

# **cmsBuild**

## **CMS SW Packaging tool**

Shahzad Malik MUZAFFAR  
Fermilab

# CMS Offline Software: CMSSW

- Over 200 external packages
  - ~40 data externals needed by CMSSW/Geant4
- Six active release cycles (5.3.X, 6.2.X, ..., 7.5.X)
- Many build architectures e.g  
slc6\_amd64\_gcc491, fc18\_armv7hl\_gcc491
  - Combination of various
    - Operating systems: slc\*, osx\*, fc\*
    - Processors architectures: amd64, armv7hl, aarch64
    - Compilers: gcc4[7-9]\*

# CMS Software Packaging System

- Packaging tool: **RPM**
- Distribution tool: **APT**
- Build recipes: **CMSDIST**
  - Collection of simplified syntax RPM spec files
  - <https://github.com/cms-sw/cmsdist>
- Helper scripts for packaging: **PKGTOOLS**
  - Collection of python scripts
  - <https://github.com/cms-sw/pkgtools>

# Packaging: bootstrap driver kit

- Consists of packaging & distribution tools
  - RPM, APT and their dependencies
    - gcc, bz2lib, db4, file, libxml2, lua, nspr, nss, openssl, popt, sqlite, zlib, xz
    - Minimal distribution: Includes only binaries & libraries which are needed by apt/rpm at run-time
- Checks for required packages which are not distributed via CMS SW Packaging System
  - glibc, coreutils, bash, tcsh, zsh, perl, X11 .....

# Build recipes: CMSDIST

- Over 400 build recipes
  - Shared between CMS Offline and Computing
  - 150 SCRAM tool-files (XML file for package definition for SCRAM)
- Simplified syntax RPM spec file
  - Pre-processed & converted in to RPM spec files by PKGTOOLS/cmsBuild
- Separate git branches for various architectures
  - Ideally one git branch for each compiler version

# PKGTOOLS

- Collection of python scripts (mainly cmsBuild)
  - Converts build recipes in to RPM Specs
  - Resolves dependencies
  - Downloads & installs packages which are already available in apt repository
  - Downloads sources (in parallel) for the packages which are going to be (re-)build
  - Runs rpmbuild to built rpm of a package
    - Independent packages build in parallel

# PKGTOOLS

- Each package is assigned a hash based on
  - Build recipe
  - Contents of local sources and patches (if any)
  - Hashes of its fully expanded dependencies
- Unique name for each package
  - `<pkg-group>+<pkg-name>+<pkg-version>[-prefix[N]]`
- Package's RPM version & revision is always set to “1” e.g.
  - `cms+coral+CORAL_2_3_21-cms19-1-1.sl6_amd64_gcc491.rpm`

# PKGTOOLS

- Tests installation of the package to
  - Check if it is relocatable
  - Find out any hidden dependencies
- Generates environment scripts for each package
  - [etc/profile.d/init.\[c\]sh](#)
- Uploads RPMs, source RPMs and Sources to the APT server
  - Sources are shared between various architectures
  - Concurrent uploads



# Build Recipe Example

```
### RPM external gmp 4.2.1
```

```
Source: ftp://mirrors.kernel.org/gnu/%n/%n-%realversion.tar.gz
```

Build Recipe

```
#variables definitions .....
```

```
Name: external+gmp+4.2.1
```

```
Version: 1
```

```
Summary: CMS Experiment package SpecChecksum:ad1b0eaedc11b307f2f799be0822600e
```

```
Requires: external+gcc+4.9.1-cms
```

```
Prefix: /opt/cmssw
```

```
Source: ftp://mirrors.kernel.org/gnu/{pkgname}/{pkgname}-%realversion.tar.gz
```

```
%prep
```

```
%setup -n {pkgname}-%{realversion}
```

```
%build
```

```
./configure --prefix={pkginstroot}
```

```
make
```

```
%install
```

```
make install
```

```
#Create {pkginstroot}/etc/profile.d/init.[c]sh
```

```
%post
```

```
{relocateConfig}etc/profile.d/init.sh
```

```
{relocateConfig}etc/profile.d/init.csh
```

