Package Management

A deeper look

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Overview

- Motivation
- Package manager
- Various roles in package management: developer, maintainer, tester
- Quick overview of Debian
- Package life-cycle in the RedHat family, i.e. Fedora, RHEL, CentOS
- Package security
- Docker container

Motivation

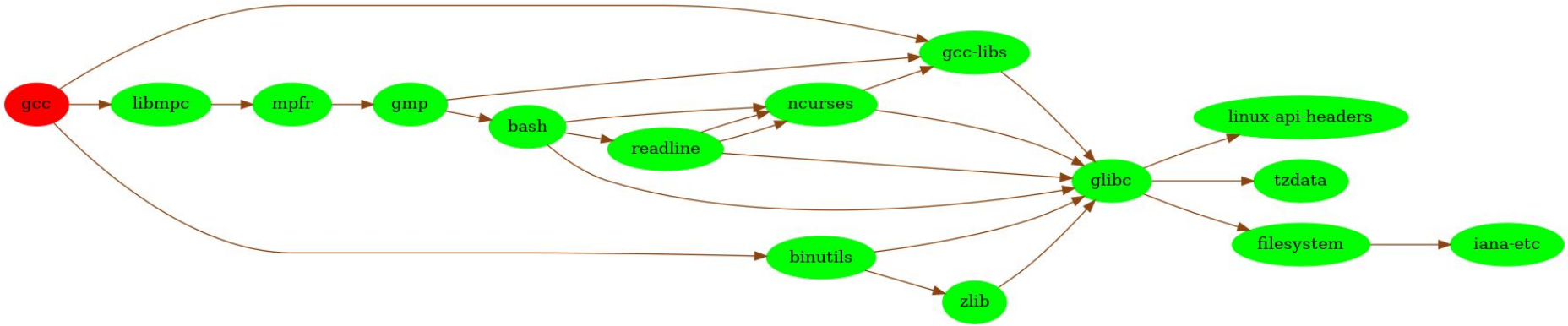
Manual Installation

Installation wizards like these are not **scalable**:

Manual Installation

```
wget https://iperf.fr/download/source/iperf-3.1.3-source.tar.gz
tar zxf iperf-3.1.3-source.tar.gz
cd iperf && ./configure && make && sudo make install
```

What if they have dependencies?



Manual Installation

```
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tar zxf iperf-3.1.3-source.tar.gz
cd iperf && ./configure && make && sudo make install
```
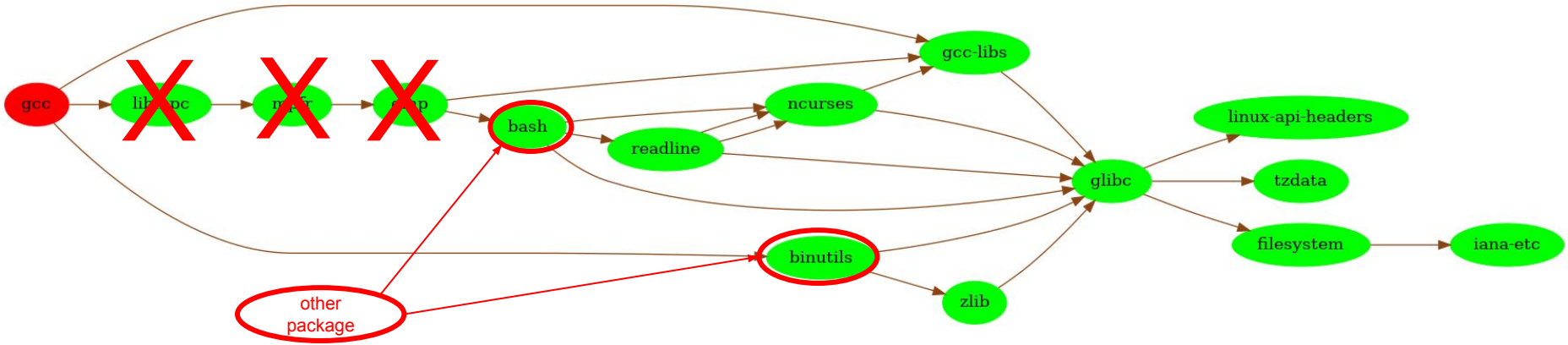
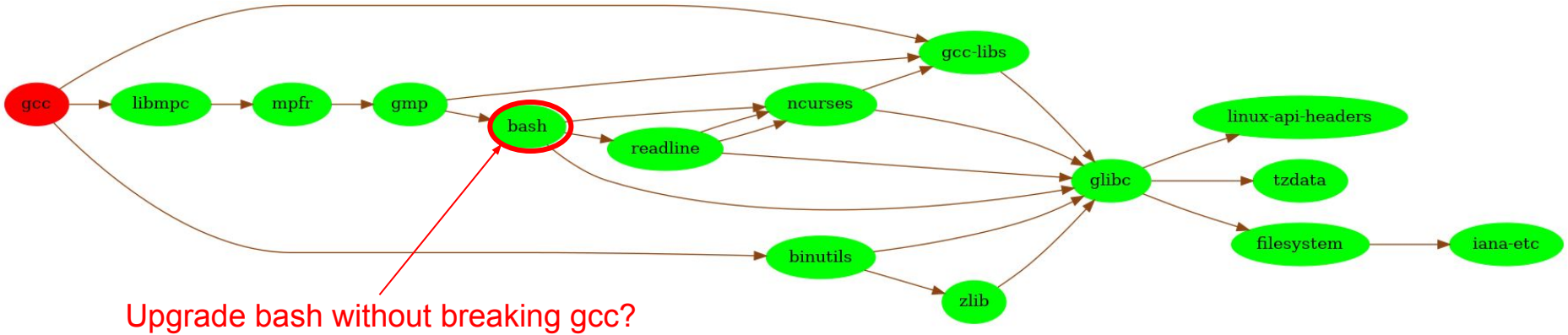

