

Automated Installation of Operating System and Control System

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Abstract

With respect to the TESLA[3] project it's required to install, configure and run thousands of front-end computers. These procedures should be automated and predictable. The first installation, the upgrade of a system and the exchange of a defect node should be completely automatic. The loss of data should be minimal. With the Distributed Object Oriented Control System DOOCS[2] and the Debian[4] GNU/Linux Operating System we have demonstrated such a system at the TESLA Test Facility. It's realised with the Full Automatic Installation FAI[5] which is based on a class concept. To install a new node it's only necessary to register the MAC address, define the node name and the FAI classes. All software dependencies are resolved by the Debian package system and all Control System configuration are defined in FAI classes. In case of a reinstallation, the configuration is retrieved from a backup system.

1 MOTIVATION

- To be able to install hundreds or thousands of control system computers.
- Automated installation guarantees identical installations on all computers.
- Reliable installations
- Central repository of all configurations and logs.
- Solve automatically software dependencies.
- Decrease down times (quick reinstallation after breaks).
- Group computers in classes for easy management.

2 REQUIREMENTS

The following components are required for a fully automated installation of Debian GNU/Linux and the DOOCS Control System:

- A install server with Debian GNU/Linux and
 - fai, fai-kernels
(Fully automatic installation)
 - bootp or dhcp
(bootp = Internet Boot Protocol)
(dhcp = Dynamic Host Configuration Protocol)
 - tftpd
(Trivial File Transfer Protocol)
 - nfs-kernel-server or nfs-user-server
(Network File System)
- packages.
- A local Debian mirror to decrease installation time.
- All control system programs as Debian packages.
- Client computers that are able to boot from the network.

3 AUTOMATED DOOCS INSTALLATION

3.1 Initial installation of the operating and control system

It takes approximately 5 minutes to install a DOOCS front end computer and approximate 20 minutes to bring a new server online. But only for the computer itself; the administrator needs only one minute to setup the BOOTP and FAI server, that's all!

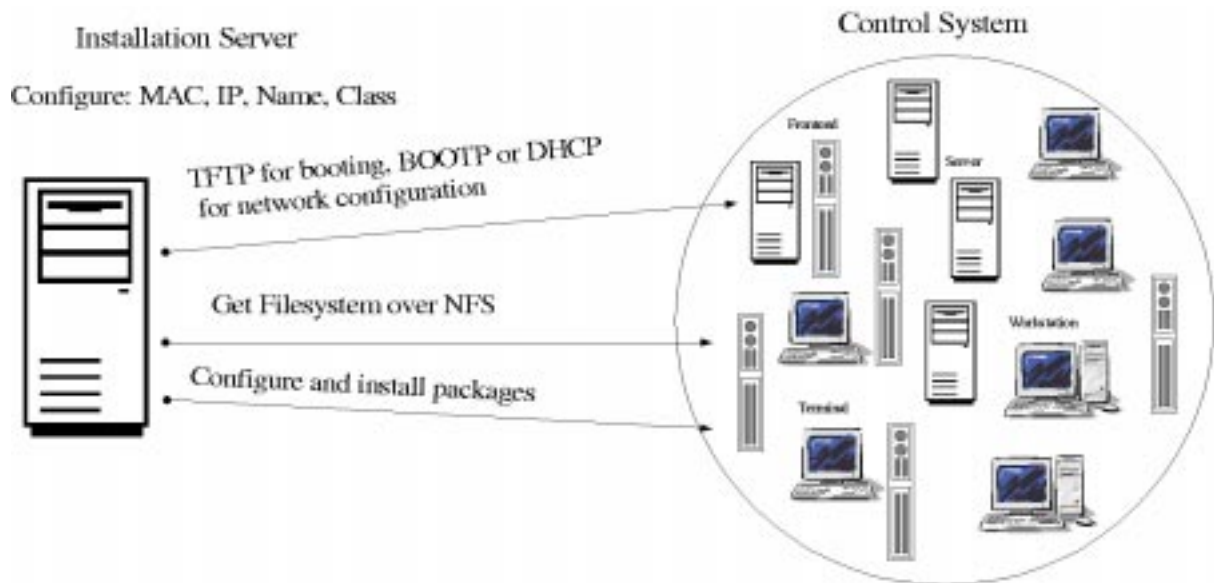


Figure 1: Sequence of Installation

Sequence of installation:

- The computer gets its network configuration with DHCP or BOOTP.
- Loads the kernel image via TFTP.
- Root file system over NFS (no local disk usage for installation).
- Partitioning the harddisk.
- Create file systems on local harddisk.
- Installation of software packages.
- Configuration of operating system, programs and control system.
- Save the installation logs on the install server.
- Boot the new system.
- That's it.

