Hadoop 叢集設定解說

Setup Hadoop Fully Distributed Mode

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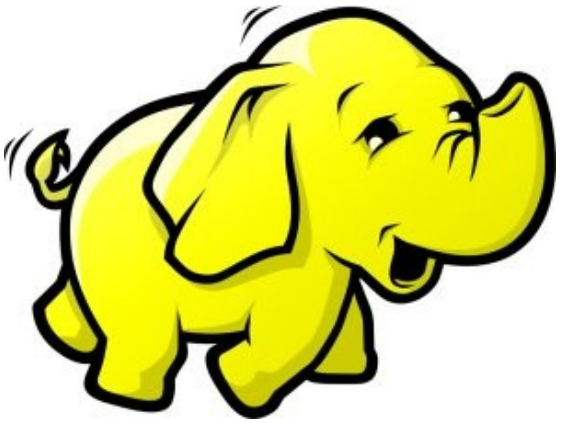


Yahoo's Hadoop Cluster
雅虎的大象軍團

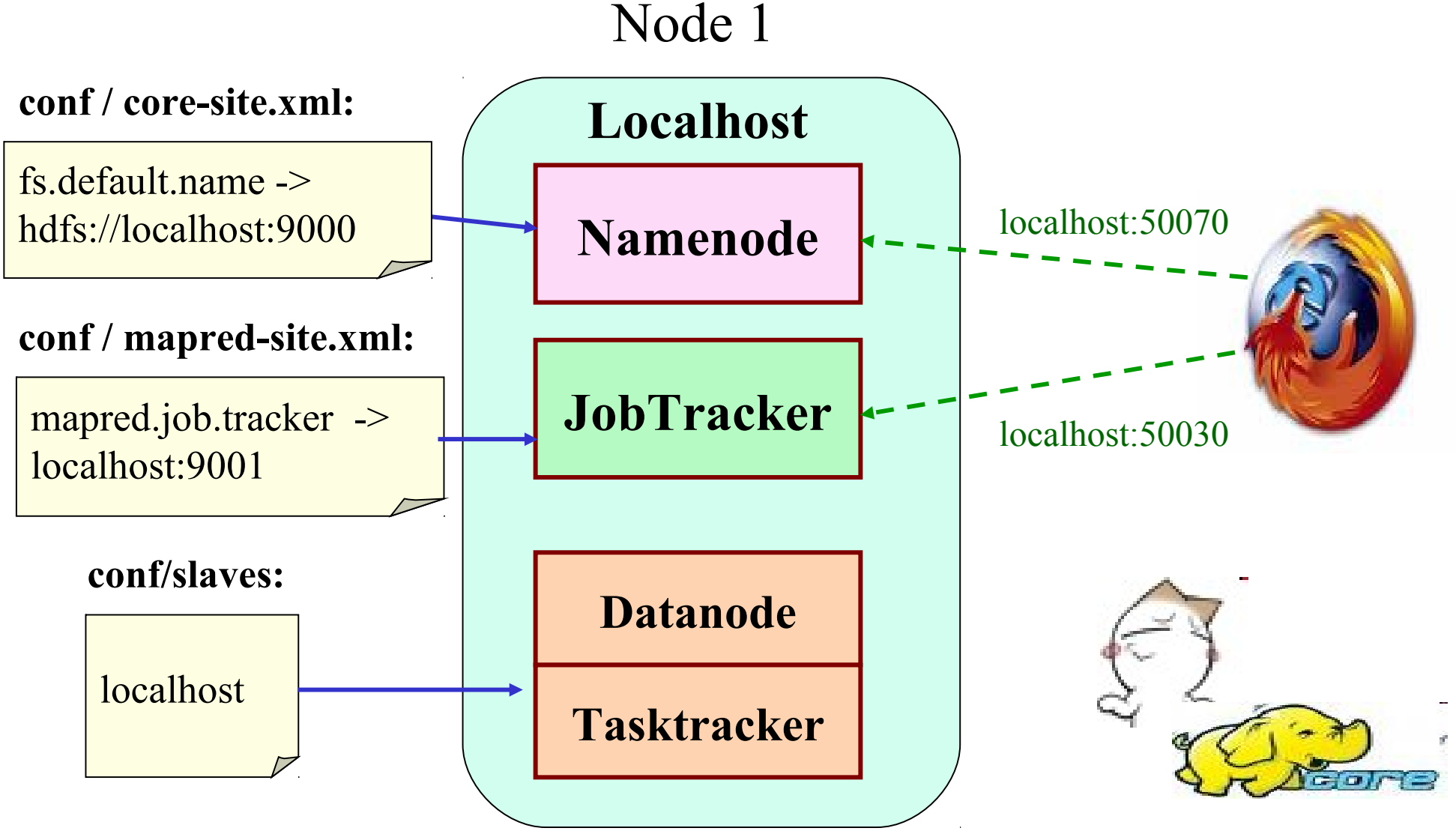
- ~10,000 machines running Hadoop in US
- The largest cluster is currently 2000 nodes
- Nearly 1 petabyte of user data (compressed, unreplicated)
- Running roughly 10,000 research jobs / week

Hadoop Pseudo-Distributed Mode
我們已經實作過單機模式

- Step 1: Setup SSH key exchange
- Step 2. Install Java
- Step 3: Download Hadoop Source Package
- Step 4: Configure hadoop-env.sh
  - export JAVA_HOME=/usr/lib/jvm/java-6-sun
- Step 5: Configure *-site.xml
  - Set Namenode to hdfs://localhost:9000
  - Set Jobtracker to localhost:9001
  - bin/hadoop namenode -format
- Step 6: Format HDFS
- Step 7: Start Hadoop
  - bin/start-all.sh
- Step 8: Complete!! Let's check the status of Hadoop
  - Job admin http://localhost:50030/ HDFS http://localhost:50070/