What if someday you want to remove them safely?



Manual Installation

```
wget https://iperf.fr/download/source/iperf-3.1.3-source.tar.gz
tar zxf iperf-3.1.3-source.tar.gz
cd iperf && ./configure && make && sudo make install
```

What if you want to upgrade them?



Manual Installation

```
wget https://iperf.fr/download/source/iperf-3.1.3-source.tar.gz
tar zxf iperf-3.1.3-source.tar.gz
cd iperf && ./configure && make && sudo make install
```

- What if they conflict with (overwrite) installed files?
- What if you can't afford compiling them?

  Compiling a Firefox on a Raspberry Pi can take days ...

- What if the install scripts are **malicious**? 

  You just use sudo, so anything can happen!

Installing a webserver on Ubuntu in a breeze

```
root@ubuntu:~# apt-get install apache2
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1 libaprutil1
  libaprutil1-dbd-sqlite3 libaprutil1-ldap liblua5.1-0 ssl-cert
Suggested packages:
  www-browser apache2-doc apache2-suexec-pristine | apache2-suexec-custom
  openssl-blacklist
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils libapr1 libaprutil1
  libaprutil1-dbd-sqlite3 libaprutil1-ldap liblua5.1-0 ssl-cert
0 upgraded, 10 newly installed, 0 to remove and 104 not upgraded.
Need to get 1,554 kB of archives.
After this operation, 6,412 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

Oops ... I just sudo something ...

install script does rm -rf /usr for ubuntu #123

Closed **ginoputrino** opened this issue on May 24, 2011 · 55 comments

ginoputrino commented on May 24, 2011

An extra space at line 351:
rm -rf /usr /lib/nvidia-current/xorg/xorg

causes the install.sh script to do an rm -rf on the /usr directory for people installing in ubuntu.

Totally uncool dude!!! The script deletes everything under /usr. I just had to reinstall linux on my pc to recover.

Removing the space will fix this. Probably should do it quickly!!!

160 18 297 103 29 130

https://github.com/MrMEEE/bumblebee-Old-and-abbandoned/issues/123

Oops ... I just sudo something ...

TcM1911 commented on Jan 16, 2015

pythoneer,

I believe the issue starts on line 19:

```
# figure out the absolute path to the script being run a bit
# non-obvious, the ${0%/*} pulls the path out of $0, cd's into the
# specified directory, then uses $PWD to figure out where that
# directory lives - and all this in a subshell, so we don't affect
# $PWD

