THE HISTORY
ros-install-osx, the evolution of development and deployment at Clearpath

THE PROBLEM
stable releases for industrial customers in a rolling release world

THE BUNDLE
the tools which power our solution, and some unanticipated benefits

THE FUTURE
how the tooling can further evolve to better support this deployment model
Building ROS Indigo on Mac OS X, two years ago.

The number of potential problems dwarfs the main body of the setup instructions.

New approach used brewed python/numpy/scipy instead of the system versions of those packages, and built in parallel with catkin_tools, rather than catkin_make_isolated. Started life as a gist, eventually evolved into runnable script. Positive side effect has been a centralized bug-tracker and place to review and collaborate on fixes with a growing community of ROS Mac users.
Process is:
1. Generate a list of all packages which will be in the workspace.
2. Download the tarball for each package.
3. Install system dependencies using rosdep (stuff like CMake, Boost, PCL).
4. Giant parallel build!

This is what the build looks like in catkin_tools. We're not going to dwell here except to say that a catkin_tools is equivalent in approach to catkin_make_isolated, meaning that each package is configured as its own project, rather than being combined together. This is critical because plain CMake packages like orocos_kdl and catkin itself can't be combined into one workspace the way catkin packages can.

This is a snippet of what's inside the rosinstall file that wstool consumes. It's a list of tarball links which will be downloaded and unpacked to populate the source workspace.
The `rosinstall_generator` tools uses as its source data the `distribution.yaml` which governs which version of every package is the current latest in a given distribution. So in this case, version 1.11.6-0 was the last bloomed release of `actionlib` into ROS Indigo. The build farm uses this data to generate Jenkins jobs to build debian packages, but `rosinstall_generator` uses it to generate source workspaces.

The generator is capable of generating a list of git URLs, but downloading tarballs is much faster than cloning git repos, so there is logic to recognize known git hosts and supply tarball URLs with the `--tar` flag.

This used to support github only, but we patched it to also recognize bitbucket and gitlab. Now the other missing piece here is the `--deps` flag. How does `rosinstall_generator` know which packages to pull in when you call for dependencies?
Every few minutes the buildfarm examines the distribution.yaml and updates a secondary yaml which is the contents of the distribution plus an additional dictionary which contains the complete package.xml string for every package. By accessing this cache, rosinstall_generator is able to quickly determine recursive dependencies.

So. That’s ros-install-osx. The second piece of history is that Clearpath has executed a pivot in the past two years, transitioning from a research products company to focusing primarily on a full-stack solution for autonomous mobile robots in the industrial logistics space. This has meant a bunch of changes in how we deploy which are what have primarily driven the development of our bundle pipeline.

About a year ago, I officially joined the industrial team, as Firmware and Integration manager. Deployments to robots, developers, simulation environments were all based on bloomed deb packages as generated by buildbot-ros and then later ros_buildfarm. We had the following issues with this approach.
Rolling release. Robots and devs would all be running "testing debs" without any clear anchor on what versions of packages they actually had.

We had scripts which would use rospack list or rosversion to at least report the versions on a machine at a given time (for example, when a problem was observed, or a crash occurred), but knowing is only half the battle—it doesn’t help you reproduce a bad state when trying to debug it later.

Coupled Repos. Having many interdependent packages in different repos meant having to bloom changes all the time to keep unit tests from breaking, rather than because there was a logical, releasable change.

Because ros_buildfarm sets up the test environment by installing the latest released version of all test dependencies.

The easy argument here is “don’t have so many repos,” but this is not so simple, particularly when you consider our relationship to upstream. Take our controls code, which is spread across three repos: navigation, the planner, and the tracker, where navigation is a fork of upstream, and the planner and the tracker are proprietary. At this point our navigation fork is permanent and permanently private, but a year ago there was still a vague ambition to try to merge our

The release process was a debmirror snapshot of the testing repo, similar to how upstream periodically syncs packages to public.

Meaning that there was no sane way to put incremental bugfixes on a build — you were either on the bleeding edge or a stale snapshot. We experimented with injecting one-off bug fix debs into a release, but it was a very manual, error-prone process.
Part of how I justify getting sucked into this project despite being the “firmware” manager is that we increasingly view the entire robot as an embedded target to be flashed, rather than a Linux PC on wheels with an ordinary computer lifecycle.

THE BUNDLE

“This centrally build a workspace of a bunch of our stuff, tar up the installspace, and use that on the robots.”

This was the proposal that my colleagues and I discussed as a starting point.
Based on ros-install-osx—just build everything! Why bother separating out an overlay?

We need versioning and a distribution scheme; let's just use a debs and an apt repo; those are already a thing.

So your first question might be “seriously, a deb package, in this age of sexy things like containers?”
And it's true, isolation is a big thing right now. Type and degree of isolation varies.

Base catkin is isolated in terms of filesystem only. Sort of a virtualenv for C++ CMake projects. We’re not doing multiple apps, and port or CPU isolation would just get in our way, so we don't need a docker container— we can ship this thing as a deb, and then there’s a lot of additional tools we can take advantage of in the debian ecosystem which don’t exist for docker (and we don’t have to run the daemon).

If you’re like me and you suddenly find yourself generating a bunch of large-ish debs, you’ll quickly discover that the default compression for dpkg-deb is single-threaded xz, which can be extremely slow. Add this PPA to your 8 or 16 core buildslave and watch it scream through that end-of-build compression step.
So, here’s basically our process. A bundle config file defines what our bundles are, where the rosdistro for each one is, and what packages should be used to “seed” rosinstall_generator.

Our rosbundler tool generates the required debian package metadata files, including instructions for how to build everything (the debian/rules file), and then downloads the tarballs, naming them according to debian conventions.

