GNU Radio Technical Update
Moving at $c_0$: Advancing GNU Radio

Marcus Müller

2018-09-18
What’ll happen in the next 40 minutes

Looking back at 5 years of 3.7

What has happened to 3.7?

What’s to come in GNU Radio 3.8?

3.8.0.0+ and beyond

Conclusion
Marcus Müller
Bearer of a couple of roles

- Support Grumpiness supplier
- Research assistant at KIT
  - I hold the exercise classes for KIT EEs’ *Probability Theory* and *Communications Theory* courses (> 300 students) and *Applied Information Theory* (ca 13 dB fewer students)
- Freelancing Engineer
  - Technical Consulting
  - Contract Development
  - Seminars
- Maintainer of the GNU Radio project
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Depending on what you want to talk to me about, contact me using

- University Research & Teaching: mueller@kit.edu
- GNU Radio aspects: Preferably, discuss-gnuradio@gnu.org, for confident matters mmueller@gnuradio.org
- Ettus support: support@ettus.com (ask for Marcus The Younger)
- Freelancing & Private: mueller@hostalia.de
State of GNU Radio 2017

GNU Radio 3.7 released June 2013

next branch forked off at that point
Looking back at 3.7

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Old Development Model
The Mergeback Model

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- **maint**: Bugfixes
- **master**: Short-term / small-scope feature development
- **next**: Long-term / coming release (3.8) development
- **maint** regularly gets merged into **master**
- 3.7.X releases practically defined by those merges
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Changing dependencies

- develop for master, next XOR maint
  - forward development happening on next, starving master
- But: next relatively unstable
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What has happened to 3.7 since then?

New versioning scheme: Semantic Versioning ([https://semver.org](https://semver.org))
- MAJOR.MINOR.ABI.PATCH
- Supposed to make releasing quick and understandable

Formalized CHANGELOG format

New development model
- Development happens on master, bugfixes backported to maint-3.7
- next is being merged into master
- 3.8 will be tagged off master
- 3.7.x.x is tagged off maint-3.7

Retirement of maint, mergeback model
What will happen to the 3.7 series?

Stability & Maintenance

3.7 has been around for 5 years, with long stagnant periods

Lot of undocumented behaviour becoming implicit API

3.8 has exciting new features and different dependencies

- long-term commitment to support 3.7 on longer-term platforms (Debian stable, RHEL/CentOS, Ubuntu 16.04LTS)

But:

- No C++11, Python3, … for 3.7.x.x: You probably won’t want to compile GNU Radio 3.7.13.4 on your bleeding edge Linux distro in a couple of years
What’s to come in GNU Radio 3.8?

Innovation and Future-Proofing

- Dependency deprecations: No choice, lots of benefits
- Language progression
- Dependency cleanup
- Removed components
- New functionality
Dependency Deprecation

- Python 2 is dead, long live Python 2.7&3
  - 3.8 allows either to make migration easy
- Qt4: dead
- Cheetah: dead (also, Py2 only)
- Ubuntu 14.04LTS: dead (yay!) (contained many decade-obsolete dependencies)
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Language Progress

Python3 supported in GR 3.8

Python2.7 still supported

C++11

- More beauty (auto, std::for_each, lambdas)
- Reliability- and performance-improving features (nullptr, constexpr)
- Getting rid of a lot of Boost includes
Releasing 3.8

Dependency Progress

Bumping required tooling/dependency versions where helpful for maintenance

- Removed several in-tree external dependencies
- CMake
- SWIG
- Boost

New Dependencies

- GMP / MPIR (runtime: proper rational resampling ratio calculation)
- Qt5 (gr-qtgui: well, Qt)
- libgsm (gr-vocoder: 13kb/s speech compressor)
Removed Components

- **gr-wxgui**
  - nobody knows how to maintain
  - bad computational performance
  - **gr-qtgui**: we have an option
  - But: **gr-qtgui** doesn’t (yet) have full feature set

- **gr-comedi**
  - Does someone remember what that was used for?

- **gr-fcd**
  - needs hardware interface libraries
  - Should spin off nicely into an Out-Of-Tree (OOT) module

- **gr-atsc, gr-noaa, gr-pager**
  - Application-specific modules
  - Insufficient test coverage → Want us to get it back into the tree? Submit tests!
  - Should spin off nicely into an Out-Of-Tree (OOT) module
New Functionality

- Swapnil’s GSoC 2018 gr-modtool overhaul (better CLI, better processing)
- GRC
  - Complete GUI Overhaul (gobject/gi repacing pygtk)
  - Restructured code
    - Clearer separation of church and skate
    - Hardly changed the GUI
    - Made development a lot easier
  - Templating Engine (Cheetah) replaced (Mako/Static)
  - Håkon’s GSoC 2017 C++ flowgraph generation (finally!)
  - Better canvas (optical quality, zoom ability, export option)
  - Blocks, Flowgraphs: now YAML (XML begone!)
Challenges To Face

▶ Fight the bitrot!
  ▶ Unit testing
  ▶ Integration testing
  ▶ *Understanding* the scheduler

▶ Change of compute platforms
  ▶ Thread-Per-Block Scheduler just lets the OS decide where and when to schedule (with no knowledge or understanding of the data flow whatsoever)
  ▶ We've seen (simpleXecutive at GRCon'17) tremendous performance increases by *not using* arbitrary multi-threading for block scheduling
    ▶ Limit number of threads to something feasible on a given platform
    ▶ Something like single-threaded scheduling domains
  ▶ Come and argue with me at the heterogeneous computing workgroup (Fri 08:45)

▶ Examples, Reference Designs
  ▶ There's more than one way to do things, but some ways are better than others
  ▶ DSP is something people know are taught how to deal with, software architecture ... not so much

▶ De-screw-ify a lot of aspects
  ▶ PMT is plain bad (no actual cross-language bindings, not actually portable, slow, unsafe, hard to use)
Conclusion

- 3.7 development has picked up momentum again
- 3.8 is coming Soon™
  - C++11
  - Python3
  - Qt5
  - YAML
- 3.9 will overcome technical debt
Questions?