STEAMROOT="$(cd "${0%/*}" && echo $PWD)"
STEAMDATA="$STEAMROOT"
```

This probably returns as empty which mean: `rm -rf "$STEAMROOT/"*` is the same ass `rm -rf "/"*`.

2 2

https://github.com/valvesoftware/steam-for-linux/issues/3671

What's wrong?

index.js | webpack.config.js | README.md | Untitled-1 | packa

```
#!/bin/sh
DUMP=mongodump
OUT_DIR=/data/backup/mongod/tmp    // 备份文件临时目录
TAR_DIR=/data/backup/mongod        // 备份文件正式目录
DATE=`date +%Y_%m_%d_%H_%M_%S`     // 备份文件将以备份时间保存
DB_USER=Guitang                    // 数据库操作员
DB_PASS=qq                         // 数据库操作员密码
DAYS=14                            // 保留最新14天的备份
TAR_BAK="mongod_bak_$DATE.tar.gz" // 备份文件命名格式
cd $OUT_DIR                        // 创建文件夹
rm -rf $OUT_DIR/*                  // 清空临时目录
mkdir -p $OUT_DIR/$DATE            // 创建本次备份文件夹
$DUMP -d wecard -u $DB_USER -p $DB_PASS -o $OUT_DIR/$DATE  // 执行备份命令
tar -zcvf $TAR_DIR/$TAR_BAK $OUT_DIR/$DATE       // 将备份文件打包放入正式目
find $TAR_DIR/ -mtime +$DAYS -delete             // 删除14天前的旧备份
```

https://stackoverflow.com/questions/55323391/delete-database-accidentally-by-a-bash-rescue-please

Quality Assurance

Packages are repeatedly tested before every release.

- **Automatic testing in a cluster**
- **Manual testing by QA engineer**
- **Source of changes:**
  - New features
  - Bug fixes

Oracle’s spaghetti code survives thanks to testing: https://news.ycombinator.com/item?id=7545171

Package Manager

