Linux on z/VM Systems Management

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Contents

Things you need to run a lot of Linux virtual machines on z/VM

- Linux Installation
- Automated Installs and Cloning
- Software Management
- Systems Programmer Management
  - SSH - Secure Shell
  - Using sudo

Enterprise (Systems Management)

versus

(Enterprise Systems) Management

SuSE QuickStart Disk

Introduction

- Linux for S/390 is normally installed over the network
  - IPL from virtual reader
  - Load packages from FTP or NFS server
- Network install is relatively expensive
  - Uses resources in virtual routers
  - Consumes bandwidth
  - Requires network access to an FTP or NFS server
  - Often it takes too long to wait for
- QuickStart Disk is like a virtual CD
  - Linked R/O by the virtual machine
  - Can be IPLed to get a ramdisk system
  - Holds a copy of the RPM binaries packages

Not for SLES 8

SuSE QuickStart Disk

Logging on the virtual machine

- Read Only link to virtual CD in the directory
- Override IPL statement from directory during first logon
- More virtual storage for ramdisk IPL

```
L GWA8083F IPL 1CD STORAGE 96M
ENTER PASSWORD  (IT WILL NOT APPEAR WHEN TYPED):

z/VM Version 4 Release 2.0, Service Level 0000 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES: 0002 RDR,   NO PRT,   NO PUN
LOGON AT 09:52:49 DST SUNDAY 06/02/02
hwc low level driver: can write messages
hwc low level driver: can not read state change notifications
hwc low level driver: can read commands
hwc low level driver: can read priority commands
Linux version 2.4.7-SuSE-SMP (root@s390vm11) (gcc version 2.95.3 20010315 (SuSE)
) #1 SMP Tue Oct 30 23:24:09 GMT 2001
```

SuSE QuickStart Disk

Load the dasd driver

```
SuSE Instsys linux390:/root # insmod dasd dasd=200-207,1cd
Using /lib/modules/2.4.7-SuSE-SMP/kernel/drivers/s390/block/dasd.o

SuSE Instsys linux390:/root # cat /proc/dasd/devices
0200(FBA ) at ( 94:  0) is dasda:active at blocksize: 512, 50000 blocks, 24 MB
0201(ECKD) at ( 94:  4) is dasdb:active at blocksize: 4096, 72000 blocks, 281 MB
0202(ECKD) at ( 94:  8) is dasdc:active at blocksize: 4096, 180000 blocks, 703 MB
0203(ECKD) at ( 94: 12) is dasdd:active at blocksize: 4096, 180000 blocks, 703 MB
0204(none) at ( 94: 16) is dasde:unknown
0205(none) at ( 94: 20) is dasdf:unknown
0206(none) at ( 94: 24) is dasdg:unknown
0207(none) at ( 94: 28) is dasdh:unknown
01cd(ECKD) at ( 94: 32) is dasdi:active at blocksize: 4096, 450000 blocks, 1757 MB

SuSE Instsys linux390:/root # cat /proc/partitions
major minor  #blocks  name

....
  94    12     720000 dasdd
  94    13     719904 dasdd1
  94    32    1800000 dasdi
  94    33    1728000 dasdi1
  94    34      71904 dasdi2
```

