

# hackerspace global grid

world domination - one measurement at a time

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shackspace - devision for aerospace research, space exploration and other  
improbable sciences

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What is hgg

## Once upon a time

- There were 3 guys wanting to understand satellite communications
- Build networked receiver stations just for kicks

# Now

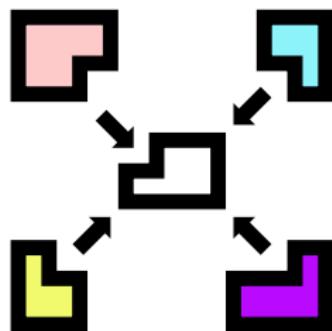
- Joined forces with the Constellation project (Andreas Hornig)
- We're building a distributed measurement network
- Aiming to track HAMSATs

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What is hgg

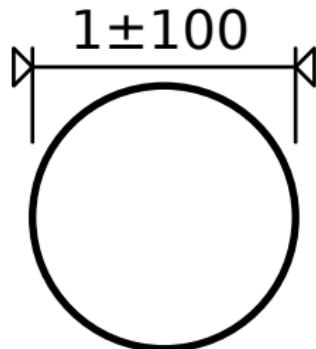
hgg in a nutshell

# Build a modular system



- Easier to develop
- Easier to extend
- Easier to improve

# Make it as accurate as possible



- One second resolution is "boring"
- Let's aim for 100 ns
- Allow scaling up to "ridiculous"(for a hobby project)

What is hgg

hgg in a nutshell

# Measure stuff



- Airplanes
- Satellites
- Background radiation
- Or even just the temperate

# Make it a distributed system



- Many simple measurement stations
- networked together
- providing geo-coded data

# Make it easy to use



- Ideal: build your own
- Realistic: assemble a kit
- Lazy: buy it, plug it in, forget about it

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What is hgg

Who's behind it?

What is hgg

Who's behind it?

## Who's behind it?

- Just a bunch of folks, really
  - reloc0 & hadez & Timm working on hgg
  - -horn- working on Constellation
  - Paweł, Isaac, and a few others working on various projects

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What we're actually doing

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What we're actually doing

The core idea

# Consolidating existing and new information

- There is already *a lot* of information available
  - HAM radio community
  - Amateur satellite community
  - Hackers & makers
- We're collecting information relevant to the ask
- Improve documentation where we had found details difficult to understand
- Document our findings, results and failures for others to learn from

# Learning the basics

- PCB design
- FPGA programming in VHDL
- Microcontroller programming in C
- Antenna design

# Open source everything

- Code available at [github.com/shackspace/hgg](https://github.com/shackspace/hgg)
- Documentation and planning at [hgg.aero/](https://hgg.aero/)

# What is it actually good for?

- Public access to all measurement results (don't get cheated)
- Access to infrastructure to deploy your own (measurement) equipment

# What about applications?

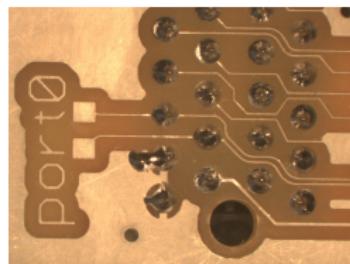
- Constellation
  - Track amateur satellites
  - Using pseudo-ranging w/ multiple receiver stations
- Once ground stations start gathering and publishing data, the possibilities are endless
  - Live-track background radiation levels
  - Spot minute changes in the environment over time
  - Accurate, geo-referenced time
  - Basis for assisted GPS solutions
  - and many, many more

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What we're actually doing

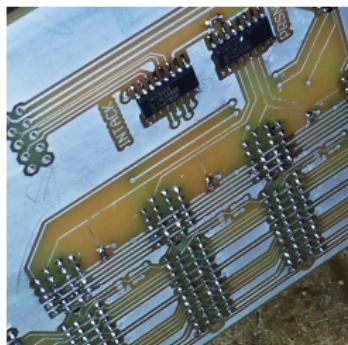
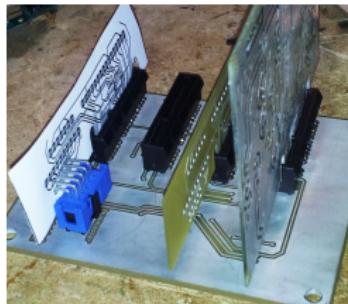
Status quo

# Specification of physical interface between modules



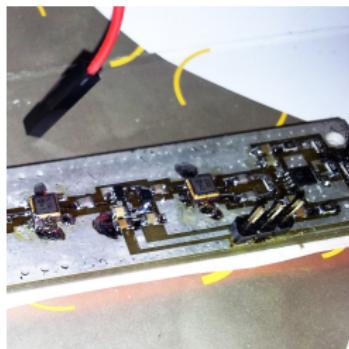
- Modules are connected via a backplane
- PCIe 4x plug w/ custom pinout
- 2x RS485 lanes for inter-module communication
- SPI-ish time broadcast bus
- Differential clock signal for high-res timing signal
- Each module sports storage for calibration data

# friendship0 backplane



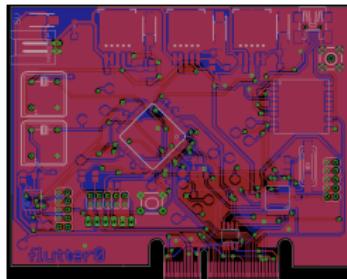
- Four modules slots, one dedicated to bus master module
- ICs for interrupt handling
- Can be easily scaled up, next step eight or nine slots

# dash0 proof of concept



- ADS-B receiver based around miniADSB module
- Easily track commercial aircrafts
- Perfect for verifying pseudo ranging algorithms

# flutter0 high precision distributed time source module



- Spartan3 FPGA for high-res timing (<100 ns)
- ATmega 168 for lo-res timing (1 s to 1/10th s)
- Low cost GPS module w/ external antenna support

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What we're actually doing

How to help

## Join us

- We meet almost every Saturday at shackspace, the stuttgart hackerspace

# Keep in touch

- Wiki
  - Edit away at <http://hgg.aero/>
  - There's a list of open tasks. Pick one or add one!
- GitHub
  - All source code, schematics and layouts available at [github.com](https://github.com)
  - Issue tracking. Find a problem, raise an issue!
- Public mailing list
  - [lists.shackspace.de/listinfo/constellation](mailto:lists.shackspace.de/listinfo/constellation)
  - Fairly low traffic at the moment, this might change in the foreseeable future.
- twitter
  - @hxglobalgrid