Package Manager, heart of every Linux distribution

dpkg / apt

pacman

rpm / yum / dnf

rpm / zypper

The goal of package manager

Enable the user to do the following things with ease:

- Search & install new software
- Upgrade software
- Safely remove software
- Verify the downloaded software content

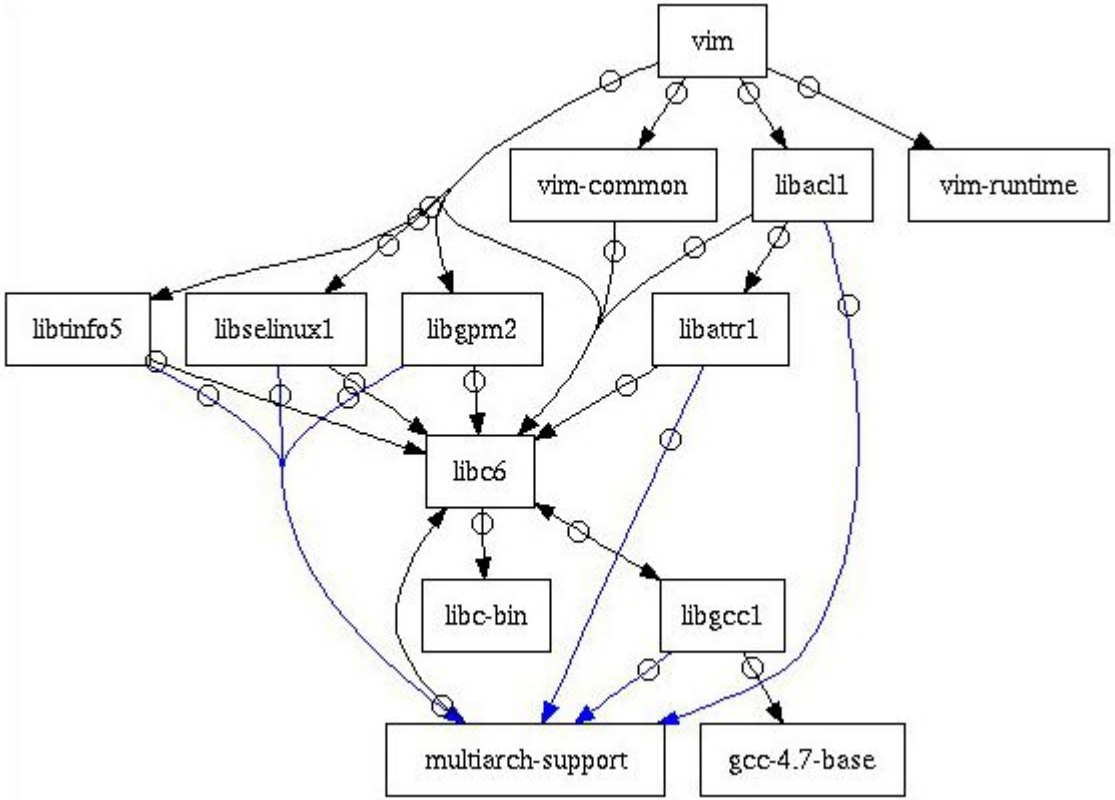
The goal of package manager

Enable the user to do the following things with ease:

- Search & install new software
  - Search package list in local database
  - Check conflict
  - Traverse dependency tree (*NP-complete* !)
- Upgrade software
  - Remove old version then install new version
- Safely remove software
- Verify the downloaded software content

https://research.swtch.com/version-sat

Dependency Tree of Vim: DAG



People

Developer

Working on **upstream** project

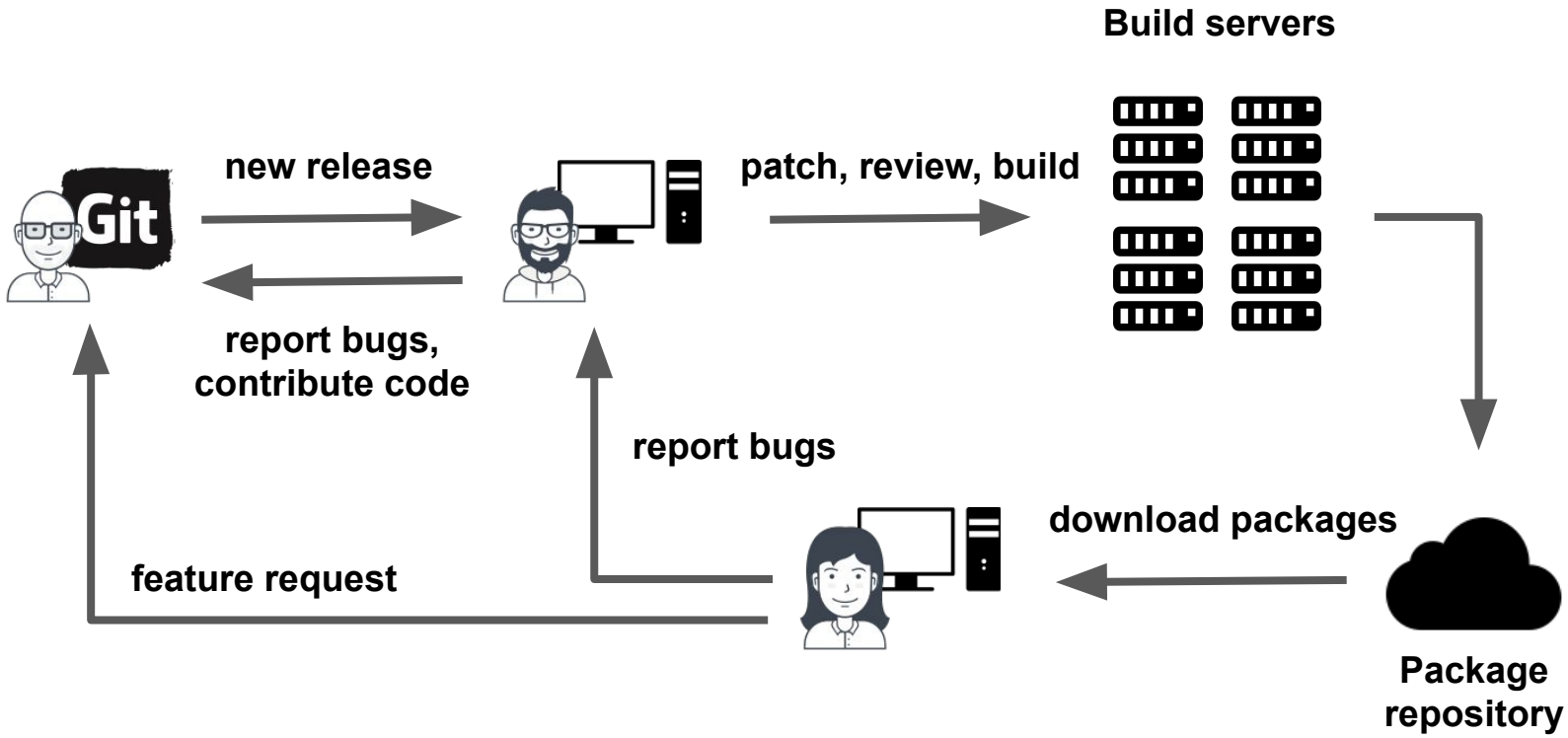
Maintainer

* Every distribution has their own maintainers
* Create the distribution-specific experience
* Package stability, default options, usability

User

You
Enjoy & give feedback

Workflow


Build servers
Git
new release
patch, review, build
report bugs,
contribute code
report bugs
download packages
feature request
Package
repository

Mirror

Exercise: What is the organization who hosts the primiary Debian mirror in Taiwan? (Hint: `ftp.tw.debian.org`)

- **Fun mirror**: `mirror.facebook.net`
- **Our mirror**: `debian.csie.ntu.edu.tw`

Vim as an example

Vim experience on Ubuntu