two partitions

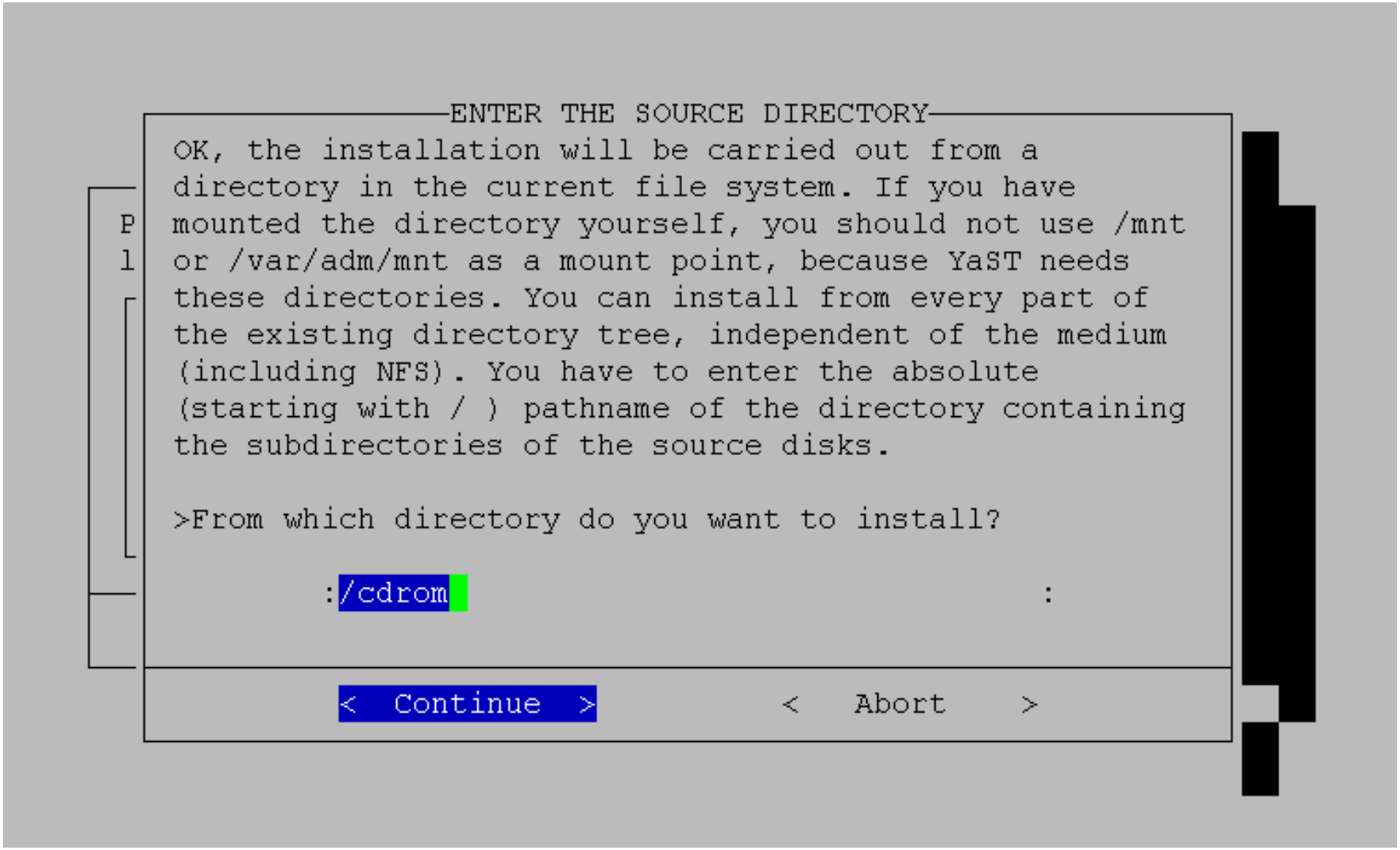
SuSE QuickStart Disk

Access the virtual CD

```
SuSE Instsys linux390:/root # ln /dev/dasdi1 /dev/cdrom
SuSE Instsys linux390:/root # ls -l /dev/cdrom
brw-rw-r--    2 root     disk      94,   33 Oct 30  2001 /dev/cdrom
SuSE Instsys linux390:/root # ls -l /dev/dasdi1
brw-rw-r--    2 root     disk      94,   33 Oct 30  2001 /dev/dasdi1

SuSE Instsys linux390:/root # mkdir /cdrom
SuSE Instsys linux390:/root # cat /etc/fstab
/dev/cdrom      /cdrom          ext2    ro,noauto       0 0
SuSE Instsys linux390:/root # mount /cdrom
SuSE Instsys linux390:/root # df
Filesystem           1k-blocks      Used Available Use% Mounted on
/dev/root                26294     23309      1664  94% /
/dev/cdrom             1700792   1577116     37276  98% /cdrom
```

SuSE QuickStart Disk



SuSE QuickStart Disk

- Installation continues like any other installation
  - Typically much faster than with FTP or NFS installs
  - No resources used by virtual routers etc
- Some repair work needed after reboot of Linux
  - Include the virtual CD in the kernel command line again
  - Add the /cdrom entry to /etc/fstab
- YaST will use the installation medium for extra packages
- Manual steps can be automated by changes in the initrd
- All Linux images have access to the virtual CD
  - Very easy access to packages that were not yet installed
  - Not possible to update the virtual CD afterwards

