# CS 447/647

Software Management

### Overview

What is required for a network-based installation?

What is a high-level package manager? (Know Debian + RHEL)

What is a low-level package manager? (Knowl Debian + RHEL)

What is Debian?

How is a .deb package structured?

## Installation

- Many different Methods
- Media Easiest but doesn't scale
  - CDROM
  - o DVD
  - USB
- Network Scales but requires development
  - PXE, iPXE more likely
  - o TFTP
  - DHCP
  - PXE Kernel
  - PXE Menu
- chroot Specialized
  - Virtual Machines
  - Containers

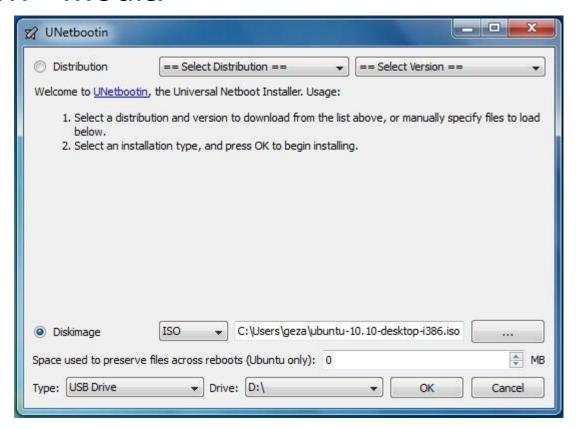
### Installation - Media

```
wget \
https://mirrors.ocf.berkeley.edu/ubuntu-releases/18.04.3/ubuntu-18
.04.3-desktop-amd64.iso

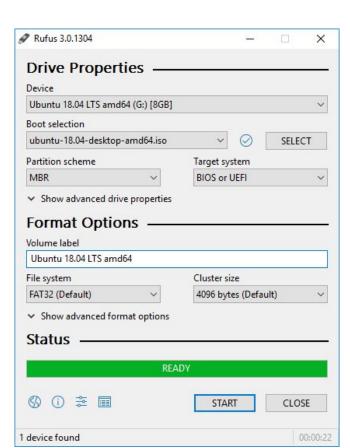
dd if=ubuntu-18.04.3-desktop-amd64.iso of=/dev/sd[a-z] bs=1M
# or use a GUI

apt install unetbootin
```

### Installation - Media



## Installation - Media

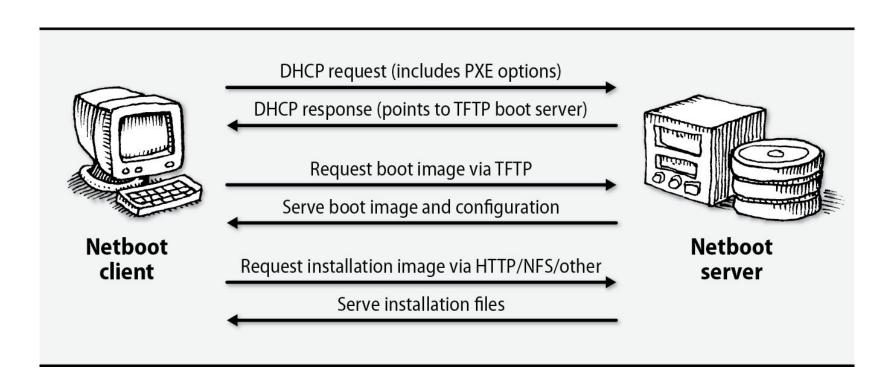


# Network

### Network

- Much more advanced than a media based installation.
- Requires
  - DHCP
  - iPXE https://ipxe.org/
  - TFTP Trivial File Transfer Protocol
  - Networking knowledge
  - Scripting and menu creation
  - HTTP (optional but likely)
- Some open-source solutions
  - Cobbler
  - FOG Project (https://fogproject.org/)

### Network - PXE



### Network - DHCP

- Dynamic Host Control Protocol
- RFC2131 1997
- Provides a framework for passing configuration information to hosts on a TCP\IP network
- UDP User Datagram Packet Based
- "DHCP in its current form is quite insecure."

https://tools.ietf.org/html/rfc2131

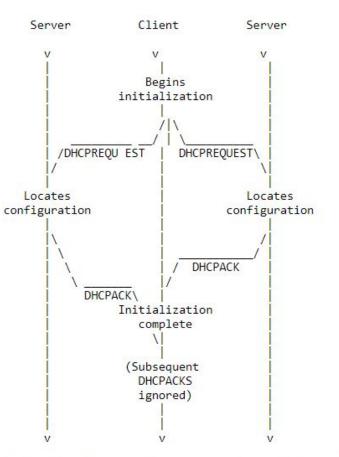


Figure 4: Timeline diagram of messages exchanged between DHCP client and servers when reusing a previously allocated network address

### **Network - DHCP Extensions**

"Configuration parameters and other control information are carried in tagged data items that are stored in the 'options' field of the DHCP message."