```
vim-basic
vim-athena
vim-athena-py2
vim-gnome
vim-gnome-py2
vim-gtk
vim-gtk-py2
vim-gtk3
vim-gtk3-py2
vim-nox
vim-nox-py2
vim-scripts
vim-tiny
```

Vim experience on Fedora

```
vim-x11
vim-minimal
vim-enhanced
```

- Different way of packaging
- Different default options
- Different plugin inclusion
- Different usability

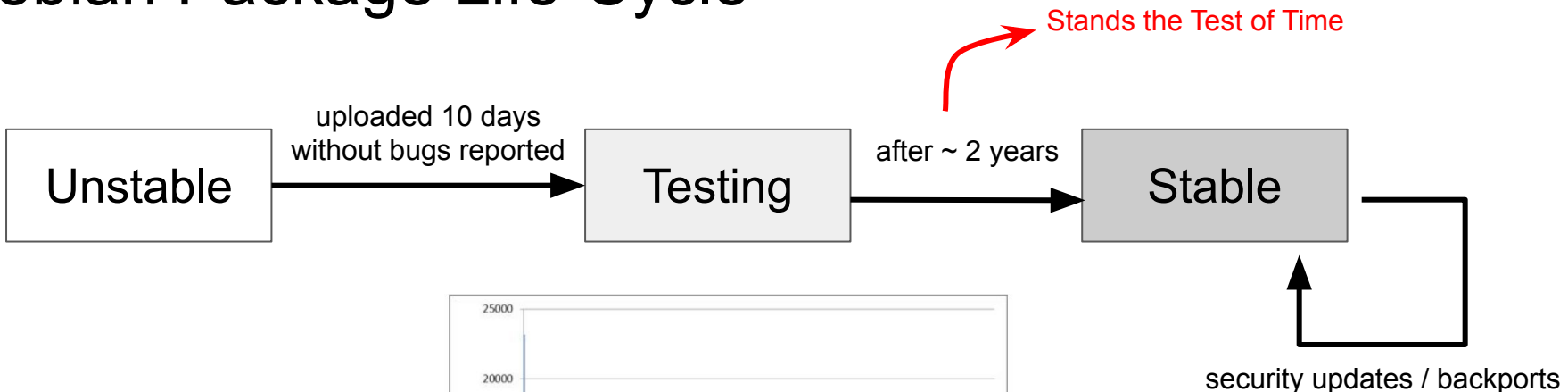
https://src.fedoraproject.org/cgit/rpms/vim.git/
https://packages.debian.org/sid/vim

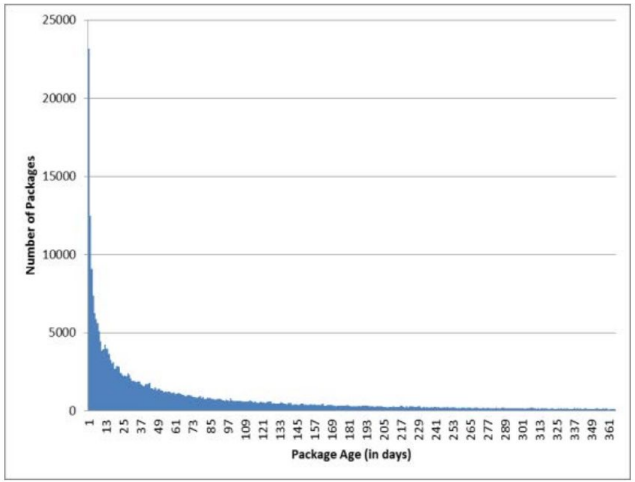
Package Life-cycle

Standard release v.s. Rolling release

- Standard release
  - Major package updates released in fixed cycle (six months for Fedora)
  - Packages well-tested when released
  - Only bugfix + small update between releases
  - **Long Term Support** (LTS)
  - Example: Ubuntu, Debian, Fedora
- Rolling release
  - Limited testing before shipping updates (Just Ship It!) 
  - Good for the *adventurer*
  - Example: Arch Linux (CSIE workstation !!!!)

Debian Package Life-Cycle





https://debian-handbook.info/browse/stable/sect.release-lifecycle.html
Life and Death of Software Packages: An Evolutionary Study of Debian, CASCON '12 Proceedings of the 2012 Conference of the Center for Advanced Studies on Collaborative Research Advanced Studies on Collaborative Research

Security Updates / Backports

Security Updates:

Only fix security-related bugs without introducing new features.

Backports:

New packages compiled with old-version libraries: enjoy new features without breaking compatibility.

The Redhat family

* sponsored by Redhat
* Free
* 6 month release cycle
* Bleeding edge

* Long-term support
* Security fix
* Non-free

* Use RHEL codebase
* Free
* Not sponsored by Redhat

Redhat, a giant in open source

The Linux Kernel

Gnome Desktop Environment

Xorg server, Systemd, NetworkManager

libvirt

Fedora

- Include only **FREE** open source software.
  - Software must not be proprietary or patented
  - **Excluded**: Flash Player, Nvidia driver (not excluded in Ubuntu)
- The driving force of software innovation
  - NetworkManager, SELinux, Wayland, Systemd, etc.
- Six-month release cycle: reasonably stable new software

Package Security

Distribution keys

