Universal Packages

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Introduction
A **package** is an archive containing a collection of executable files or source code, along with metadata, which represent a computer program.
What is a package format?

A **package format** is an organizational structure for delivering packages to users.
Why do we need package formats?

- They provide a common way to bundle executables, libraries, assets, etc. for deployment on user machines.
- They provide metadata about programs for use in package managers.
- It would suck if we had to go find the source code for every single program we want to use and compile from source.\(^1\)

\(^1\)Actually, some package formats do require compilation from source (for example some AUR packages) but at least it helps automate this process.
A bit of history

1994 dpkg — the package format behind apt and apt-get. Used by Debian-based systems.

1997 RPM — the package format behind yum and dnf. Used by RHEL-like systems.

2002 pacman — the package manager for Arch Linux. It just uses tar files.


2006 nix — a purely functional package format. Primarily used by NixOS.

June 2016 snapd — the Canonical-backed universal package format is ported to a wide range of Linux distros.

June 2016 Flatpak — the Red Hat-backed universal package format becomes generally available.
Universal Package Formats
Common objectives

- Linux distro agnosticism
- Solve the “dependency hell”
- Create a “single” deployment target for all of Linux
Why is AppImage cool?

- **AppImage does not require installation.** The AppImage file is just its compressed image that is mounted with FUSE when it runs.

- **AppImage does not require root permission.** The application is run as the user and the base system is left untouched.

- **The AppImage itself is executable.** Just `chmod +x` the `.AppImage` file and run.

- **Linus says so**
  
  "This is just very cool."
  
  ~ Linus Torvalds
Application developers use the `appimagetool` converts an AppDir into a self-mounting filesystem image.

AppImages can be integrated with the system via menu entries, icons, MIME types, etc. The `appimaged` daemon handles this registering and unregistering process.
How to create an AppImage

Create an AppDir with the following files (totally copied from their documentation):

- The files of the original application.
- A `.desktop` file that tells `appimagetool` about the name of the application, and the icon it should use.
- A PNG, SVG or an XPM icon with the name given in the `.desktop` file with the `Icon` entry.
- An AppRun file, which is used to start up the application inside the filesystem. Once the AppImage ELF has mounted the filesystem, it invokes this file. In the AppRun file, you can run some initialization procedures (such as setting environment variables), and then start up the real application.
- Optionally, you should also add AppStream metadata in `usr/share/metainfo`.
Live Demo: Running an AppImage
Snaps & snapd
Why are Snaps cool?

- **Snaps are squashFS filesystems.** They contain your app code and a `snap.yaml` file with metadata.

- **Snaps are self-contained.** The necessary libraries and runtimes are bundled in the snap. This allows you to have different library versions in your application than exist on your base system.

- **Snaps can have different levels confinement.**
  - **strict** is the default policy. The snap has read and/or write rights only in its own install space and selected areas.
  - **devmode** is for development of Snaps.
  - **classic** confinement behaves as a traditionally packaged application, with full access to the system.

- **Snaps can communicate with one another via interfaces.**
How do Snaps work?

Snap Confinement

- Private storage area
- Snap package
  - Binaries
  - Interfaces
- Third-party snap
  - Interfaces
- OS
How to create a Snap

- Make your application.
- Make a `snapcraft.yaml` with a bunch of stuff.
  - name
  - version
  - summary
  - description
  - grade
  - confinement
  - ...
- Run `snapcraft`. 
Live Demo: Running a Snap
flatpak
Flatpak is a system for building, distributing and running sandboxed desktop applications on Linux. (https://github.com/flatpak/flatpak)
Why is flatpak cool?