Diagram of Pseudo-Distributed Mode

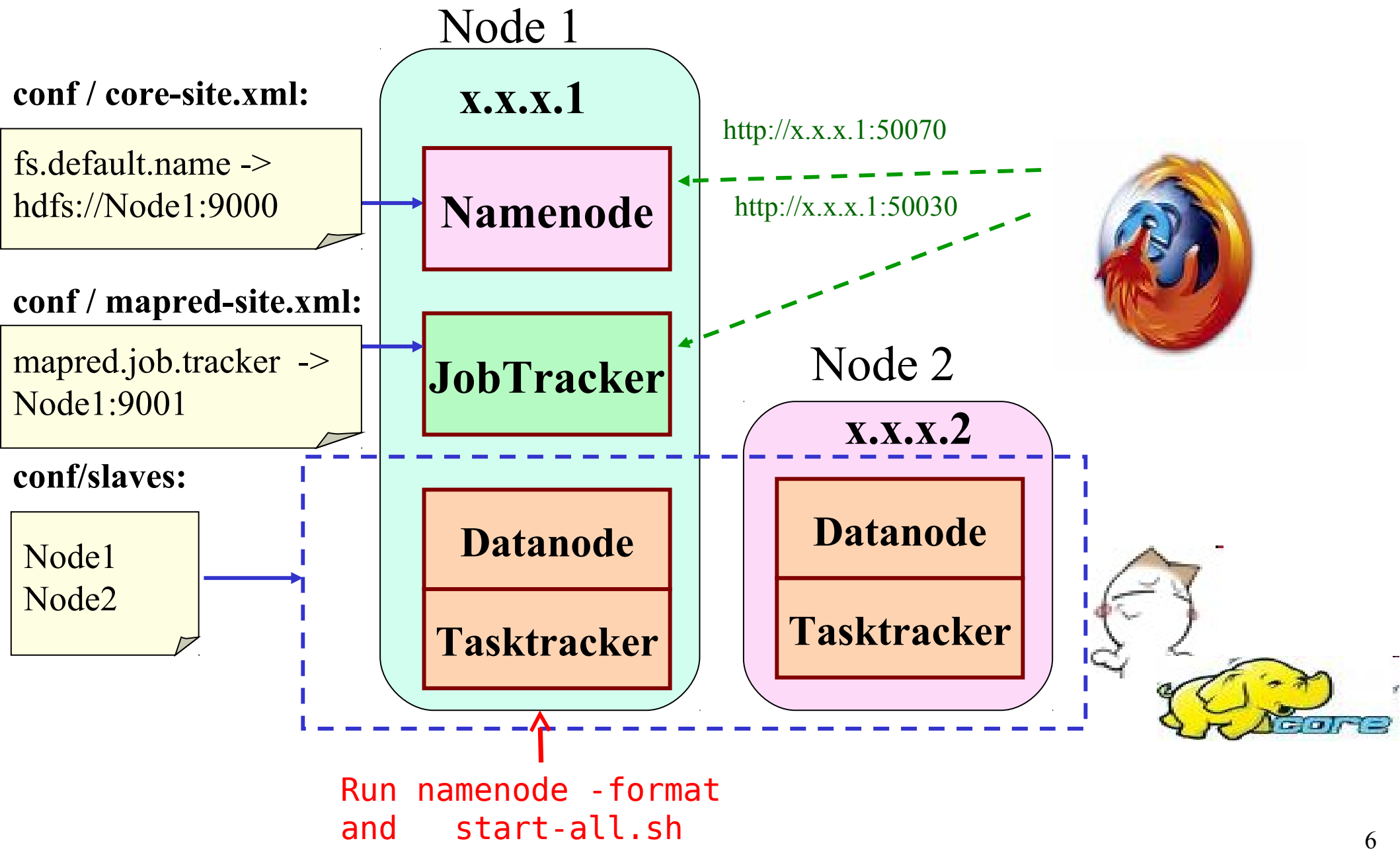
Hadoop 單機環境示意圖



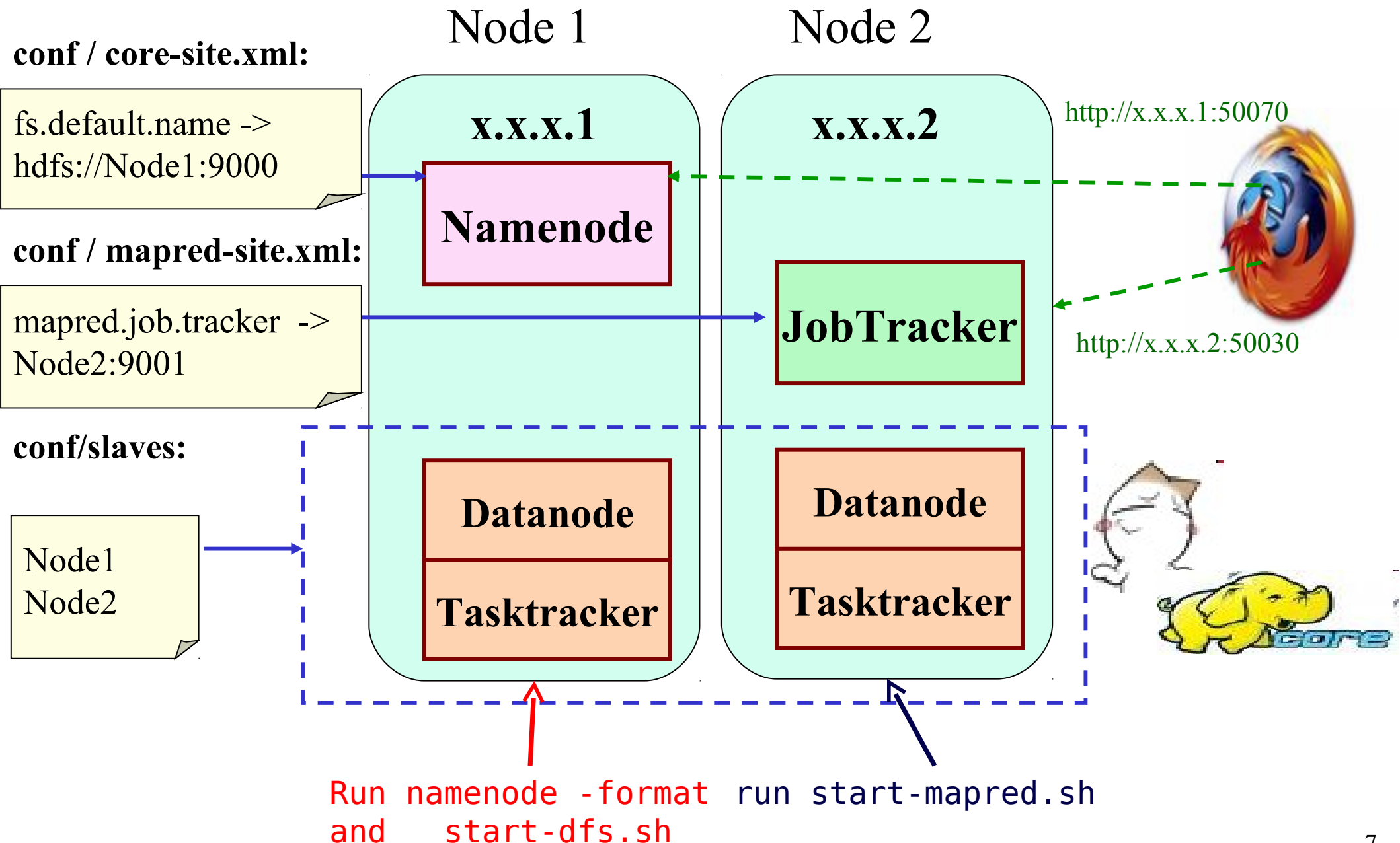
Hadoop Fully-Distributed Mode
我們接著要用兩台電腦實作叢集模式

- Step 1: Setup SSH key exchange
- Step 2. Install Java
- Step 3: Download Hadoop Source Package
- Step 4: Configure hadoop-env.sh
  - export JAVA_HOME=/usr/lib/jvm/java-6-sun
- Step 5: Configure *-site.xml
  - Set Namenode to hdfs://x.x.x.1:9000
  - Set Jobtracker to x.x.x.2:9001
- Step 6: Configure Slaves
- Step 7: Syncronization of all slaves
- Step 8: Format HDFS
  - bin/hadoop namenode -format
- Step 9: Start Hadoop
  - On NameNode ： bin/start-dfs.sh
  - On JobTracker ： bin/start-mapred.sh
- Step 10: Complete!! Let's check the status of Hadoop
  - Job admin http://x.x.x.2:50030/ HDFS http://x.x.x.1:50070/

Use case #1
設定情境一



Use case #2
設定情境二



Use case #3
設定情境三

conf / core-site.xml:

fs.default.name ->
hdfs://Node1:9000

conf / mapred-site.xml:

mapred.job.tracker ->
Node1:9001

conf/slaves:

Node2
…..
NodeN

Node 1

x.x.x.1

Namenode

JobTracker

http://x.x.x.1:50070

http://x.x.x.1:50030

Node 2

x.x.x.2

Datanode

Tasktracker

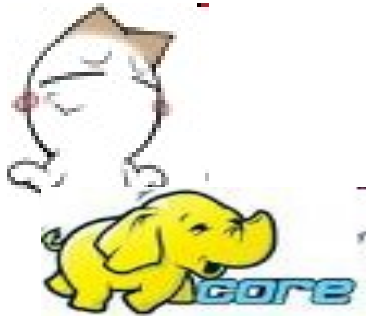
…

Node N

x.x.x.n

Datanode

Tasktracker



Use case #4
設定情境四

conf / core-site.xml:

fs.default.name ->
hdfs://Node1:9000

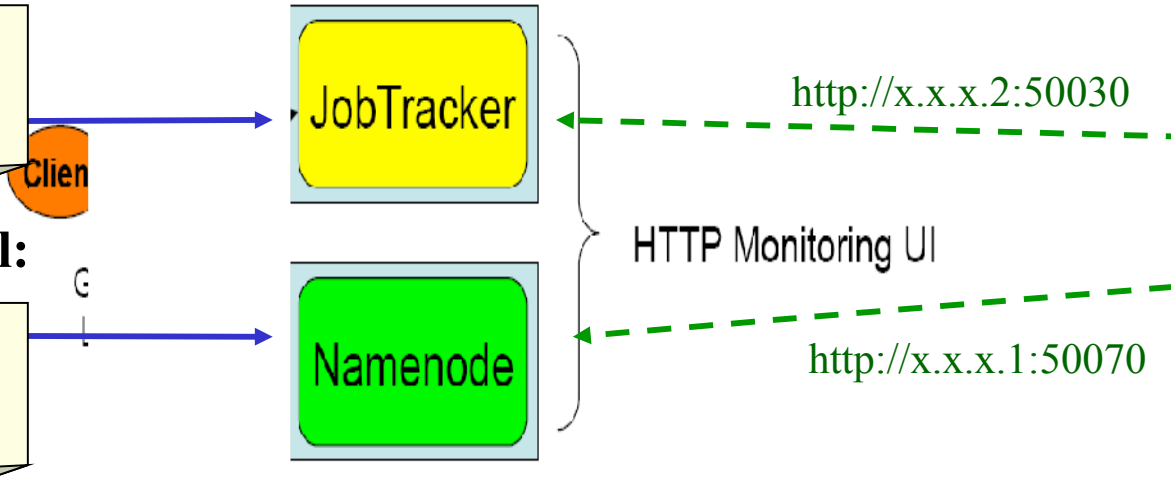
Clien

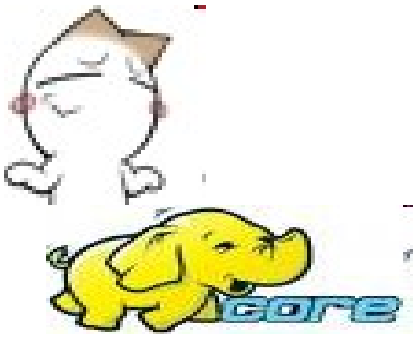
conf / mapred-site.xml:

mapred.job.tracker ->
Node2:9001

conf/slaves:

Node3
…..
NodeN





Hadoop 叢集佈署工具

Hadoop Deployment Tool : SmartFog and DRBL

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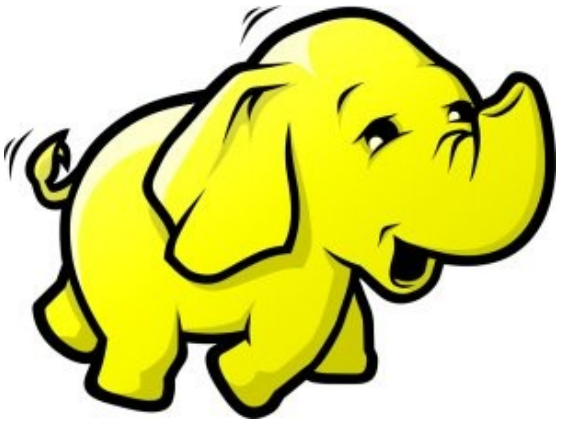

Programmer v.s. System Admin.