```
[root@ubuntu]# apt-key list
/etc/apt/trusted.gpg
--------------------
pub   1024D/437D05B5 2004-09-12
uid                  Ubuntu Archive Automatic Signing Key <ftpmaster@ubuntu.com>
sub   2048g/79164387 2004-09-12

pub   4096R/C0B21F32 2012-05-11
uid                  Ubuntu Archive Automatic Signing Key (2012) <ftpmaster@ubuntu.com>
......
```

```
[root@centos]# rpm -ql centos-release | grep KEY
/etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
/etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-Debug-7
/etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-Testing-7
[root@centos]# cat /etc/pki/rpm-gpg/RPM-GPG-KEY-CentOS-7
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: GnuPG v1.4.5 (GNU/Linux)
........
```

Installing VirtualBox on CentOS

```
[root@centos]# cd /etc/yum.repos.d
[root@centos]# wget http://download.virtualbox.org/virtualbox/rpm/rhel/virtualbox.repo
[root@centos]# yum --enablerepo=epel install dkms
Retrieving key from https://www.virtualbox.org/download/oracle_vbox.asc
Importing GPG key 0x98AB5139:
 Userid     : "Oracle Corporation (VirtualBox archive signing key) <info@virtualbox.org>"
 Fingerprint: 7b0f ab3a 13b9 0743 5925 d9c9 5442 2a4b 98ab 5139
 From       : https://www.virtualbox.org/download/oracle_vbox.asc
Is this ok [y/N]: y

....