3.2 Upgrade, service and extention

To upgrade a debian system to the latest version of all software packages currently installed, one needs only two commands to execute.

\$ apt-get update

To resynchronise the package index files from the corresponding installation server.

\$ apt-get upgrade

To install the newest versions of all packages currently installed on the system.

For upgrade, service and extention of the systems a script was developed that executes the required commands on all computers. The behaviour of the script can be controlled with parameters. There are parameters for the commands to execute, sequential or parallel execution, type e.g. class or list of computers on which commands should be executes, which command for remote acces to use e.g. ssh and one can define the default character on stdin. Stdout and stderr is written together into a log file.

\$ debian_update -B -TFILESERVER

Reports a detailed log which can be analysed.

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$ grep -i error /tmp/rcmd.20975
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$ grep -i offline /tmp/rcmd.20975
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For service and extensions the same technics are used.

3.3 System Exchange

In case of a hardware failure the following steps are required:

- Switch off the defect computer.
- Enter a spare computer into the configuration file of the bootp server.
- Then start the normal installation procedure.
- At the end of the normal installation procedure the last DOOCS server configurations and archives are installed from the backup (the loss of data is minimal).
- **After reboot the system is completely restored to a state of the last backup.**

4 THE REAL WORK

The real work is to find the best structure for the computer system. It needs to be extendable, easy

changeable and simple.

As an example a brief description of the class configuration for a front-end computer:

- TTF_CLUSTER
Defines some general software packages to install, a generic harddisk configuration and the root password.
 - NETWORK
Takes care of some network configurations (disable fingerd, talkd, ntalkd, rexecd, discard, daytime, identd in inetd.conf; create eth0 configuration, resolv.conf, copy ssh_known_hosts)
 - NTP
Configures the network time protocol daemon
 - BOOT
Create kernel modules configuration, called at boot-time.
 - DOOCS_FRONTEND
Installs some major DOOCS software packages, defines the general nfs mounting philosophy for an front-end and configurs the general DOOCS packages.
 - TMAP
Installs for example the DOOCS temperature-mapping server and configures it.
 - DOOCSRECOVER
Looks into the main DOOCS backup and if needed, it copies the last DOOCS archive and config files for this computer in to the correct place.
- The classes TTF_CLUSTER, NETWORK, NTP and BOOT will also be used by other computer types. The class DOOCS_FRONTEND is the base of all front-end computers, and the class TMAP is only for one DOOCS server as an example.

5 EXPERIENCE

5.1 Installation

During the computer installation only problems with new type of hardware or with configuration files errors occurred.

5.2 Common updates

Due to security reasons and to be able to run always the latest DOOCS software we do updates of the hole cluster e.g. once a month. No problems have been opserved.

5.3 Operating system release upgrade

We had a problem with a new default linux kernel driver and one special type of old Ethernet cards on 2 of 26 computers (from debian version 2.1 to debian version 2.2).

This allmost perfect upgrade was possible due to a upgrade test on a spare computer before.

5.4 Actual state of our cluster

1 installation server, 11 file-server, 14 front end nodes, 47 workstations or displays, 3 network gateways and 17 remote stations.

The conclusion of the experiance with system, we would do it again.

5 HISTORY

In 1994 the porting of DOOCS to linux was started. The first linux distribution was Slackware. Then we switched to the comfortable german SuSE distribution. But there was one major problem with the SuSE distribution:

It was not possible to update the SuSE distribution without local access to the computers.

In 1999 it was decided to switch to Debian. Debian has a very powerful packaging system which makes the software administration safe and easy (dependency checks, post- and preinstal scripts and a lot of tools to build own Debian packages). With Debian one is able to change the operating system versions on the fly via the network.

Debian is a free operating system based on Open Source software. It doesn't depend on any manufacturer or distributor and it doesn't depend on the market.

For most of the DOOCS programs, libraries and servers were created Debian packages. Now its "easy" to install and maintain a DOOCS-Linux Front-end, Display, Workstation or Server computer. For the maintenance a "rcmd" (remote command) script was developed. That executes commands on a group of computers in parallel and writes logfiles.

With FAI (Fully Automatic Installation) the Debian and DOOCS installation is fast, safe and easy. It's only

necessary to define the type of computer class (Front-end, File-server, ...) , register the MAC address and define the IP address. The installation is completely automatic.

6 REFERENCES

- [1]DESY Deutsches Elektronen Synchrotron
<http://www.desy.de/>
- [2]DOOCS Distributed Object Oriented Control System
<http://doocs.desy.de/>
- [3]TESLA The International Linear Collider and X-ray Laser Project
<http://tesla.desy.de/>
- [4]Debian is a free operating system (OS) for your computer
<http://www.debian.org/>
- [5]FAI Fully Automatic Installation for Debian GNU/Linux
<http://www.informatik.uni-koeln.de/fai/>