Automated Installs and Cloning

- Manual installation is not attractive for a large number of Linux images
  - time consuming and waste of resources
  - error prone
- There is a need for automated installs

Typical Linux for S/390 installation:

- IPL with ramdisk system and get network connection
- Format the disks and create filesystems etc
- Install selected packages with RPM
- Modify some of the configuration files for this system

Automated Installs and Cloning

Red Hat - Kickstart

- Automated install for Red Hat Linux
- Configuration file with all answers to install questions
- Creates a unique boot floppy (or boot via network)
- Mainly aimed at Intel installations
- For S/390 installs the loader program takes answers from the parm file
- Could punch the files and then autolog the guest
- The installer needs a lot of work to use the virtual CD

`http://www.redhat.com/docs/manuals/linux/RHL-7.2-Manual/custom-guide/`

Automated Installs and Cloning

SuSE - ALICE

- Automated Linux Installation and Configuration Environment
- On request of T-Online and made available in Open Source
- Very specific for Intel installations
- Duplicates most of the function in YaST
- Unique boot floppy, loading packages via network
- Unique boot CD, including the packages
- Lacks most of the zSeries specific things

Automated Installs and Cloning

Installing systems through "third party" install

- Linux 2.4.7 can dynamically link and detach minidisks
- A Linux virtual machine can prepare the disks for the new image
  - prepare filesystem
  - link to target minidisk in R/W
  - mount the device
  - install packages (using rpm --root)
  - apply configuration changes
  - detach the minidisk
  - have someone autolog the new Linux image

Automated Installs and Cloning

Applying the Configuration Changes

- Process described in the ISP/ASP Redbook
- When systems are similar enough you can compare them
  - Often you can help make the systems very similar
- Perform a manual install of two systems
- Do not reboot, but mount filesystems in another image
  - Run md5sum against files in both systems and compare
  - Study the list of files and take out the 'wrong' files
    - backup files from YaST
    - work files from RPM and YaST

Automated Installs and Cloning

- Run `diff` to compare the versions of the file

```
--- disk2/etc/rc.config Mon Apr 29 08:12:55 2002
+++ disk3/etc/rc.config Fri May 10 00:11:55 2002
@@ -152,7 +152,7 @@
 #
 # IP Adresses
 #
-IPADDR_0="192.168.8.2"
+IPADDR_0="192.168.8.3"
 IPADDR_1=""
 IPADDR_2=""
 IPADDR_3=""
@@ -171,7 +171,7 @@
 # Sample entry for ethernet:
 # IFCONFIG_0="192.168.81.38 broadcast 192.168.81.63 netmask 255.255.255.224"
 #
-IFCONFIG_0="192.168.8.2 pointopoint 192.168.8.1 mtu 1500 up"
+IFCONFIG_0="192.168.8.3 pointopoint 192.168.8.1 mtu 1500 up"
 IFCONFIG_1=""
 IFCONFIG_2=""
 IFCONFIG_3=""
```

Automated Installs and Cloning

- Make the differences between files generic

```
--- disk2/etc/rc.config Mon Apr 29 08:12:55 2002
+++ disk3/etc/rc.config Fri May 10 00:11:55 2002
@@ -152,7 +152,7 @@
 #
 # IP Adresses
 #
-IPADDR_0="192.168.8.2"
+IPADDR_0=":ipaddr:"
 IPADDR_1=""
 IPADDR_2=""
 IPADDR_3=""
@@ -171,7 +171,7 @@
 # Sample entry for ethernet:
 # IFCONFIG_0="192.168.81.38 broadcast 192.168.81.63 netmask 255.255.255.224"
 #
-IFCONFIG_0="192.168.8.2 pointopoint 192.168.8.1 mtu 1500 up"
+IFCONFIG_0=":ipaddr: pointopoint :gateway: mtu 1500 up"
 IFCONFIG_1=""
 IFCONFIG_2=""
 IFCONFIG_3=""
```

Automated Installs and Cloning

- Run **patch** to apply the changes
- Patch can be applied to pure copies of first image
  - Copy from installed system instead of format
- When copies are made in advance, creation of a new Linux images takes a few seconds
- Will get more complicated when systems are less equal