"Security issues are not discussed in this memo."

RFC2132 - https://tools.ietf.org/html/rfc2132

## **Network - DHCP Extensions**

- Hostname
- LPR Line Printer Remote protocol
- Root Path
- IP Lease Time
- TFTP server name
- Bootfile name
- Client-identifier DHCP Client
- Username
- Password 😳

## **Network - PXE**

- Two popular options
  - PXELINUX in SYSLINUX
  - o iPXE (We use this)
    - Scripting
    - Proprietary Devices
    - TLS Authentication
- The PXE kernel is stored in the in TFTP servers **tftpboot** directory
- The DHCP Server points to
  - Server IP
  - Filename
- The kernel loads a menu
  - PXELINUX TFTP File
  - o iPXE TFTP File, HTTP URL, Script

[?] Debian installer main menu

Choose the next step in the install process:

Choose language

Configure the keyboard

Detect and mount CD—ROM

Load installer components from CD

Change debconf priority

Check the CD—ROM(s) integrity

Save debug logs

Execute a shell

Abort the installation

## **Network - PXE**

```
# Debian preseed.cfg# Locale sets language and country.d-i debian-installer/locale string en_US
```

```
# Keyboard selection.
d-i console-setup/ask_detect boolean false
d-i console-setup/layoutcode string us
```

### Network configuration
d-i netcfg/choose\_interface select eth0
d-i netcfg/dhcp\_timeout string 60

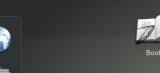
- .tar.gz was the original package format
  - Had to compile
  - Messy
- Package management systems
  - Create order from chaos\*
  - Easy to install and remove packages
  - Contains
    - Binaries, shared libraries, manpages and configurations
  - Handle dependencies
  - Run scripts before, during and after installation
    - systemctl

Package versions different than software versions

```
apt search strace | grep ^strace
strace/bionic,now 4.21-lubuntul amd64 [installed]
strace -V
strace --version
UNKNOWN
```

- System administrators can create packages
  - o rpm for CentOS\Redhat
  - dpkg for Debian\Ubuntu
  - snap self-contained, no dependencies
- Meta-packages
  - Package that contains nothing
  - Used to install other packages
  - "ubuntu-desktop"

### Q Type to search...



























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Frequent

Αl

# rpm - Redhat\CentOS

- RPM Package Manager (rpm)
- Useful arguments

```
o -i (install), -U (upgrade), -e (erase), and -q (query)
```

- Query all packages
  - o rpm -qa
  - o rpm -qa | grep strace
- List files in a package
  - rpm -ql strace
- Not often used alone
  - Dependency hell
    - rpm -q --whatrequires strace

# dpkg - Debian

- Package manager for Debian
- Useful arguments
  - -i (install), -r (remove)
- Query all packages
  - o dpkg -l
- List files in a package
  - o dpkg -L strace
- Reconfigure dpkg-reconfigure
  - apt install slapd
  - dpkg-reconfigure slapd

High-Level Package Managers

# High-Level Package Managers

- Meta Packaging system
  - o apt Debian
  - yum Redhat\CentOS
  - dnf Fedora, Redhat eventually
- Simplifies
  - Finding packages
  - Automates installation, updating and OS upgrading
  - Handle inter-package dependencies
- Requires a significant amount of infrastructure
  - Maintainers
  - Web-servers
  - Certificates
- Distributed
  - Anyone can host a repository

# High-Level Package Managers

### Red Hat Network

- Commercial
- Offers site-wide system management
- Works with the proprietary Satellite Server
- Supports apt and yum

### APT\*

- Better documentation
- Vibrant community
- rpm support (alien)
- o dpkg + .deb

### yum

- RHEL\CentOS
- o RPMs
- o "Enterprise"

# Package repositories

- HTTP or FTP based
  - https://mirrors.ocf.berkeley.edu/ubuntu
- Supports a release
  - 18.04 bionic or 9.1 stretch
  - Package versions are frozen
    - 4.15 Kernel
  - Security updates Backported
- Component
  - Subset of software
  - o main, free, non-free, contrib
  - GPL vs non-GPL
- Architecture
  - I686, amd64, and arm64