Source:http://www.funnyjunksite.com/wp-content/uploads/2007/08/programmer.jpg

Source:
http://www.sysadminday.com/images/people/136-3697.JPG

PART 1 :

PC Cluster 101

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At First, We have “ 4 + 1 ” PC Cluster

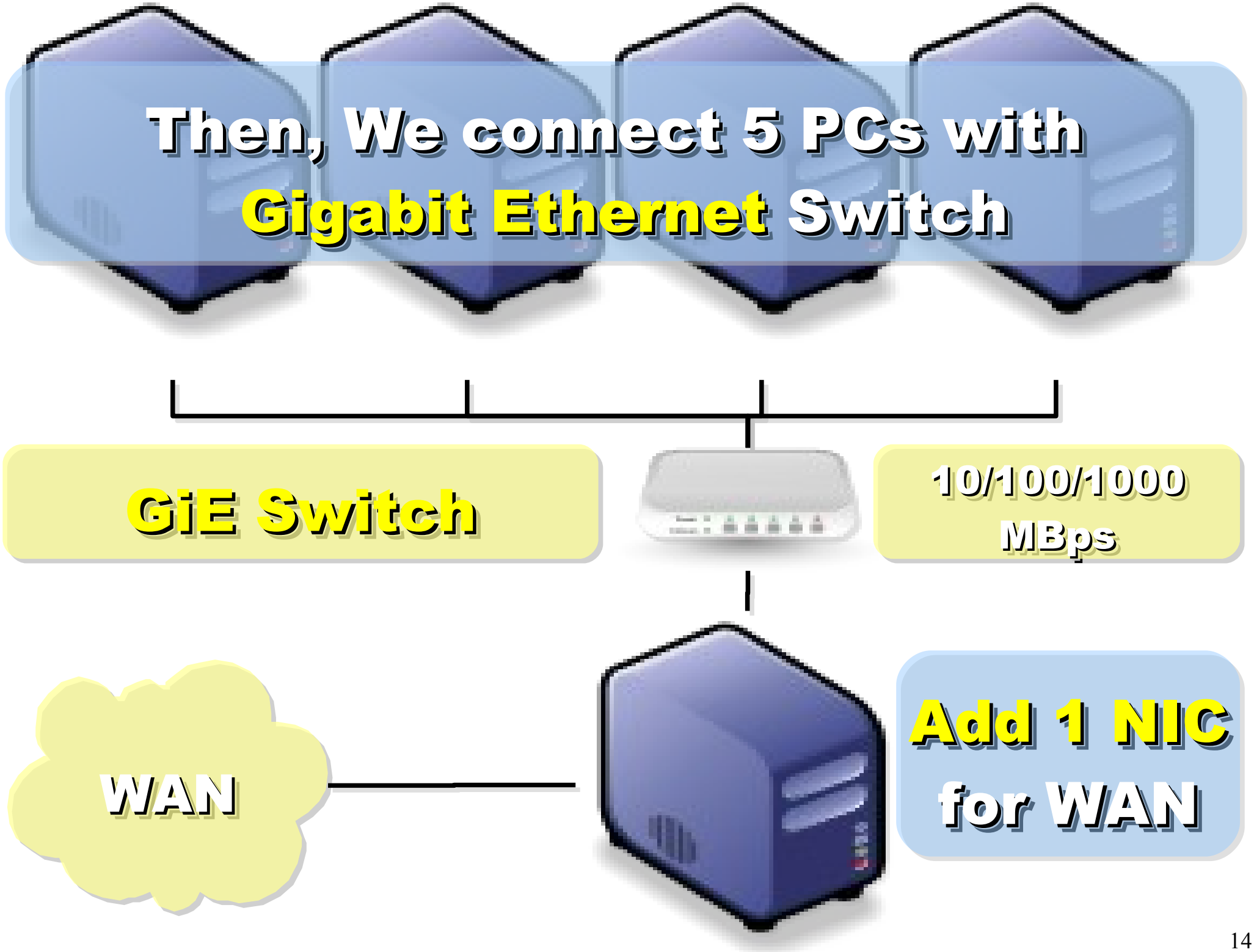
It’d better be

2^n

Manage

Scheduler

Then, We connect 5 PCs with Gigabit Ethernet Switch

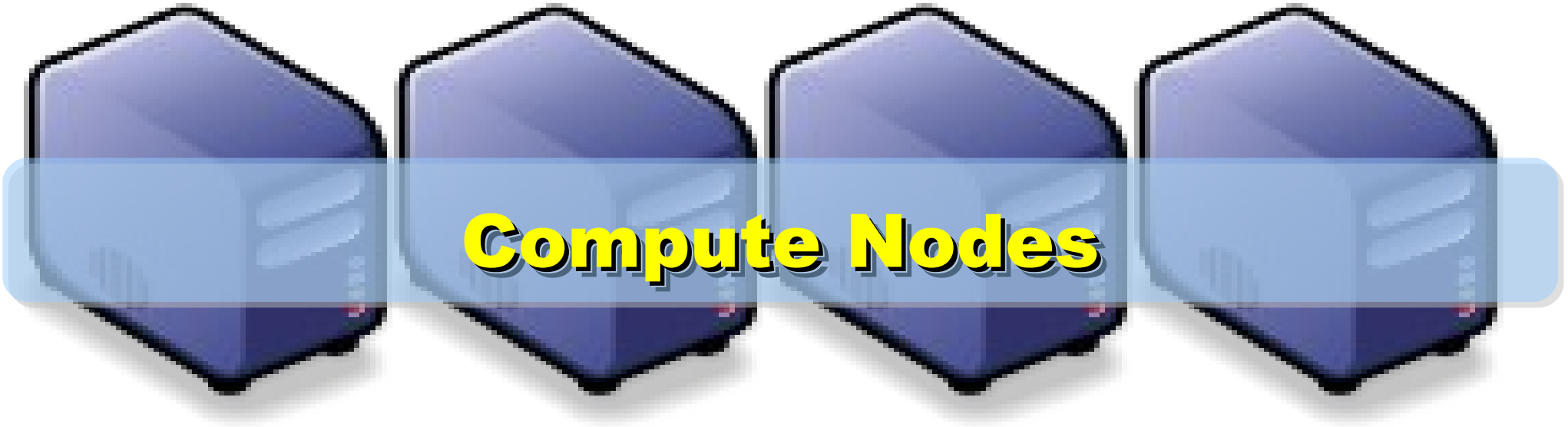


Compute Nodes

4 Compute Nodes will communicate via LAN Switch. Only Manage Node have Internet Access for Security!

WAN

Manage Node



Basic System Setup for Cluster

Messaging

Account Mgnt.

MPICH

SSHD

NIS

YP

GCC

GNU Libc

Bash

Perl

Kernel Module

Linux Kernel

Boot Loader

On Manage Node,
We need to install Scheduler and Network File System for sharing Files with Compute Node

Job Mgnt.

OpenPBS

File Sharing

NFS

Extra

Messaging

MPICH

Account Mgnt.

SSHD

NIS

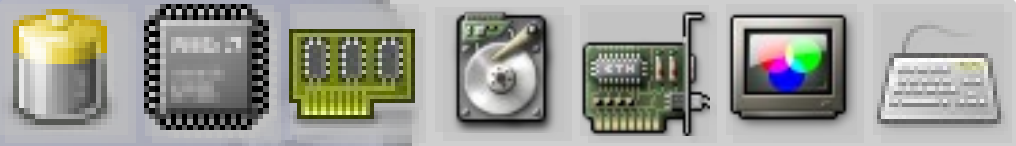
YP

GCC

GNU Libc

Bash

Perl



Kernel Module

Linux Kernel

Boot Loader

Challenges of Cluster Computing

- **Hardware**
  - Ethernet Speed / PC Density
  - Power / Cooling / Heat
  - Network and Storage Architecture
- **Software**
  - Job Scheduler (Cluster level)
  - Account Management
  - File Sharing / Package Management
- **Limitation**
  - Shared Memory
  - Global Memory Management

Common Method to deploy Cluster

1. Setup one **Template** machine

2. Cloning to multiple machine

3. Configure Settings

↓

4. Install **Job Scheduler**

↓

5. Running **Benchmark**

Challenges of Common Method

Add New User Account ?