- Flatpak includes a system of runtimes that allow developers to build their application against a stable base.
- Runtimes allow deduplication of dependencies between packages
- Flatpak makes uses of bubblewrap for sandboxing
- Flatpak supports a system of Appstream metadata to allow packages to show up nicely in various package managers
Runtimes

- org.freedesktop.Platform
  - D-Bus
  - GLib
  - PulseAudio
  - X11
  - Wayland

- org.gnome.Platform (based on freedesktop)
  - GStreamer
  - PyGObject
  - Vala
  - GVFS
  - other stuff to make Gnome work...
Runtimes

- org.kde.Platform
  - Qt Frameworks
  - KDE Frameworks
Sandboxing

- All processes run as the user with no capabilities
- All processes run in a transient systemd user scope with the name `flatpak-$appid-$pid`
- `/` is a private tmpfs not visible anywhere else. This is `pivot_root`ed into so it is the new and all other mounts from the host are unmounted from the namespace.
- Environment variables set:
  - `PATH=/app/bin:/usr/bin`
  - `LD_LIBRARY_PATH=/app/lib`
  - `XDG_CONFIG_DIRS=/app/etc/xdg:/etc/xdg`
  - `XDG_DATA_DIRS=/app/share:/usr/share`
  - `XDG_RUNTIME_DIR=/run/user/$pid`
How to build a flatpak package
- Install the flatpak-builder package
- See https://flatpak.org/getting.html for instructions
---

**Runtimes**

- Add the repository hosting your runtime
  
  ```
  $ flatpak remote-add --if-not-exists flathub https://flathub.org/repo/flathub.flatpakrepo
  ```

- Install the runtime and corresponding SDK
  
  ```
  $ flatpak install flathub org.freedesktop.Platform//1.6 org.freedesktop.Sdk//1.6
  ```
---
{  
  "app-id": "org.flatpak.Hello",
  "runtime": "org.freedesktop.Platform",
  "runtime-version": "1.6",
  "sdk": "org.freedesktop.Sdk",
  "command": "hello.sh",
  "modules": [
    {
      "name": "hello",
      "buildsystem": "simple",
      "build-commands": [  
        "install -D hello.sh /app/bin/hello.sh"
      ],
      "sources": [  
        {  
          "type": "file",
          "path": "hello.sh"
        }
      ]
    }
  ]
}
Packaging

- Package application
  
  $ flatpak-builder app-dir org.flatpak.Hello.json

- Test application
  
  $ flatpak-builder --run app-dir org.flatpak.Hello.json hello.sh

- Upload to repository
  
  $ flatpak-builder --run app-dir org.flatpak.Hello.json hello.sh
Comparison
Advantages of each of these universal package formats

- AppImage is great for portable, self-contained applications.
- Snaps are good for deploying single applications.
- Flatpak is good for distributing a set of applications. For example, Gnome development builds are in a Flatpak repository.
- Nix is a cool functional package manager. Everytime you build the same version of the same package you should get the same output.
Love to Hate Them
Proprietary enterprise applications are coming to Linux

Currently, when enterprises want to make a cross-platform application, they see this:

macOS .dmg
Windows .exe

Linux .deb and .rpm and PKGBUILD and …, then deal with the dependency hell\(^2\)

However, when companies like Canonical come in and say “just target snaps”, all of a sudden, it may tip the scale at enterprises for them to start targeting Linux. If they create a snap, then they capture all of the Linux market, not just the subset that uses a particular format.

\(^2\)Yes, you have to deal with dependency hell on other platforms too, but every platform has a different type of dependency hell. Coming to Linux is an expensive prospect for many enterprises.
Pros and cons

Pros

- More application availability.
- More abstraction! No more dealing with a bunch of different packaging formats.
- Easier troubleshooting: Developers can be certain (ideally) that users are using the same software configuration.
Cons

- The applications are going to be crap. Bloated, Electron, enterprise crap.
- More abstraction! Not much improvement on ease of deployment in comparison to deploying to .deb.
- Library version management is somewhat delegated to the application developers, Windows style. Heartbleed anybody. This hopefully can be somewhat alleviated by runtimes.
Questions?
Resources

ApplImage https://appimage.org/
Snapcraft https://snapcraft.io/
Flatpak https://flatpak.org/
Nix https://nixos.org/nix/
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