.35.tgz

%prep
%setup foo-2.35.tgz

%build
make
```

```
%install
make install

%files
/usr/bin/foo
```

A Real Specfile (1)

```
Summary: change protection on Zip disk
Name: ziplock
Version: 1
Release: 2
Copyright: GPL
Group: Utilities/System
Source: ziplock-1-2.tgz
Packager: Paul Anderson<paul@dcs.ed.ac.uk>
BuildRoot: /var/tmp/ziplock-build
```

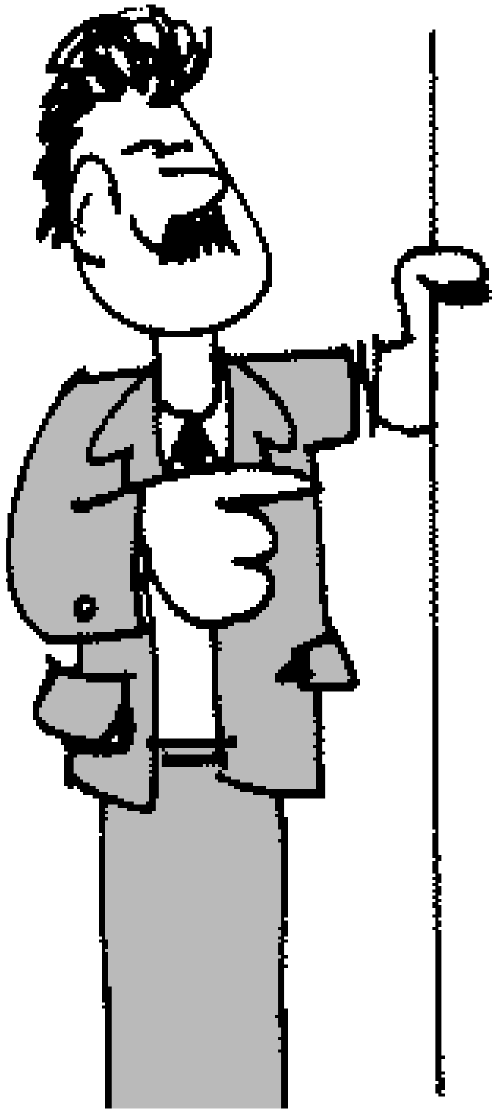
A Real Specfile (2)

```
%description
This program .....


%prep
%setup ziplock-1.2


%build
make
```

A Real Specfile (3)