Upgrade Software ?

How to share user data ?

Configuration Syncronization

How to deploy 4000+ Nodes ????

資料標題：Scaling Hadoop to 4000 nodes at Yahoo!

資料日期：September 30, 2008

Total Nodes	**4000**
Total cores	**30000**
Data	**16PB**

	500-node cluster		4000-node cluster	
	write	**read**	**write**	**read**
number of files	990	990	14,000	14,000
file size (MB)	320	320	360	360
total MB processes	316,800	316,800	5,040,000	5,040,000
tasks per node	2	2	4	4
avg. throughput (MB/s)	**5.8**	**18**	**40**	**66**

Advanced Methods to deploy Cluster

- **SSI (Single System Image)**
  - **Multiple PCs as Single Computing Resources**
  - **Image-based**
    - **homogeneous**
    - **ex. SystemImager, OSCAR, Kadeploy**
  - **Package-based**
    - **heterogeneous**
    - **easy update and modify packages**
    - **ex. FAI, DRBL**
- **Other deploy tools**
  - **Rocks : RPM only**
  - **cfengine : configuration engine**

Comparison of Cluster Deploy Tools

	Distribution	Support Diskless/ Sysmless	Type	Node configuration tools	Cluster management tools	Database installation
System Imager	ALL	Yes	Image	Yes	No	No
OSCAR	RPM-based	Yes	Image	Yes	Yes	No
Kadeploy	ALL	No	Image	Yes	Yes	Yes
DRBL	ALL	Yes	Package	Yes	Yes	No
FAI	Debian-Based	Yes	Package	Yes	No	No

PART 2-1 :

Hadoop Deployment Tool

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- Make Hadoop deployment *agile*
- Integrate with dynamic cluster deployments

Source: Deploying hadoop with smartfrog
http://people.apache.org/~stevel/slides/deploying_hadoop_with_smartfrog.pdf

SmartFrog - HPLabs' CM tool

- Language for describing systems to deploy —everything from datacentres to test cases
- Runtime to create *components* from the model
- Components have a lifecycle
- LGPL Licensed, Java 5+

http://smartfrog.org/

Source: Deploying hadoop with smartfrog
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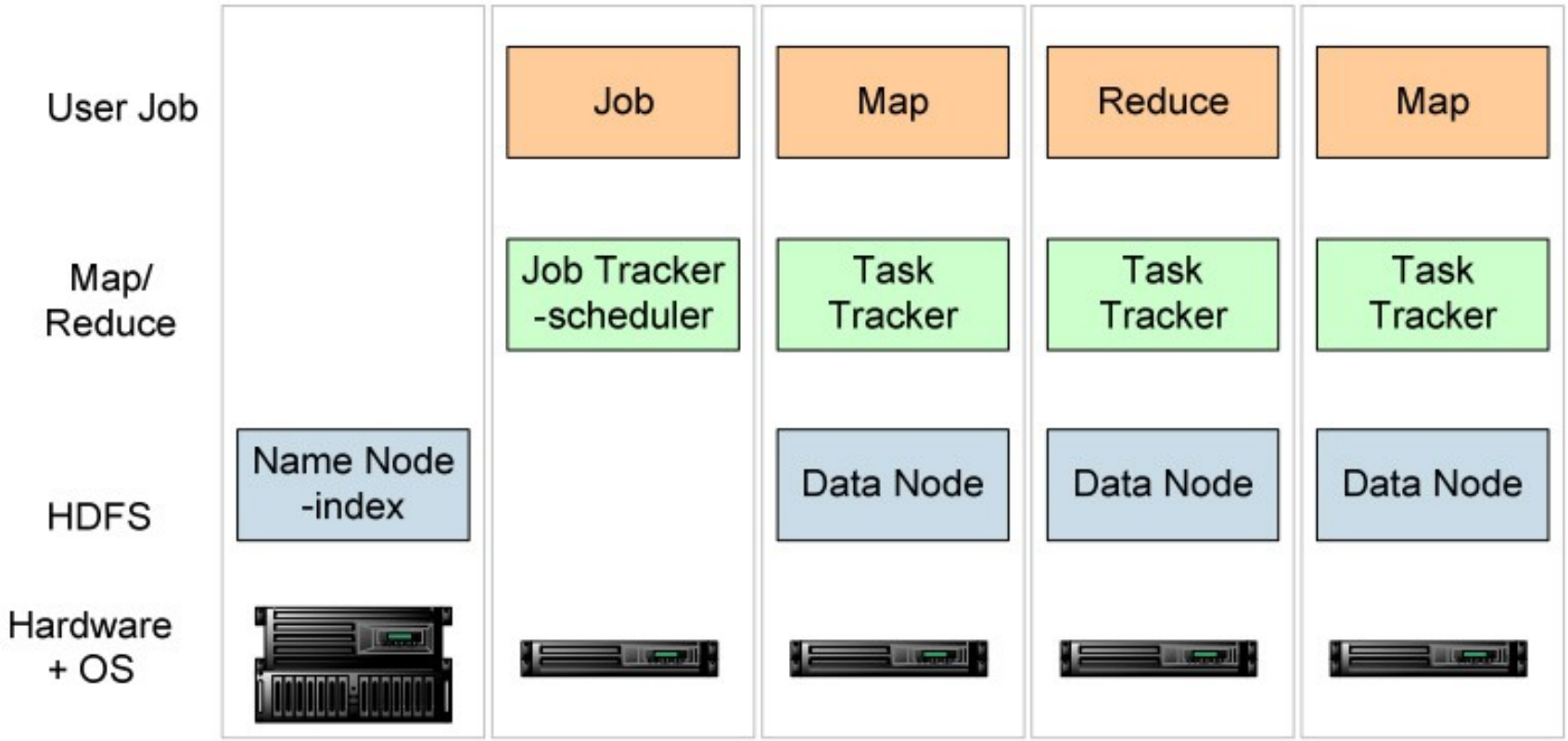
LABS hp

Basic problem: deploying Hadoop



one namenode, 1+ Job Tracker, many data nodes and task trackers

Source: Deploying hadoop with smartfrog
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The hand-managed cluster

- Manual install onto machines
- SCP/FTP in Hadoop zip
- copy out hadoop-site.xml and other files
- edit /etc/hosts, /etc/rc5.d, SSH keys …
- Installation scales O(N)
- Maintenance, debugging scales worse

Source: Deploying hadoop with smartfrog
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The locked-down cluster

- PXE Preboot of OS images
- RedHat Kickstart to serve up (see instalinux.com)
- Maybe: LDAP to manage state, or custom RPMs

Requires:

uniform images, central LDAP service, good ops team, stable configurations, home-rolled RPMs

Source: Deploying hadoop with smartfrog
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CM-tool managed cluster

Configuration Management tools

- State Driven: observe system state, push it back into the desired state
- Workflow: apply a sequence of operations to change a machine's state
- Centralized: central DB in charge
- Decentralized: machines look after themselves

CM tools are the only way to manage big clusters

Source: Deploying hadoop with smartfrog
http://people.apache.org/~stevel/slides/deploying_hadoop_with_smartfrog.pdf