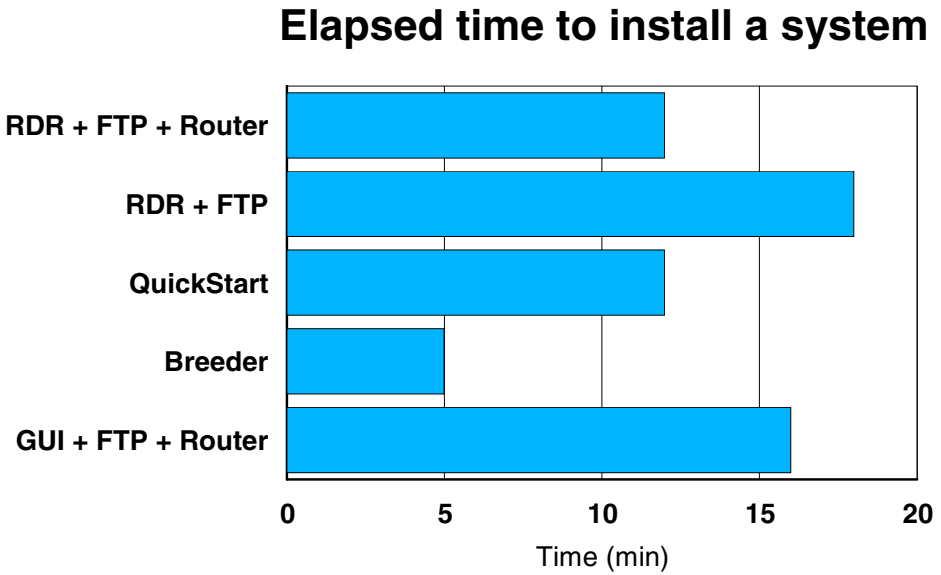
```
cat /mnt/one.patch | \
   sed "s/:hostname:/$uid/g" | \
   sed "s/:ipaddr:/$ipa/g" | \
   sed "s/:gateway:/194.255.207.1/g" | \
   sed "s/:tunnel:/$tun/g" | \
   (cd /mnt/disknew ; patch -p1)
```

Automated Installs and Cloning

- Automated installation can be done much quicker
- Measurements shown are for a minimal install

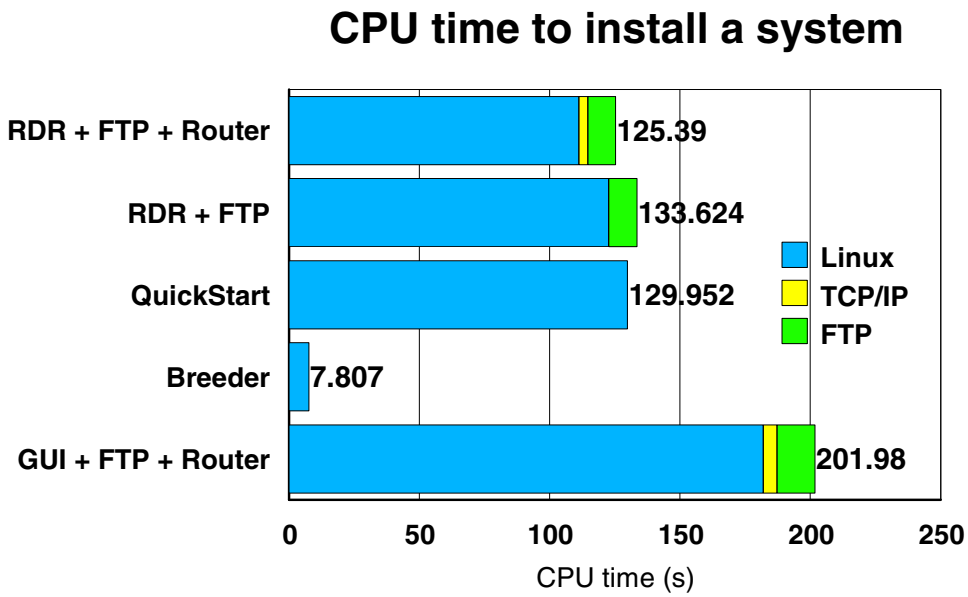
- Breeder is a home grown "cloning" approach
  - copy a pre-installed system
  - apply configuration changes

