

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

27. Oktober 2012

1 What is hgg

2 What we're actually doing

Once upon a time

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

Once upon a time

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- 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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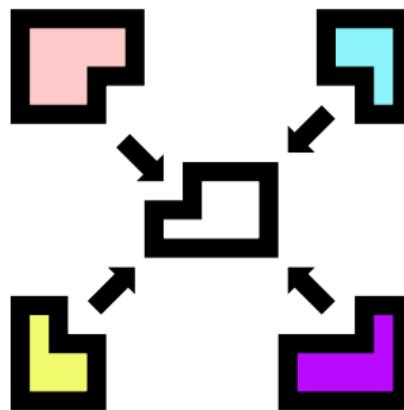
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- hgg in a nutshell
- Who's behind it?

2 What we're actually doing

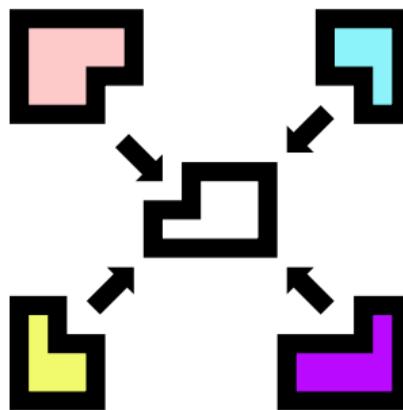
- The core idea
- Status quo
- How to help

Build a modular system



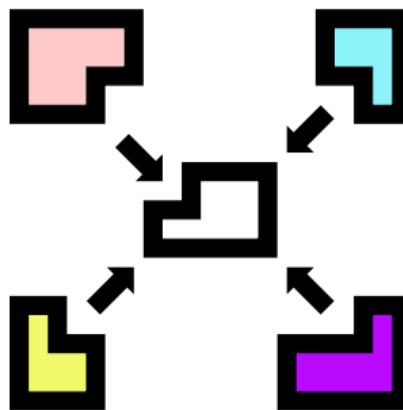
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 - Easier to extend
 - Easier to improve

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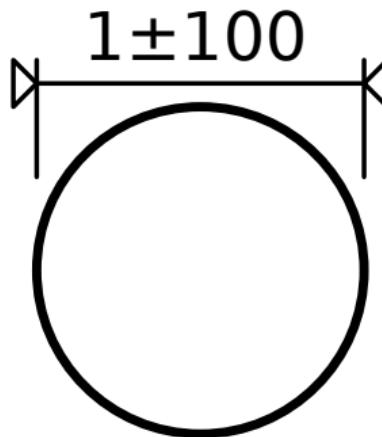
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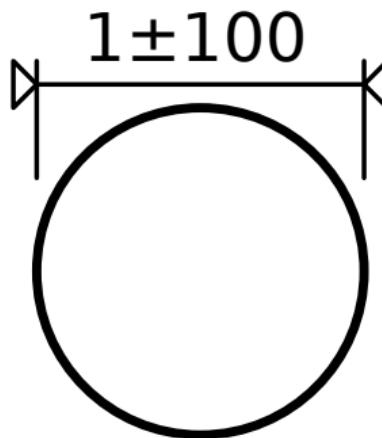
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Make it as accurate as possible



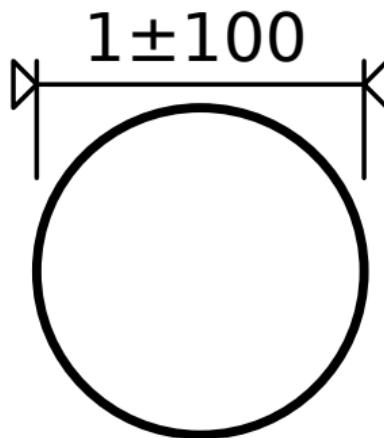
- One second resolution is "boring"
- Let's aim for 100 ns
- Allow scaling up to "ridiculous" (for a hobby project)

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Measure stuff



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

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Make it a distributed system



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

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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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Who's behind it?

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- The core idea
- Status quo
- How to help

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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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

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- FPGA programming in VHDL
- Microcontroller programming in C
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- Code available at github.com/shackspace/hgg
- Documentation and planning at hgg.aero/

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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

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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

- Weather monitoring

- Radio frequency spectrum monitoring

- Space debris tracking

- Space weather monitoring

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 - Track amateur satellites
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- Once ground stations start gathering and publishing data, the possibilities are endless
 - Live-track background radiation levels
 - Predict orbital decay and reentry
 - Determine orbital parameters
 - Identify debris fields
 - Track atmospheric density