Model the system in the SmartFrog language

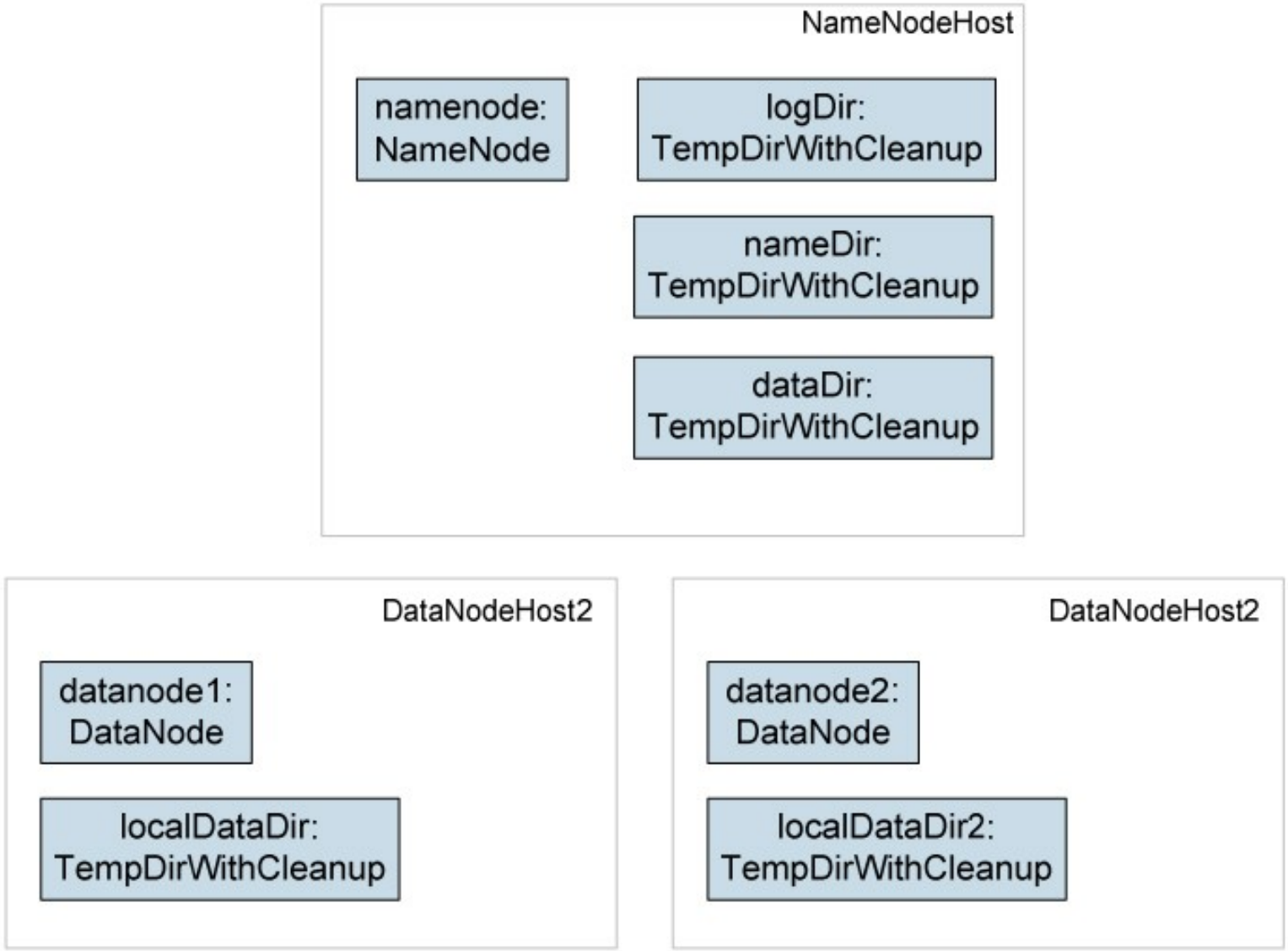
```
TwoNodeHDFS extends OneNodeHDFS {

  localDataDir2 extends TempDirWithCleanup {

  }

  datanode2 extends datanode {
    dataDirectories [LAZY localDataDir2];
    dfs.datanode.https.address "https://localhost:0";
  }
}
```

Inheritance, cross-referencing, templating

Source: Deploying hadoop with smartfrog
http://people.apache.org/~stevel/slides/deploying_hadoop_with_smartfrog.pdf

LABS hp

The runtime deploys the model



Source: Deploying hadoop with smartfrog
http://people.apache.org/~stevel/slides/deploying_hadoop_with_smartfrog.pdf

Steps to deployability

1. Configure Hadoop from an SmartFrog description
2. Write components for the Hadoop nodes
3. Write the functional tests
4. Add *workflow* components to work with the filesystem; submit jobs
5. Get the tests to pass

Source: Deploying hadoop with smartfrog
http://people.apache.org/~stevel/slides/deploying_hadoop_with_smartfrog.pdf

PART 2-2 :

Introduction to DRBL

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What is DRBL ??

- **Diskless Remote Boot in Linux**
- Network is cheap, and our time is expansive
- In simple words, DRBL is .....
  - Replace IDE/SATA cable with network cable
  - 40+ student PCs connected to one DRBL server

Diskfull PC

=

+

+

Diskless PC

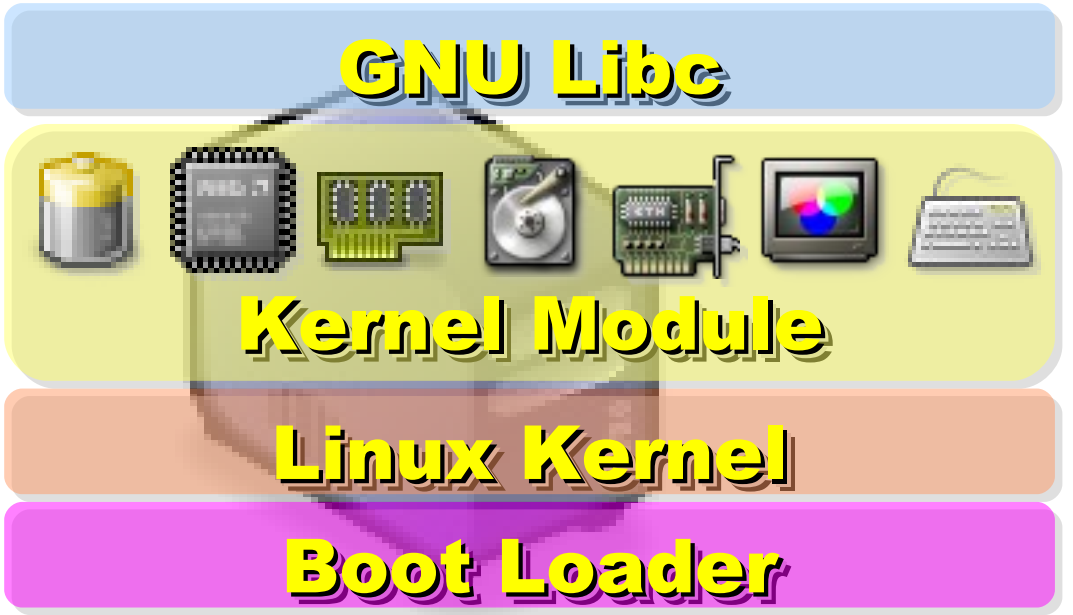
Server

source: http://www.mren.com.tw

1st, We install Base System of GNU/Linux on Management Node.

You can choose:

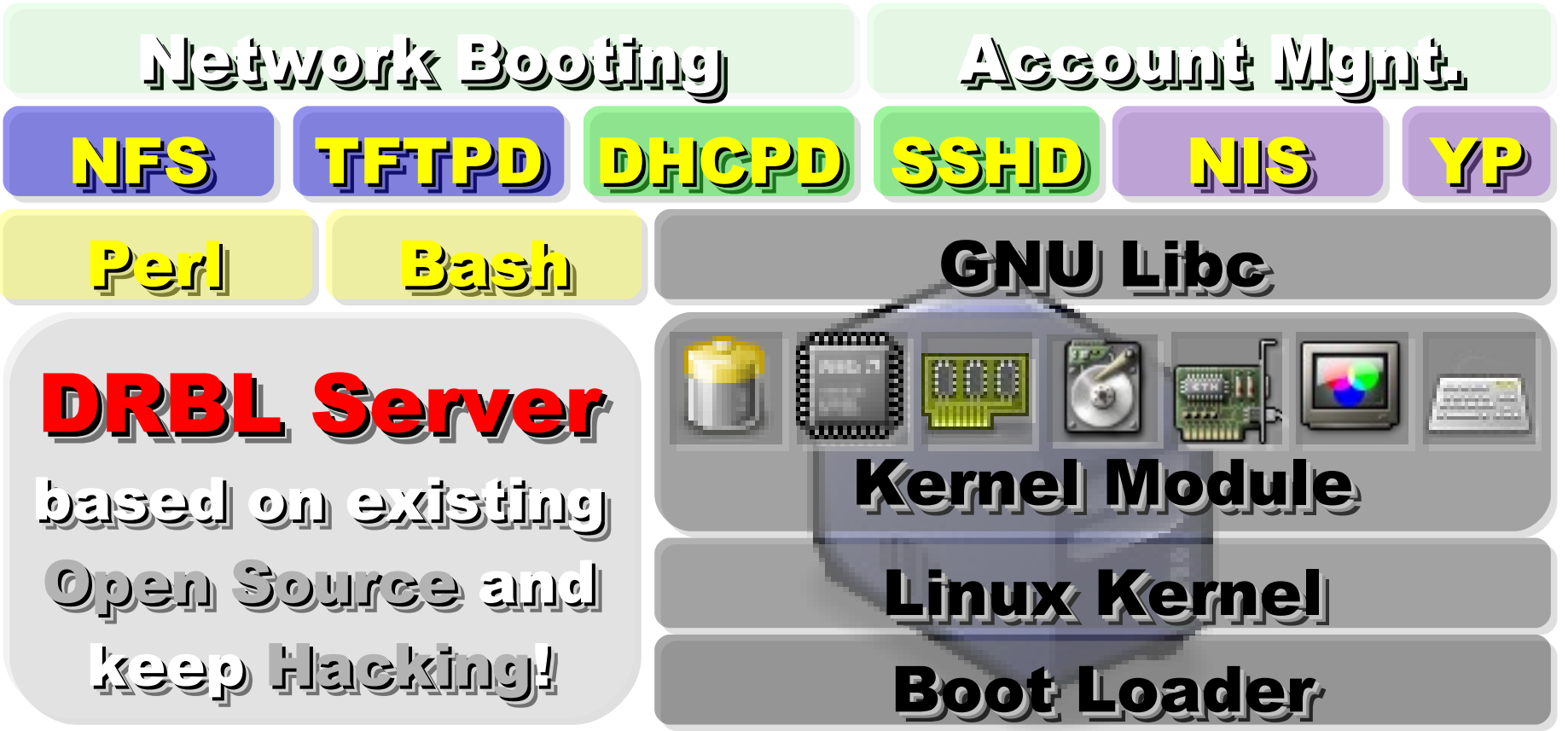
Redhat, Fedora, CentOS, Mandriva, Ubuntu, Debian, ...