- CLONEDISK support in DirMaint - VM63122



Automated Installs and Cloning

- Savings in CPU time are considerable
- Resources used for install can not be used to run the business
- Third party install allows systems to be configured to run the application rather than the installer
  - Virtual machine size
  - Network connectivity
  - Allocated capacity
  - Installed packages



Automated Installs and Cloning

- Process works when systems are similar enough
  - It can be used to get a common base system
- Biggest savings are by not installing software
  - Resources for installation
  - Disk space (and backup)
  - Need for maintenance
  - Security and System Administration
- PC approach with dedicated hardware: install everything

Automated Installs and Cloning

- Installing additional packages must be easy
- Additional packages can be installed from R/O linked minidisk
  - Can not be updated afterwards so hard to stay current
- Need for hierarchy in the RPM repository
  - Provide different sets of packages for various customers
  - Different levels of stability (e.g. test versions)
  - Service Levels may be different
- YaST is rather restrictive, so manual RPM installs needed
  - Uses control files in proprietary format
- Additional installs often require a lot of extra packages
  - Sometimes hard to find the missing packages (rpmfind.net)
  - Pre-required packages cause incompatibility

APT - Advanced Packaging Tool

- APT is the package manager for Debian distributions
- Debian uses .deb packages rather than rpm
- Conectiva made the apt-rpm port to work with rpm's

Features provided by apt-rpm:

- automatically resolve dependencies
- hierarchy in the respository
- concept of local and remote repositories
- upgrade process

`https://moin.conectiva.com.br/AptRpm`

APT-RPM

Server Side Installation

- Rebuild and install apt port from Conectiva
- An apt-rpm repository can be made out of symlinks to the binary rpm's in a copy of SuSE or Red Hat distribution
- Generate dependency index for the repository
  - The apt index can be stored on the virtual CD as well
- Multiple repositories can be used to keep different categories
  - Different type of access to repositories (e.g. CD, FTP, NFS)
  - Useful to separate add-on's from original distribution
  - No need to update the virtual CD to provide upgraded packages
- Clients can use multiple repositories
  - Use local (partial) replica repositories
  - Include repositories with early versions or specific customization
- During installation of a package apt will pick the 'best' version

APT-RPM

Client Side Installation

- Install apt and libapt packages
- Prepare sources.list

```
linux008:~ # cat /etc/apt/sources.list
# See sources.list(5) for more information, especialy
# Remember that you can only use http, ftp or file URIs
# CDROMs are managed through the apt-cdrom tool.

rpm     file:/cdrom/apt/SuSE-7.2 suse os
rpm     ftp://emealinux.ehone.ibm.com/apt/SuSE-7.2 suse t4vm
```

base set of packages from virtual CD

additional packages via anonymous ftp

APT-RPM

Client Side Installation

- Run **`apt-get update`** to build a cache of the index

```
linux008:~ # cp sources.list /etc/apt/sources.list
linux008:~ # apt-get update
Ign file: suse release.os
Get:1 ftp://emealinux.ehone.ibm.com suse/base/pkglist.t4vm [8640B]
Get:2 ftp://emealinux.ehone.ibm.com suse release.t4vm
Ign ftp://emealinux.ehone.ibm.com suse release.t4vm
Fetched 8640B in 12s (697B/s)
Processing File Dependencies... Done
Reading Package Lists... Done
Building Dependency Tree... Done
file:/cdrom/apt/SuSE-7.2/ will not be authenticated.
ftp://emealinux.ehone.ibm.com/apt/SuSE-7.2/ will not be authenticated.
```

APT-RPM

Client Side Installation

- Run **`apt-get -f install`** to fix any unresolved dependencies

```
linux000:~ # apt-get -f install
Reading Package Lists... Done
Building Dependency Tree... Done
Correcting dependencies... Done
The following packages will be REMOVED:
  yast2 yast2-config-cups yast2-config-environment yast2-config-hwinfo
  yast2-config-inet yast2-config-lvm_config yast2-config-network
  yast2-config-online-update yast2-config-package-manager yast2-config-printer
  yast2-config-rcconfig yast2-config-security yast2-config-update
  yast2-config-users yast2-db-printer yast2-lib-printer yast2-menu
  yast2-module-support yast2-trans-cups yast2-trans-hwinfo
  yast2-trans-libprinter yast2-trans-network yast2-trans-online-update
  yast2-trans-package-manager yast2-trans-printer yast2-trans-security
0 packages upgraded, 0 newly installed, 26 to remove and 3 not upgraded.
Need to get 0B of archives. After unpacking 11.6MB will be freed.
Do you want to continue? [Y/n]
```