[root@centos]# yum install VirtualBox-4.1
```

Typing y means you trust the repository!

Distribution keys

- A set of public keys imported when you enable a repository
- When installing new packages, binary content checked against the keys
- Only the person who signs the package has the private key
- Prevent ***Man-in-the-middle*** **attack**
  - Attacker takes control of a package mirror
  - Add malicious code into package
  - Add malicious dependencies into package metadata
  - Download package via HTTP instead of HTTPS

Distribution keys (2)

- CentOS, Ubuntu store just a few keys, either in plain text or keyring
- Arch Linux stores many keys owned by core maintainers
  - `pacman-key -l`
- Language package repository like PyPI, Rubygem allows arbitrary developers to upload packages. **Hard to enforce package signing.**

🚫 **`sudo pip install xxx`**

- Further security enhancement: *Debian's Reproducible Builds*

See: https://wiki.debian.org/ReproducibleBuilds/About

Malicious packages

Dec 2009: DDOS caused by malicious Gnome screen-saver, distributed as a regular Debian package.

```
ping -s 65507 www.mmowned.com
```

May 2017: Mirror of a major video transcoder for Mac OS X, HandBrake, was compromised:

https://www.cyberciti.biz/open-source/handbrake-for-mac-mirror-server-was-compromised-and-infected-with-proton-malware/

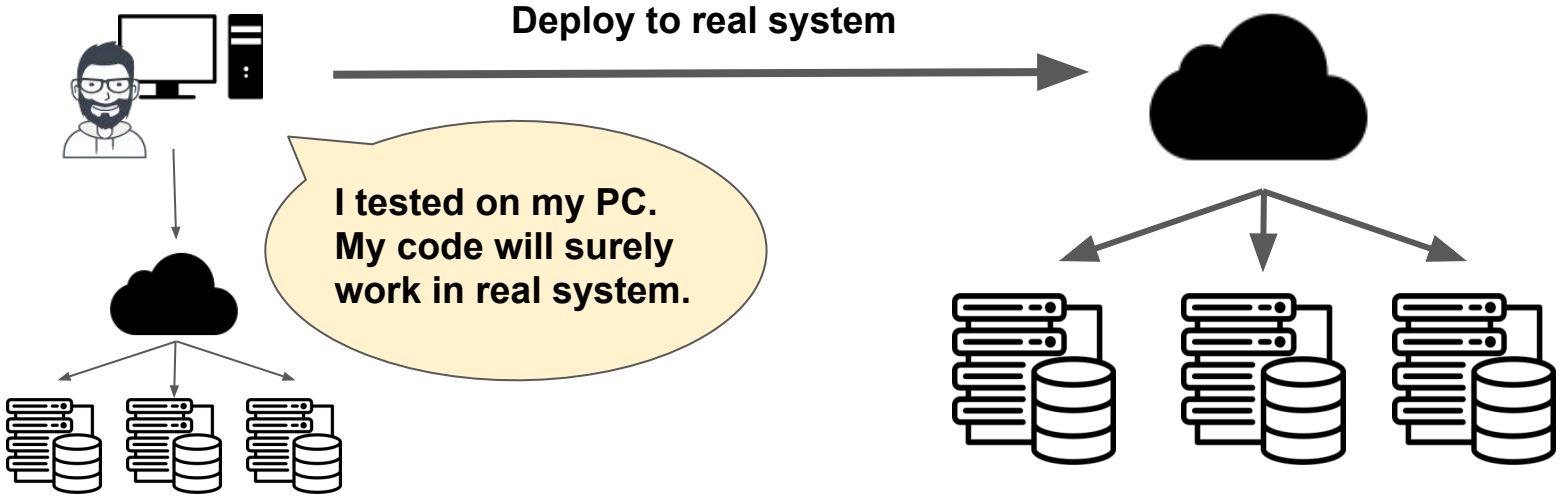
Docker container

Docker: an effective method of software distribution

Package an application with its dependencies

→ Like VM, a Docker image is guaranteed to work anywhere once tested

→ Instead of upgrade, simply **switch** to new environment + new code.



Docker Hub is a big target

May 2017: Hackers injected cryto-currency miner into images on Docker Hub. Downloaded 5 million times, resulting in $90,000 of revenue.

April 2019: 190,000 accounts (5% of users) were stolen on Docker Hub. The hacker can inject malicious scripts into Docker images.

Wrap-up

- Packages make your life 100% easier than manual installation
- Package life-cycle: software stability v.s new features
- Don’t blindly trust arbitrary package provider

  🚫 `sudo pip install xxx`

- Docker container can make testing easier