2nd, We install DRBL package and configure it as DRBL Server.

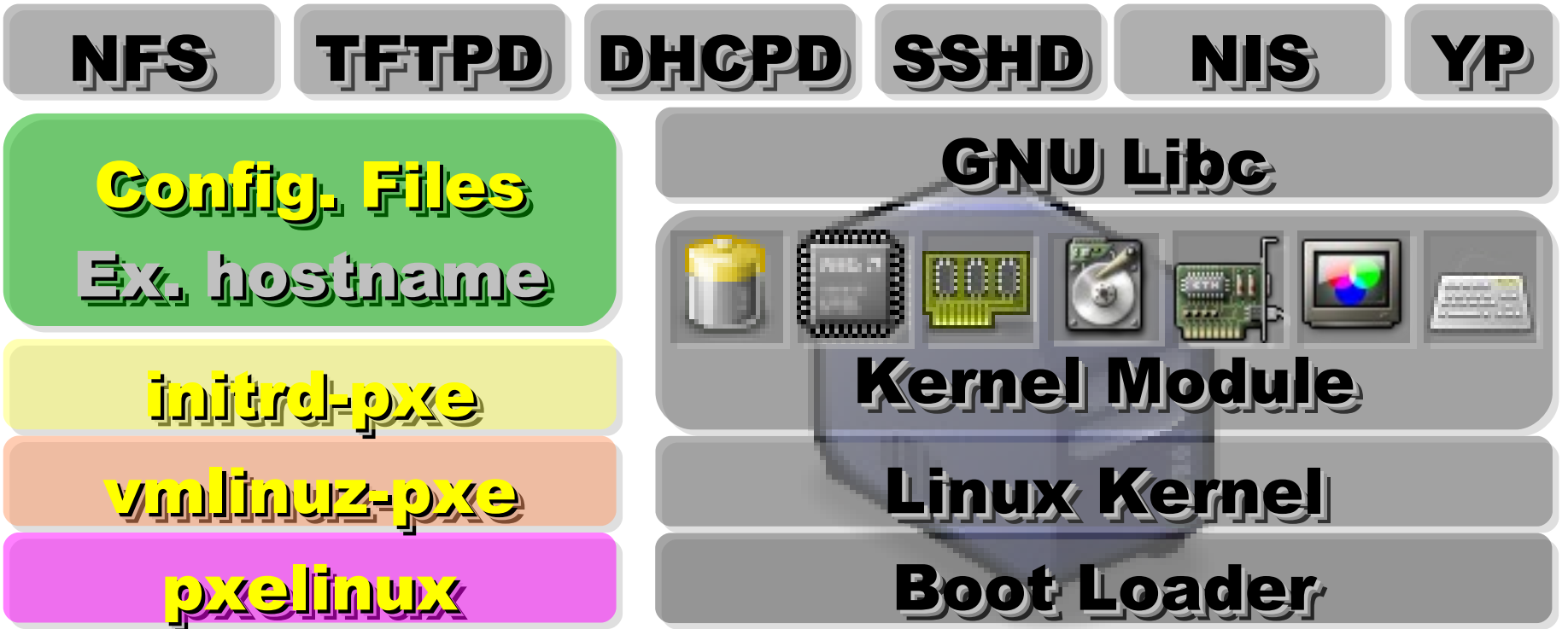
There are lots of service needed:

SSHD, DHCPD, TFTPD, NFS Server,
NIS Server, YP Server ...



DRBL Server
based on existing Open Source and keep Hacking!

After running "drblsrv -i" & "drblpush -i", there will be pxelinux, vmlinux-pex, initrd-pxe in TFTPROOT, and different configuration files for each Compute Node in NFSROOT



3nd, We enable PXE function in BIOS configuration.

BIOS PXE | BIOS PXE | BIOS PXE | BIOS PXE

NFS | TFTPD | DHCPD | SSHD | NIS | YP

Config. Files
Ex. hostname

initrd-pxe

vmlinuz-pxe

pxelinux

GNU Libc

Kernel Module

Linux Kernel

Boot Loader

While Booting, PXE will query IP address from DHCPD.

BIOS PXE | BIOS PXE | BIOS PXE | BIOS PXE

NFS | TFTPD | DHCPD | SSHD | NIS | YP

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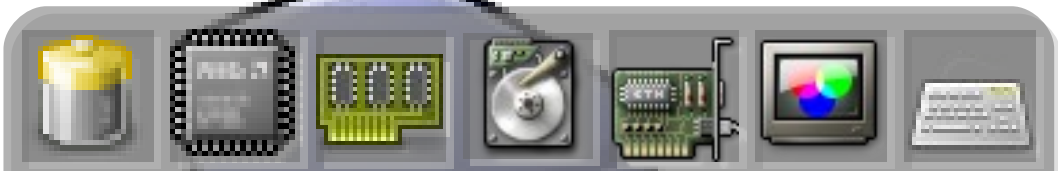

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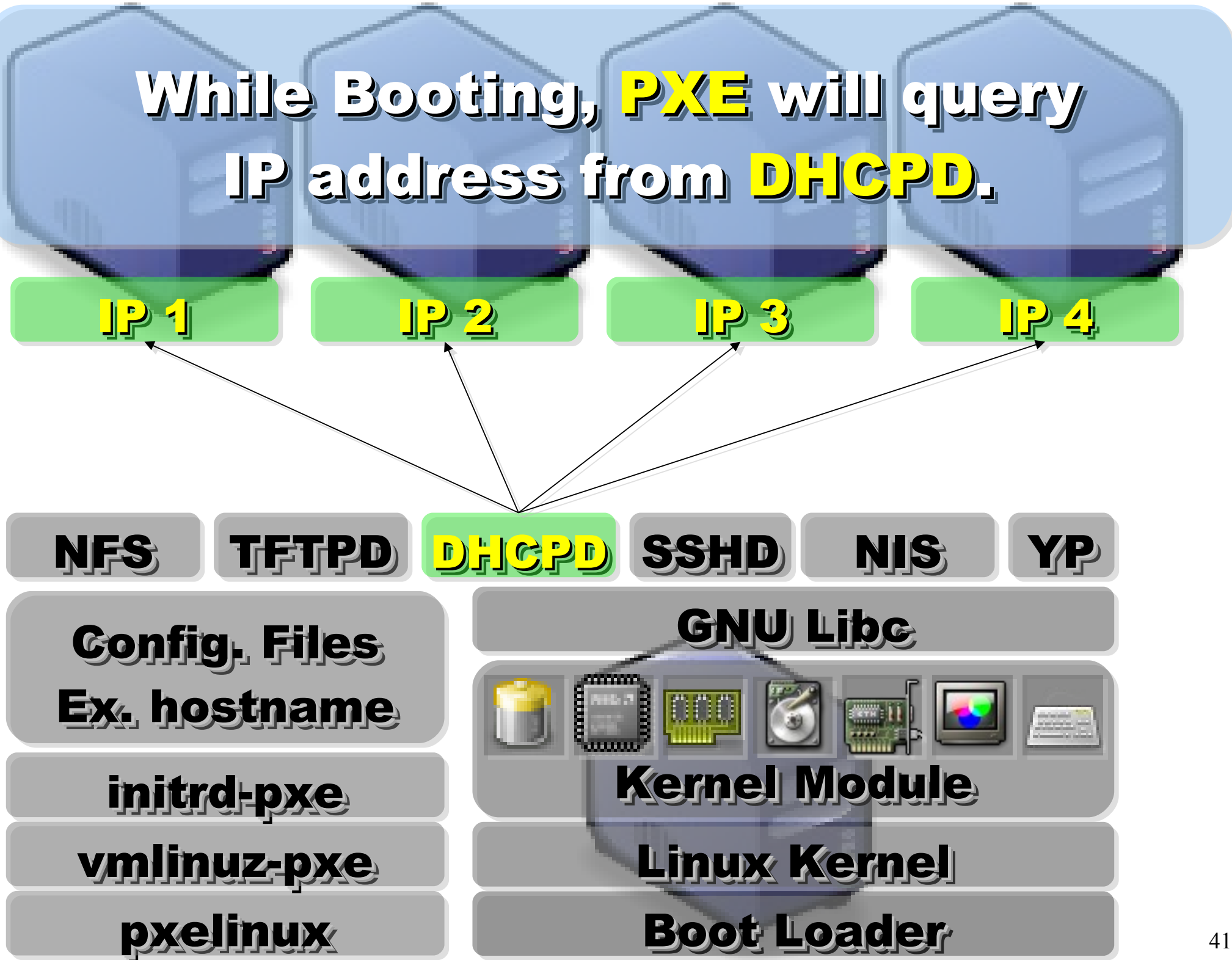


After PXE get its IP address, it will download booting files from TFTPD.