Keen observers will note that this doesn’t actually address a lot of the problems listed above. By default, rosinstall_generator is always grabbing the latest released version of every package, so this bundle is equivalent to whatever the testing debs are at the moment that the bundle is built. How do we actually lock in the versions of the packages?

Well, here’s the distribution file which actually defines the versions of everything. This lives in a git repo, and a git repo can be tagged.
So we'll tag the repo with the number of our major release, and that'll forever give us a reference point to regenerate this configuration.

In fact, we use a regular Debian changelog file which lives alongside the bundles.yaml file, and the version specified in each changelog entry refers directly to a rosdistro tag.

Big and bold so it can't be missed.

Each major release of our entire software stack is a tag on our rosdistro repo, locking the version of every package.
So to finish this out, when we’re building a “release” bundle, we use the package versions from a tag of our rosdistro, rather than the master branch.

And prior to tagging a legit “release”, we can still build a “prerelease”, which is each package at its latest version. Eventually we may tag those as well—it would be nice to understand which repos have mutated when we’re looking at a regression.

Now, we’ve talked a lot about the release stanza of the distribution.yaml entry—this is the entry whose git URL references a GBP repo, one managed by bloom.
But the source stanza is actually where the bundle really comes into its full potential. Let’s look at a new rosinstall_generator flag.

Adding --upstream-development means that instead of getting the source from the bloom GBP repo, we get it directly from the source repo.

Above is what we get by default—this is the latest released source, pulled from the GBP repo. Underneath is with the --upstream-development flag, this is the development branch from the upstream repo.

Can you see what’s happening here? There’s a new type of bundle that’s possible, where we don’t need to bloom at all.
The devel bundle is built entirely of devel sources. Seems scary right? This has actually worked out phenomenally well for us, for a few reasons.

<table>
<thead>
<tr>
<th>BUNDLE TYPE</th>
<th>MAJOR VERSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>devel</td>
<td>clearpath-2.0devel-robots clearpath-2.0devel-nimbus clearpath-2.0devel-sdk</td>
</tr>
<tr>
<td>prerelease</td>
<td>clearpath-2.0pre-robots clearpath-2.0pre-nimbus clearpath-2.0pre-sdk</td>
</tr>
</tbody>
</table>

- test fleet is always running the latest devel code.
- when something breaks upstream (eg, ros_comm), we catch it immediately.
- we’re motivated to push patches, since we get the fix right away.
- we bloom for logical functional releases releases only.
- devel bundle can feed other testing workflows, including multi-robot simulation testing and unit test jobs.
In terms of our actual infrastructure, we build the bundles on Jenkins, and then send them to Aptly. Aptly is super cool for many reasons—two of them are that it can run as a REST service, so you don’t have to deal with SSH or SCP, you can just POST packages to it with curl if you want.

This is our build status page, which is source repo oriented as opposed to the build farm one, which is deb package oriented.

Each row pops open to reveal the changelog and commits which have occurred between the last release and the current level branch.
Freeze a rosdistro's source branch versions to hashes or tags. If neither --release-version nor --release-tag are specified, the hashes of the current devel branches are used.

positional arguments:
index Path to a local index.yaml file
dist_names The names of the distributions (default: all)

optional arguments:
-h, --help show this help message and exit
-j JOBS, --jobs JOBS How many worker threads to use
-q, --quiet Suppress updating status bar (for script/CI usage)
--release-version Freeze to the hash of current release tag
--release-tag Freeze to name of current release tag

rosdistro_freeze_source

actionlib:
source:
type: git
url: https://github.com/ros/actionlib.git
version: indigo-devel
Once a major release for us goes into maintenance, we “freeze” the devel branches to point to the tag of the last release. This allows development to move forward, while still giving us a stable level build upon which to put hot fixes.

DEMONSTRATION

https://github.com/mikepurvis/ros-bundling

catkin test, catkin docs.

dropping release stanzas and blooming, consi.

THE FUTURE

once the ubuntu store is open source, investigate packaging as a snap.
catkin docs

- implement as catkin_tools plugin
- make rosdock_lite into plain python package, so the plugin could depend on it.
- allow building all docs in one big workspace, using the same parallel executor model as catkin build.

https://github.com/catkin/catkin_tools/issues/381

One of the big wins with this approach would be potentially giving more opportunities to supply global overrides. So, same as how building the bundle lets you do fun things like set compiler flags that correspond to the architecture of your robot PC, or archive debug symbols, a future catkin docs might allow injecting a Doxygen theme, etc.

catkin test

- implement as catkin_tools plugin
- safe parallel testing of a workspace which may contain cmake and catkin (and ament?) packages.
- have a scheme for tests to declare and then properly mutex shared testing resources, like the Gazebo port.
- would work for CI, but also be a better story locally for devs using catkin_tools.

https://github.com/catkin/catkin_tools/issues/397

One of the other major functional gaps in catkin_tools right now is not having a good story for running tests.

source only

- drop release stanzas from internal distribution yaml.
- only bloom packages which are going for public release, otherwise do only catkin_prepare_release to uprev package.xml and create tag.
- depends on source manifest caching for dependency resolution.
source only

- drop release stanzas from internal distribution.yaml.
- only bloom packages which are going for public release, otherwise do only catkin_prepare_release to uprev package.xml and create tag.

actionlib:

source:
type: git
url: https://github.com/ros/actionlib.git
version: indigo-devel
release_version: 1.11.6

Snaps

- Packaging as a squashfs is compelling.
- Delta updates are compelling.
- Multiple release streams (edge, RC, etc) is very compelling.
- Blocked on the repository code being open sourced.

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