APT-RPM

Client Side Installation

- Run **`apt-get -f upgrade`** to pick up new versions

```
linux000:~ # apt-get upgrade
Reading Package Lists... Done
Building Dependency Tree... Done
3 packages upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
Need to get 2111kB of archives. After unpacking 3022kB will be freed.
Do you want to continue? [Y/n] y
Get:1 ftp://emealinux.ehone.ibm.com suse/t4vm aaa_base 2001.10.19-4.t4vm [274kB]
Get:2 ftp://emealinux.ehone.ibm.com suse/t4vm k_deflt 2.4.7-31.t4vm.2 [1753kB]
Get:3 ftp://emealinux.ehone.ibm.com suse/t4vm s390-tools 0.5-45.c [83.5kB]
Fetched 2111kB in 26s (81.0kB/s)
Executing RPM (-Uv)...
aaa_base                    ##################################################
Updating etc/rc.config...
k_deflt                     ##################################################
s390-tools                  ##################################################
linux000:~ #
```

APT-RPM

Sample Package Installation

- Installation via **`apt-get install`**
  - Use the **`-s`** or **`-S`** option to review what will happen
- Dependencies will be resolved automatically

```
linux008:/var/cache/apt # apt-get install vmlinx
Processing File Dependencies... Done
Reading Package Lists... Done
Building Dependency Tree... Done
The following extra packages will be installed:
  cpint
The following NEW packages will be installed:
  cpint vmlinx
0 packages upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 0B/19.1kB of archives. After unpacking 42.4kB will be used.
Do you want to continue? [Y/n]
```

APT-RPM

- An easy way to install additional packages and apply upgrades
- Encourage customers to install only what they need
  - No resources wasted
  - Less exposure through backlevel software
- Options for automated upgrades
  - Manage your own repositories
  - Schedule apt-get upgrade to run off-shift

- Many more options:
  `http://www.rpm.org/software/updaters/`

IP Configuration - the easy way

- DHCP - Dynamic Host Configuration Protocol
  - Normally used to configure (mobile) IP clients
  - Pass client a free address from the pool (less IP addresses needed)
- Can also be used to configure servers
  - IP address taken from a table rather than random
  - Can use a long lease for DHCP
- Uses Broadcast capability of Guest LAN
- MAC address defined in CP directory

```
USER LINUX31 XXXXXXXX 64M 512M G
 INCLUDE RMHTUX
 NICDEF 0410 TYPE QDIO LAN SYSTEM LAN1 MACID 00201f
 MDISK 201 3390 1001  125 LX3L03  MR READ    WRITE
*
USER LINUX32 XXXXXXXX 64M 512M G
 INCLUDE RMHTUX
 NICDEF 0410 TYPE QDIO LAN SYSTEM LAN1 MACID 002020
 MDISK 201 3390 1251  125 LX3L03  MR READ    WRITE
```

IP Configuration - the easy way

- MAC address linked to IP address through dhcpd.conf
- DNS to map host name to IP address

dhcpd.conf

```
host linux30 { hardware ethernet 02:00:00:00:20:1e; fixed-address linux30; }
host linux31 { hardware ethernet 02:00:00:00:20:1f; fixed-address linux31; }
host linux32 { hardware ethernet 02:00:00:00:20:20; fixed-address linux32; }
```