IP 1 | IP 2 | IP 3 | IP 4

NFS | TFTPD | DHCPD | SSHD | NIS | YP

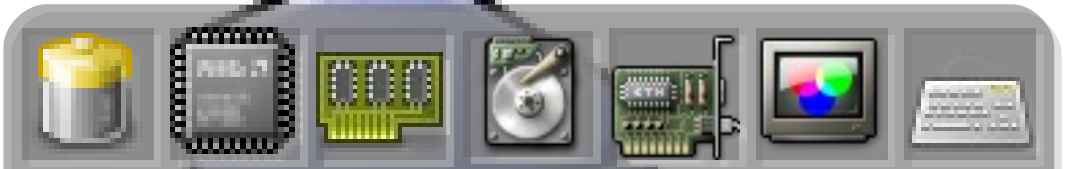
Config. Files
Ex. hostname

initrd-pxe

vmlinuz-pxe

pxelinux

GNU Libc



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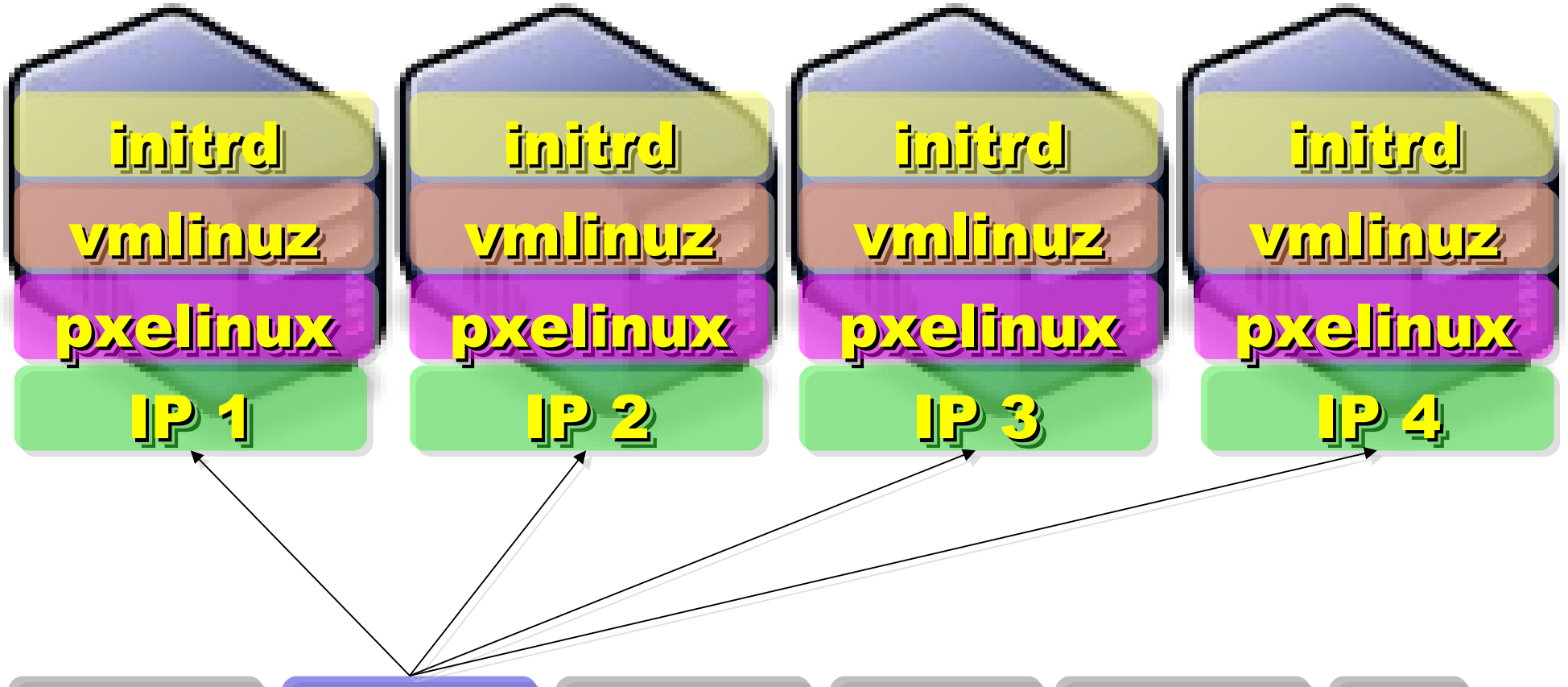