# Package repositories

- Individual packages
  - Example: python3 (python3.6)
  - Make up components
  - Architecture-specific
  - Versioned independently
- "extras"
  - Multiverse and universe
    - Non-free components
  - Manually added
  - Examples
    - Oracle Java, NVIDIA, and ALSA

# Advanced Packaging Tool (APT)

- Mature
  - First released in 1999 as part of Debian 2.1 (Slink)
- Supports updates and upgrades
  - Moving from one release to another.
  - Xenial -> Bionic
  - yum does not support release upgrades
- Distros contain many metapackages (yum calls them groupinstalls)
  - o linux-image-generic
  - xfce-desktop
  - build-essential
- Includes low level utilities
  - apt-get
  - apt-cache

### Commands

```
apt update
                  # apt downloads lists
                  # from repos defined in /etc/apt/sources.list
                                         # Look for NeoVTM
apt search neovim
                                         # Show neovim information
apt show neovim
apt-cache madison neovim
                                         # Show Versions
                                         # Show GCC versions
apt-cache madison gcc
apt -s install gcc=4:7.3.0-3ubuntu2
                                         # Downgrade
                                         # Show neovim depencies
apt-cache depends neovim
apt-cache stats
apt-cache policy gcc
                                         # Displays preferences
```

# **Debian Packaging**

### What is Debian?

- GNU/Linux distribution
- 1st major distro developed "openly in the spirit of GNU"
- Non-commercial, built collaboratively by over 1,000 volunteers
- 3 main features:
  - Quality culture of technical excellence
     We release when it's ready
  - Freedom devs and users bound by the Social Contract
     Promoting the culture of Free Software since 1993
  - Independence no (single) company babysitting Debian
     And open decision-making process (do-ocracy + democracy )
- Amateur in the best sense: done for the love of it

# Debian Packages

- .deb files (binary packages)
  - A very powerful and convenient way to distribute software to users
  - One of the two most common package formats (with RPM)
- Universal:
  - 30,000 binary packages in Debian
    - most of the available free software is packaged in Debian!
  - For 12 ports (architectures), including 2 non-Linux (Hurd; KFreeBSD)
  - Also used by 120 Debian derivative distributions

# .deb Packaging Format

.deb file: an ar archive

- debian-binary: version of the deb file format, "2.0\n"
- control.tar.gz: metadata about the package control, md5sums, (pre|post)(rm|inst), triggers, shlibs, . . .
- data.tar.gz: data files of the package

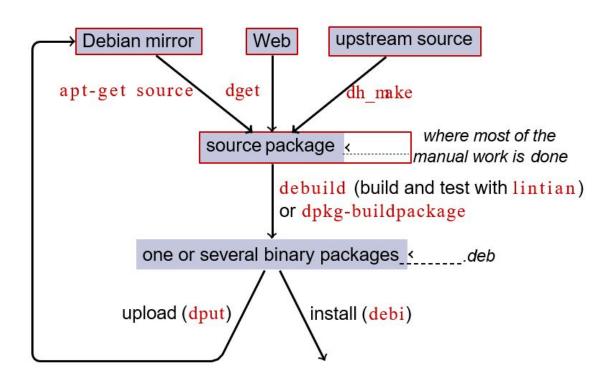
# .deb Packaging Format

- You could create your .deb files manually http://tldp.org/HOWTO/html\_single/Debian-Binary-Package-Building-HOWTO/
- But most people don't do it that way

### **Tools**

- A Debian (or Ubuntu) system (with root access)
- Some packages:
  - build-essential: has dependencies on the packages that will be assumed to be available on the developer's machine (no need to specify them in the Build-Depends: control field of your package)
    - includes a dependency on dpkg-dev, which contains basic Debian-specific tools to create packages
  - o **devscripts**: contains many useful scripts for Debian maintainers
- Many other tools are available, such as debhelper, cdbs, quilt, pbuilder, sbuild, lintian, svn-buildpackage, git-buildpackage, . . .
- Install them when you need them.

## Workflow



# Rebuilding dash

- Install packages needed to build dash, and devscripts sudo apt-get build-dep dash (requires deb-src lines in /etc/apt/sources.list) sudo apt-get install --no-install-recommends devscripts fakeroot
- Create a working directory, and get in it:
   mkdir /tmp/debian-tutorial; cd /tmp/debian-tutorial
- 3. Grab the dash source package apt-get source dash (This needs you to have deb-src lines in your /etc/apt/sources.list)
- 4. Build the package cd dash-\* debuild -us -uc (-us -uc disables signing the package with GPG)
- Check that it workedThere are some new .deb files in the parent directory
- Look at the debian/ directory
  That's where the packaging work is done

## Workflow