DNS zone

```
linux30          IN A            192.168.36.30
linux31          IN A            192.168.36.31
linux32          IN A            192.168.36.32
```

```
Mar 29 14:25:54 vmlinux3.itso.ibm.com OPERATOR 07:25:54 AUTO LOGON  ***       LINUX31  USERS = 217   BY RVDHEIJ
Mar 29 14:26:17 linuxgw dhcpd: DHCPDISCOVER from 02:00:00:00:20:1f via eth1
Mar 29 14:26:17 linuxgw dhcpd: DHCPOFFER on 192.168.36.31 to 02:00:00:00:20:1f via eth1
Mar 29 14:26:24 linuxgw dhcpd: DHCPREQUEST for 192.168.36.31 (192.168.36.254) from 02:00:00:00:20:1f via eth1
Mar 29 14:26:24 linuxgw dhcpd: DHCPACK on 192.168.36.31 to 02:00:00:00:20:1f via eth1
Mar 29 14:26:24 linuxgw dhcpd: DHCPREQUEST for 192.168.36.31 (192.168.36.254) from 02:00:00:00:20:1f via eth1
Mar 29 14:26:24 linuxgw dhcpd: DHCPACK on 192.168.36.31 to 02:00:00:00:20:1f via eth1
```

SSH - Secure Shell

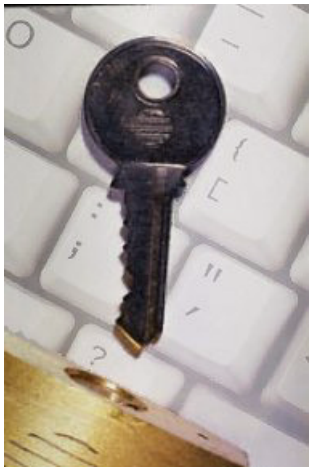
- The standard way for remote logon
- Clients available for many workstation platforms
  - OpenSSH for Linux
  - PuTTY for MS Windows
- Builds encrypted tunnel between host and workstation
  - No password visible for packet sniffers
  - All session data encrypted as well
- SSH can also 'forward' other connections though tunnel
  - Often used for X11 traffic
  - Useful for other applications too (e.g. SMTP)
  - Even possible to run a SLIP - PPP connection over it
- SSH can also do some compression (for dial-up access)

SSH - Secure Shell

Root Password Management

- The Linux root password is needed for serious work
- Customers may need the root password as well
- Root password changes are hard to communicate
- When you need to logon someone will have changed it
- More people than needed will know the password
- Customers may insist in 'fixing' /etc/securetty to reject root logon
  - Make root automatically logon via /etc/inittab
  - Control access to the console via CP or RACF/VM

☛ Use authentication via cryptographic keys instead



SSH - Secure Shell

Beyond Plain Text Passwords

- Authentication via key pairs
- End-user generates a key pair
  - Private key is stored with the client
  - Public key is placed in **`$HOME/.ssh/authorized_keys`**
- Root access controlled per system
- The same key pair can be used for different systems
- No password is needed after authentication via keys
- The private key must be kept secret
  - Should be protected by a 'passphrase'

SSH - Secure Shell

Beyond Plain Text Passwords

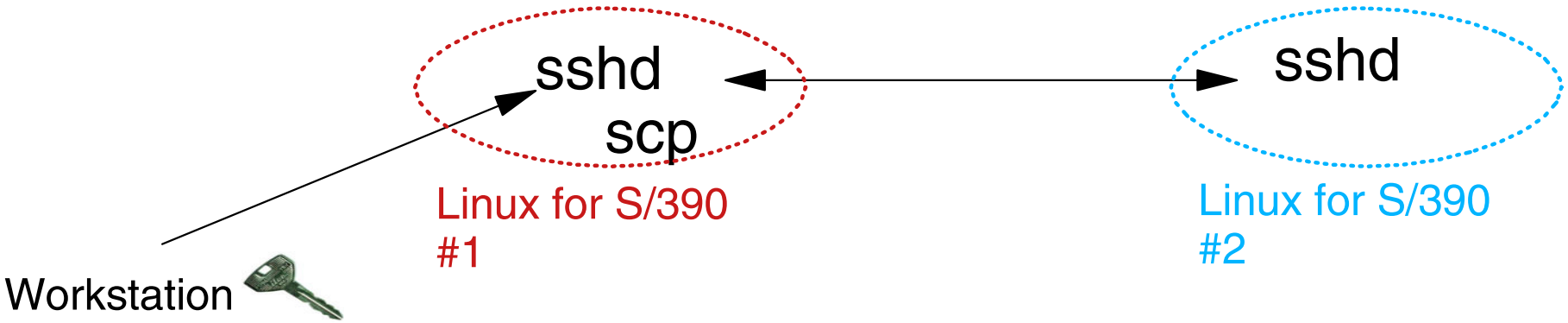
- Authentication is separated from access control
- A single passphrase is used for all systems
- The passphrase is typed only on the trusted workstation
- An ssh-agent on the workstation can hold private keys
  - Putty comes with pageant
- For Linux workstation GUI also starts the ssh-agent
  - Add your private keys with ssh-add
  - Keychain can be useful

```
http://www.ibm.com/developerworks/library/l-keyc.html
http://www.chiark.greenend.org.uk/~sgtatham/putty/
```