NFS | TFTPD | DHCPD | SSHD | NIS | YP

Config. Files
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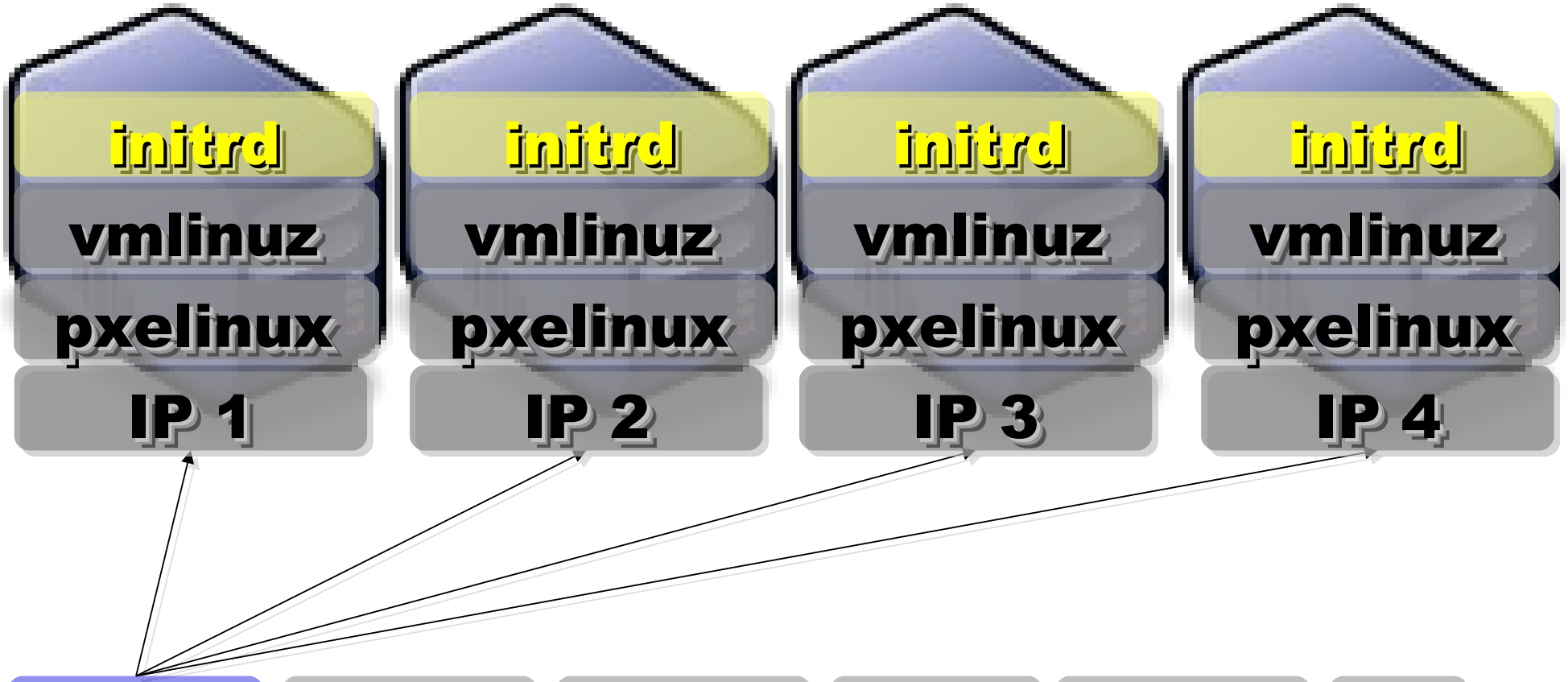
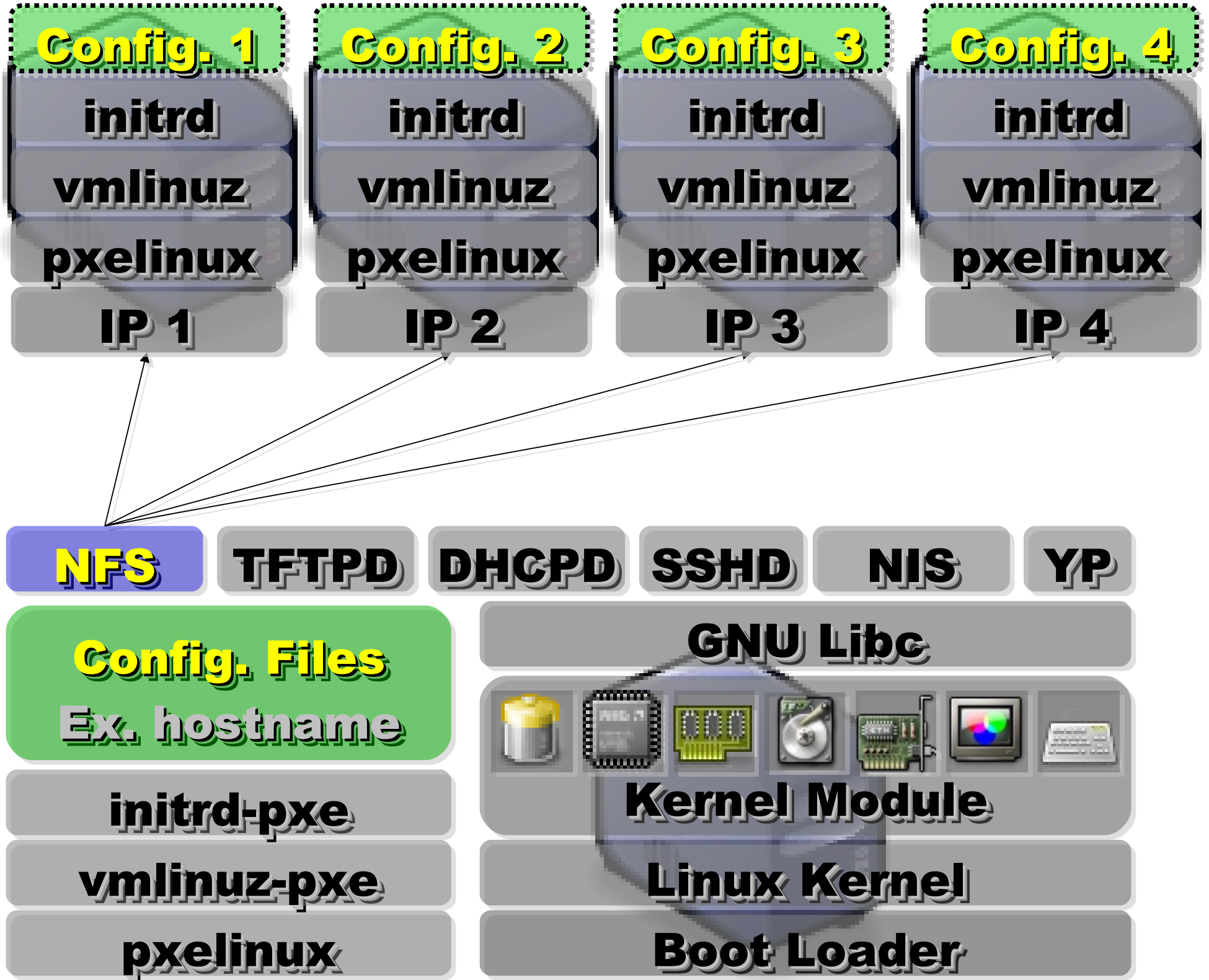
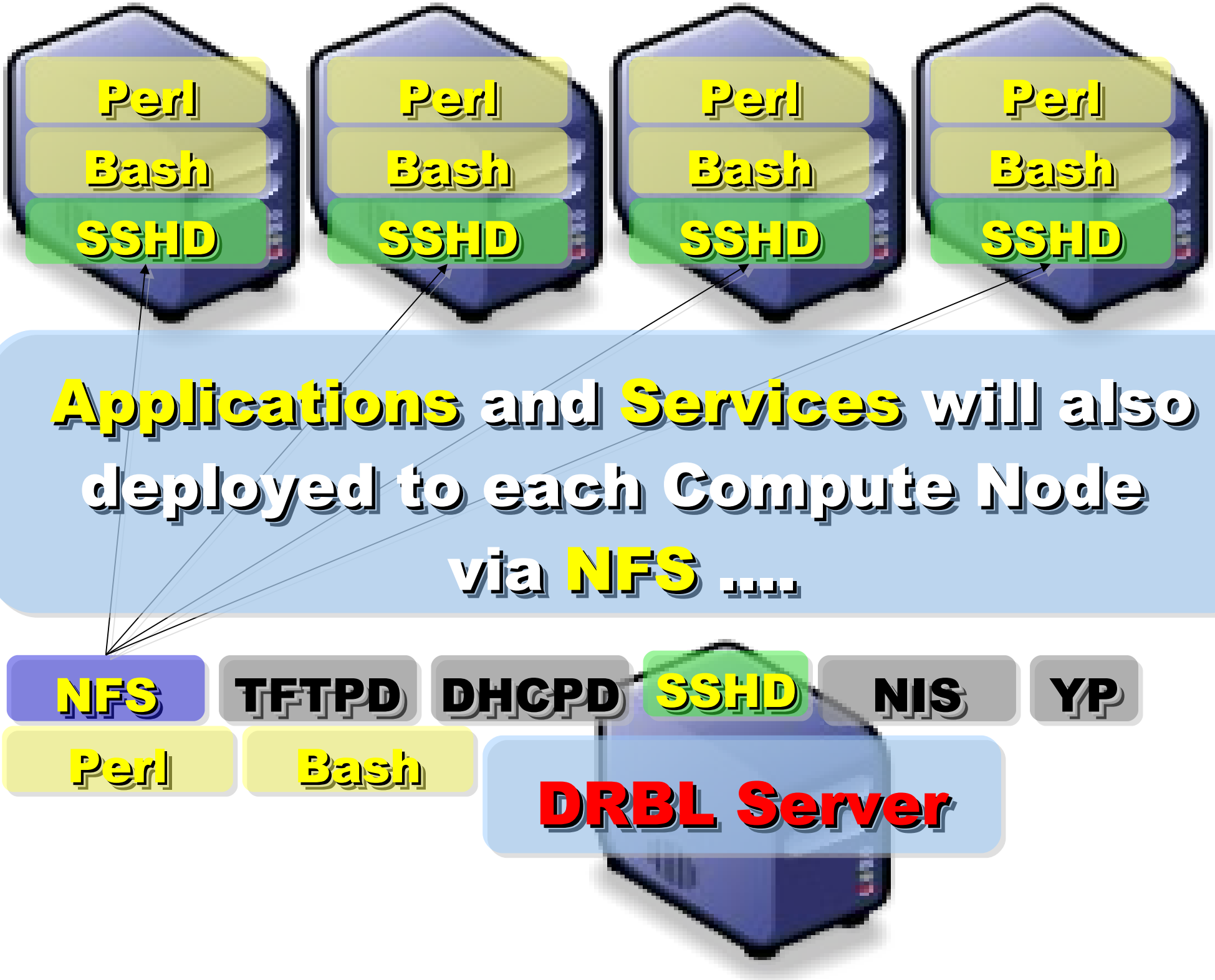


After downloading booting files, scripts in **initrd-pxe** will config **NFSROOT** for each Compute Node.


Config. 1
Config. 2
Config. 3
Config. 4
initrd
vmlinuz
pxelinux
IP 1
IP 2
IP 3
IP 4
NFS
TFTPD
DHCPD
SSHD
NIS
YP
Config. Files
Ex. hostname
initrd-pxe
vmlinuz-pxe
pxelinux
GNU Libc
Kernel Module
Linux Kernel
Boot Loader


Perl
Bash
SSHD
Perl
Bash
SSHD
Perl
Bash
SSHD
Perl
Bash
SSHD
Applications and Services will also deployed to each Compute Node via NFS ....
NFS
TFTPD
DHCPD
SSHD
NIS
YP
Perl
Bash
DRBL Server

With the help of NIS and YP,
You can login each Compute Node
with the Same ID / PASSWORD
stored in DRBL Server!

SSH Client

NFS TFTPD DHCPD SSHD NIS YP

DRBL Server

Questions?

Slides - http://trac.nchc.org.tw/cloud

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Powered by DRBL