SPEC file  
generated  
by cmsBuild

# Build Recipe Example

```
### RPM external xz 5.2.1
%define tag 14937fff889113f477d6f60098186f932e72c0e4
%define branch cms/v%{realversion}
%define github_user cms-externals
Source0: git+https://github.com/%github_user/xz.git?obj=%{branch}/%{tag}&export=%{n}-%{realversion}
&output=%{n}-%{realversion}.tgz
Requires: gcc
BuildRequires: autotools gmake

%prep
%setup -n %{n}-%{realversion}

%build
./autogen.sh
./configure CFLAGS='-fPIC -Ofast' --prefix=%{i} --disable-static --disable-nls --disable-rpath \
--disable-dependency-tracking --disable-doc
make %{makeprocesses}

%install
make %{makeprocesses} install
%define strip_files %{i}/lib
%define drop_files %{i}/share
```

# Build Recipe Example

```
### RPM lcg root 6.02.10
## INITENV +PATH PYTHONPATH %{i}/lib
## INITENV SET ROOTSYS %{i}
%define islinux %(case %{cmsos} in (slc*|fc*) echo 1 ;; (*) echo 0 ;; esac)
%define isdarwin %(case %{cmsos} in (osx*) echo 1 ;; (*) echo 0 ;; esac)
%define isarmv7 %(case %{cmsplatf} in (*armv7*) echo 1 ;; (*) echo 0 ;; esac)
```

**Requires:** [gsl](#) [libjpeg](#) [libpng](#) [libtiff](#) [pcre](#) [python](#) [fftw3](#) [xz](#) [xrootd](#) [libxml2](#) [openssl](#) [zlib](#)

```
%if %islinux
Requires: castor dcap
%endif
```

```
%if %isdarwin
Requires: freetype
%endif
```

```
....
....
```

# CMS Offline SW Configuration

```
### RPM cms cmssw-tool-conf 32.0
## NOCOMPILER
Requires: alpgen-toolfile boost-toolfile bz2lib-toolfile castor-toolfile charybdis-toolfile
Requires: gcc-toolfile classlib-toolfile coral-toolfile root-toolfile xrootd-toolfile
.....
%if %islinux
Requires: openldap-toolfile python-ldap-toolfile google-perftools-toolfile dmtcp-toolfile
%endif
%if %isdarwin
Requires: freetype-toolfile
%endif
%if %isamd64
Requires: tkonlinesw-toolfile py2-cx-oracle-toolfile oracle-toolfile
%if %isslc
Requires: openloops-toolfile
%endif
%if %islinux
Requires: igprof-toolfile
%endif
%endif
.....
```

# PKGTOOLS: Building a Package

- Building a package (e.g. root) is as simple as

- Checkout CMSDIST and PKGTOOLS

(<https://github.com/cms-sw/cms-bot/blob/master/config.map>)

```
git clone -b IB/CMSSW_7_5_X/stable https://github.com/cms-sw/cmsdist
```

```
git clone -b V00-22-XX https://github.com/cms-sw/pkgtools
```

- *Run cmsBuild*

```
./pkgtools/cmsBuild -a slc6_amd64_gcc491 -c ./cmsdist --builders=4 -j 10  
--work-dir work build root
```

- Build max of 4 independent packages in parallel and each package can run “*make -j 10*”

# PKGTOOLS: Uploading a Package

- Use **upload** instead of **build** command

```
./pkgtools/cmsBuild -a slc6_amd64_gcc491 -c ./cmsdist --builders=4 -j 10  
--work-dir work upload root
```

- Uploads RPMs to cms.**username** apt repository
- add **--sync-back** option to upload in to the official cms repository
- cmsBuild makes sure that no one else has already uploaded the same package (package with same hash)

lcg+root+6.02.00-cms5

lcg+root+6.02.00-mytest

- SSH public keys are used for authentication

# APT: Package Distribution

- One time setup (per architecture)

```
curl -O http://cmsrep.cern.ch/cmssw/cms/bootstrap.sh
```

```
bash bootstrap.sh setup -arch slc6_amd64_gcc491
```

- Package installation

```
source slc6_amd64_gcc491/external/apt/*/etc/profile.d/init.sh
```

```
apt-get update
```

```
apt-get -y install cms+cmssw+CMSSW_7_4_4
```

```
apt-get -y install cms+cmssw+CMSSW_7_4_5
```

- *Unique package name allows to have multiple versions installed*

# Summary

- Minimal standard system dependency
  - python, tar, zip, git, svn, perl, X11 ...
- Easy to build/install new package
- Multiple architectures
- Relocatable packages
- Installation of multiple versions of a package
- Multiple versions of a package within same configuration