SSH - Secure Shell

Authentication Forwarding

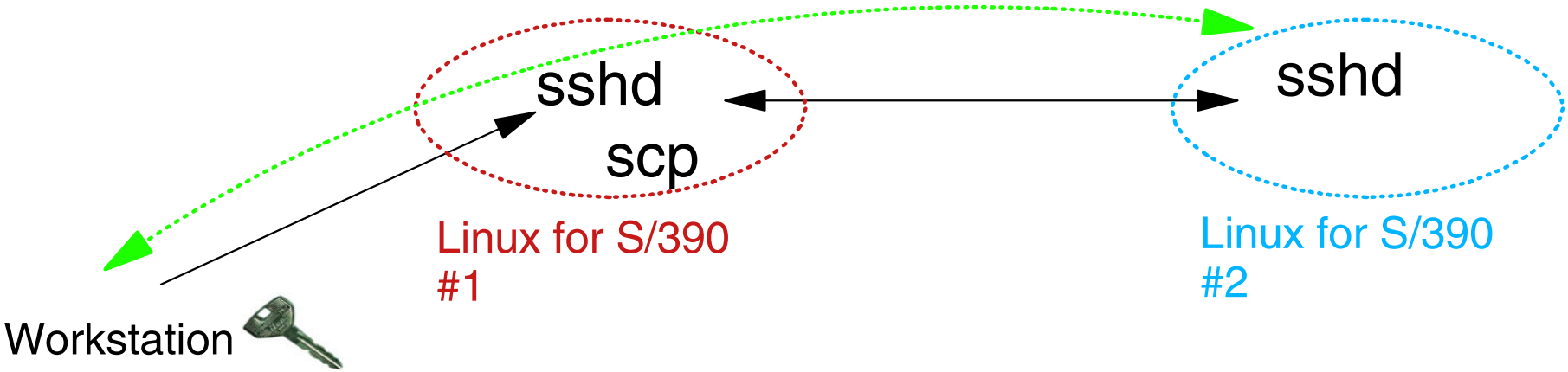
- OpenSSH comes with useful utilities
  - ssh Session to another system
  - scp Secure Copy
  - sftp Secure FTP
- These utilities also need a private key
  - Don't copy the key from your workstation (it is a secret)



SSH - Secure Shell

Authentication Forwarding

- Workstation requests ssh #1 to open an extra socket
- Authentication request from #2 arrives at #1 and is forwarded through the socket to workstation
- Workstation private key and passphrase is used
- The same public key can be used everywhere



Using sudo for Root Access

- Wrapper around setuid
- Grant root access for duration of a single command
- Controlled by /etc/sudoers
  - Lists authorized users
  - Defines commands to be issued
  - Granularity in access is hard to implement
- Provide an audit trail of commands issued as root

```
%maint emealinux = (ALL) NOPASSWD: ALL
```

```
Apr 28 06:01:56 emealinux sudo:  rvdheij : TTY=pts/1 ; PWD=/home/rvdheij ; USER=root ;
        COMMAND=/usr/bin/less /etc/sudoers
Apr 28 06:03:12 emealinux sudo:  rvdheij : TTY=pts/1 ; PWD=/home/rvdheij ; USER=root ;
        COMMAND=/usr/bin/tail /var/log/messages
```

Linux on z/VM - Systems Management

Conclusion

- Linux on z/VM shares a lot of systems management problems with conventional server farms
  - Investigate which existing processes will work for Linux
  - Do not blindly follow suggestions from (PC) Linux experts
- z/VM offers some unique solutions
  - Flexibility through Guest LAN
  - Systems management automation on low level with CMS and CP
- New z/VM function is being added for z/VM
  - Limited cloning function in DirMaint
  - Guest LAN with broadcast for DHCP
- It would be helpful if we had OpenSSH for CMS

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