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 - Using pseudo-ranging w/ multiple receiver stations
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 - 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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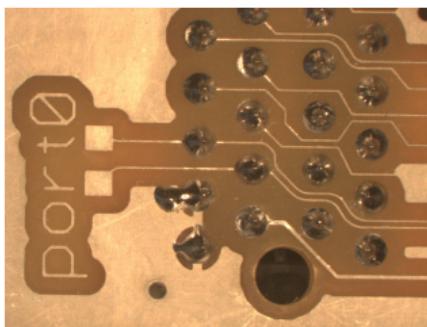
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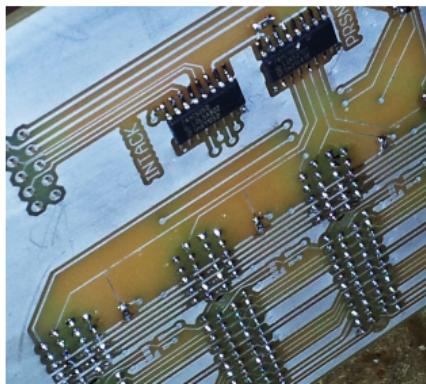
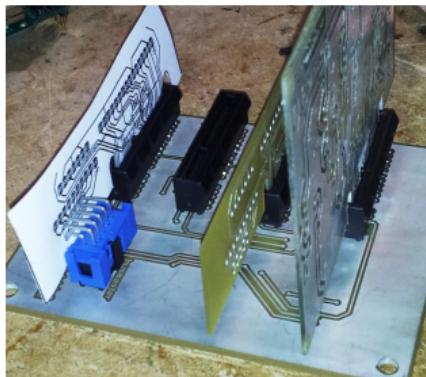
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Specification of physical interface between modules



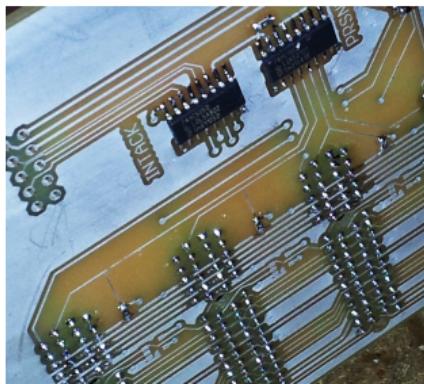
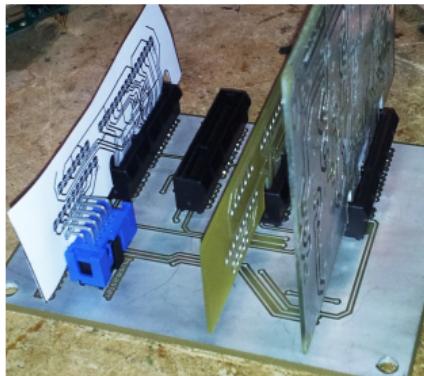
- Modules are connected via a backplane
- PCIe 4x plug w/ custom pinout
- 2x RS485 lanes for inter-module communication
- SPI-ish time broadcast bus
- Differential clock signal for high-res timing signal
- Each module sports storage for calibration data

friendship0 backplane



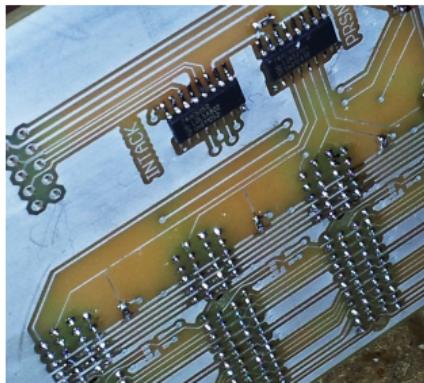
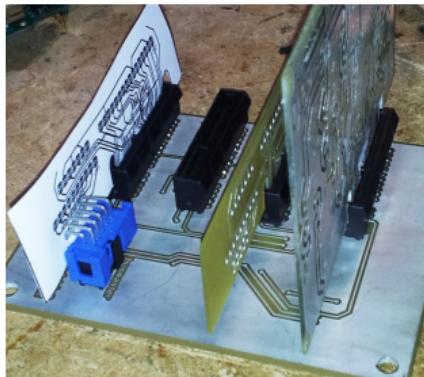
- Four modules slots, one dedicated to bus master module
 - ICs for interrupt handling
 - Can be easily scaled up, next step eight or nine slots

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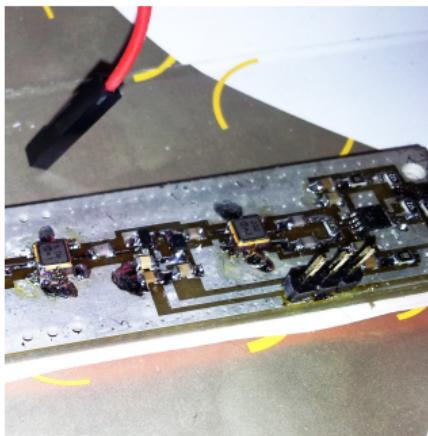
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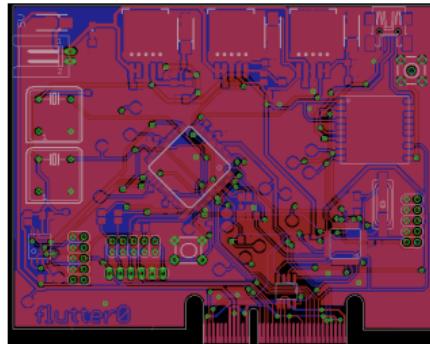
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dash0 proof of concept



- 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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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

- <https://github.com/hackerspace-global-grid>
- <https://github.com/hackerspace-global-grid/hackerspace-global-grid>

- Public mailing list

- info@hgg.aero
- <https://groups.google.com/forum/#!forum/hackerspace-global-grid>

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- lists.hackerspace.de/listinfo/constellation

- A mailing list for the constellation project, where you can discuss your ideas and ask for help.

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