```
%install
rm -rf $RPM_BUILD_ROOT
mkdir -p $RPM_BUILD_ROOT/usr/bin
mkdir -p $RPM_BUILD_ROOT/usr/man/man1
make install PREFIX=$RPM_BUILD_ROOT
%files
%defattr(-,root,root)
%doc README ChangeLog TODO
%doc /usr/man/man1/ziplock.1
/usr/bin/ziplock
```

Summary



- ✓ Choosing pathnames
- ✓ Compile-time configuration
- ✓ Packaging
  - Package management tools
  - Creating RPMs
  - Install-time configuration
- ▪ Deployment
- ▪ Runtime configuration
  - LCFG

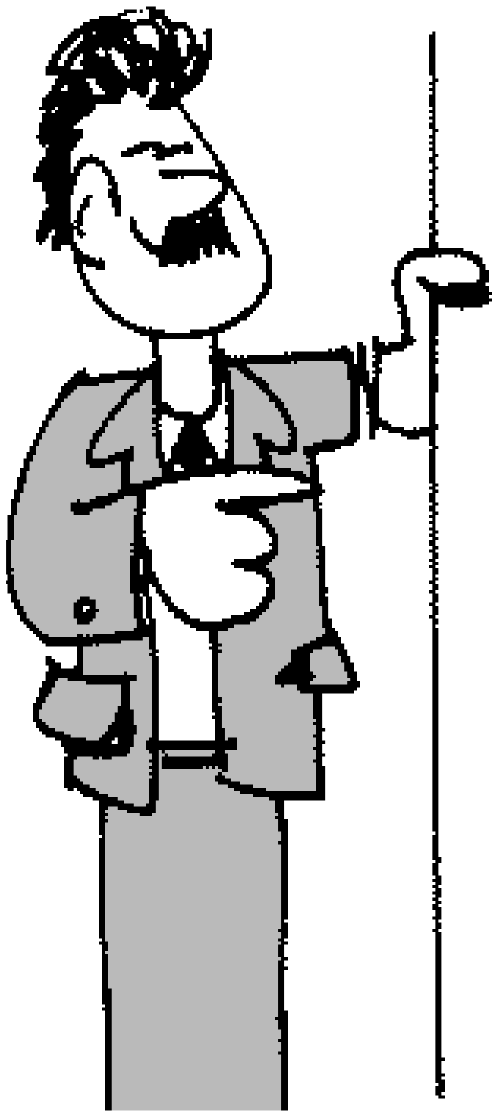
Installation

- A binary RPM can be installed with a single command:
  - `rpm –i foo-2.35-1.i386.rpm`
- This:
  - Validates prerequisite dependencies
  - Checks for file conflicts
  - Executes and pre-installs scripts
  - Installs the files
  - Records the installed files in a database
  - Executes and post-install scripts
- The rpm can later be removed with:
  - `rpm –e foo`

Deployment

- Large-scale deployment tools will manage the packages on a cluster of machines by automatically scheduling installs, de-installs and the correct ordering for updates.
  - Eg. **`updaterpms`**
  - **`www.dcs.ed.ac.uk/home/ajs/linux/updaterpms/index.html`**
- The required package sets for each machine are specified in a central configuration file
- Correct dependency information is important
- Some tools will automatically monitor a repository for newer versions

Summary



- ✓ Choosing pathnames
- ✓ Compile-time configuration
- ✓ Packaging
  - Package management tools
  - Creating RPMs
  - Install-time configuration
- ✓ Deployment
- Runtime configuration
  - LCFG

Run-time Configuration

- Runtime configuration is typically performed by reading configuration files
  - (Although, a program might also use external data sources such as LDAP)
- Any configuration files deployed with the code can only be considered as a default because they usually need to contain host-specific information
- Normally, the local site will provide some way of populating these configuration files
- Existing configuration files must not be overwritten when updating an RPM version!

LCFG

- LCFG is a configuration framework developed At Edinburgh University and currently being used by the European DataGRID testbeds
    - `www.lcfg.org/`
- Site-wide configuration information is specified in a central configuration repository which is compiled into individual host "profiles"
- The XML profiles are distributed to the clients over HTTP
- Scripts on the clients substitute parameters from the profile into individual configuration files

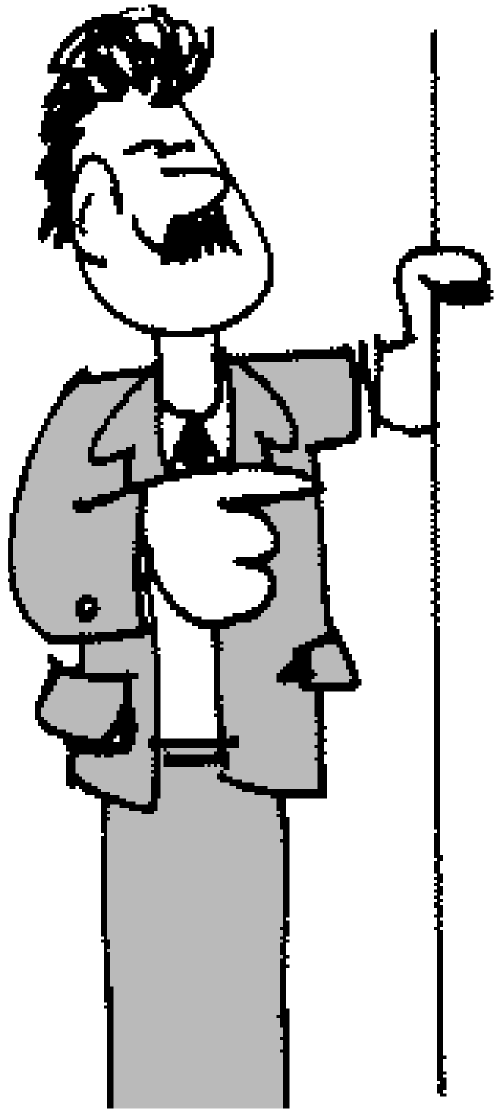
An LCFG Template File

```
# The name of the maildrop file
mmdflfil: .mail
# Hardcoded POP server name
pophost: <%mhpop%>
# List of smtp servers
<%if:<%mhsmtp%>%><%else:%>#<%end:%>
servers: <%mhsmtp%>
```

Dynamic Reconfiguration

- LCFG will normally update configuration files as soon as a central configuration change occurs
- Daemons must be prepared to reconfigure “on-the-fly” wherever possible, either on receipt of a signal, or by monitoring the configuration file for changes
- Programs can access LCFG configuration information directly

Summary



- ✓ Choosing pathnames
- ✓ Compile-time configuration
- ✓ Packaging
  - Package management tools
  - Creating RPMs
  - Install-time configuration
- ✓ Deployment
- ✓ Runtime configuration
  - LCFG

Some Key Points

- Use (global or local) standard pathnames, but make them configurable
- Integrate compile-time configuration and package construction with the build system
- Distribute software in a standard package format
- Avoid intrusive install scripts
  - If changes are required to other parts of the system, allow the system manager flexibility in how this is achieved
- Be prepared to reconfigure long-running processes "on-the-fly"