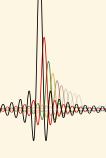
# **GNU** Radio Technical Update

Moving at c<sub>0</sub>: 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

- Ettus Pill
- Support Grumpiness supplier
- ► Research assistant at



- ▶ 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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## Marcus Müller

#### Contact

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

3.7.0 3.7.1 3.7.2	3.7.3	3.7.4	3.7.6	3.7.7	3.7.8	3.7.9	3.7.10	3.7.11		3.7.12.0 3.7.13.4
2013-07		3RCon'14			3RCon'15		3RCon'16		5RCon'17	2018-07

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2013-07		GRCon'14			GRCon'15		GRCon'16	

takeover!

GRCon'17

## Old Development Model

### The Mergeback Model

GNU Radio 3.7 released June 2013

- ▶ maint: Bugfixes
- ▶ master: Short-term / small-scope feature development
- ▶ next: Long-term / coming release (3.8) development
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### Changing dependencies

- ▶ develop for master, next XOR maint
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Development slowing down

- ▶ But: next relatively unstable
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# What has happened to 3.7 since then?

New versioning scheme: Semantic Versioning (https://semver.org)

- ► MAJOR.MINOR.ABI.PATCH
- ► Supposed to make releasing quick and understandable

#### Formalized CHANGEL OG 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



# 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-qtqui 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)
  - Distribution (Optical quality, 20011 ability, export o
  - ▶ 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<sup>™</sup>
  - ► C++11
  - ► Python3
  - ▶ Qt5
  - ► YAML
- ▶ 3.9 will overcome technical debt



Questions?



Marcus Müller