

hackerspace global grid

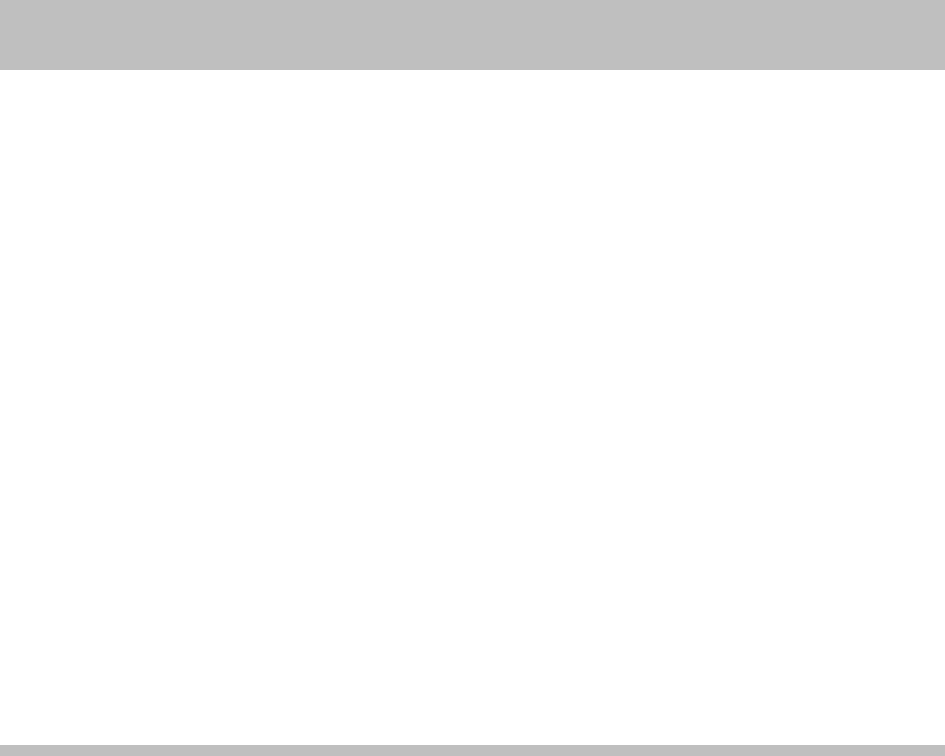
world domination - one measurement at a time

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./pic/hgg_earth_rgb_posp-300hopsack_brightbg.pdf

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

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Once upon a time

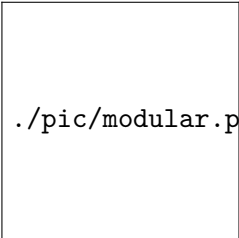
- There were 3 guys wanting to understand satellite communications
- Build networked receiver stations just for kicks

Now

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




Build a modular system



`./pic/modular.pdf`

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

Make it as accurate as possible



`./pic/accurate.pdf`

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

Measure stuff

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

Make it a distributed system

`./pic/distributed.pdf`

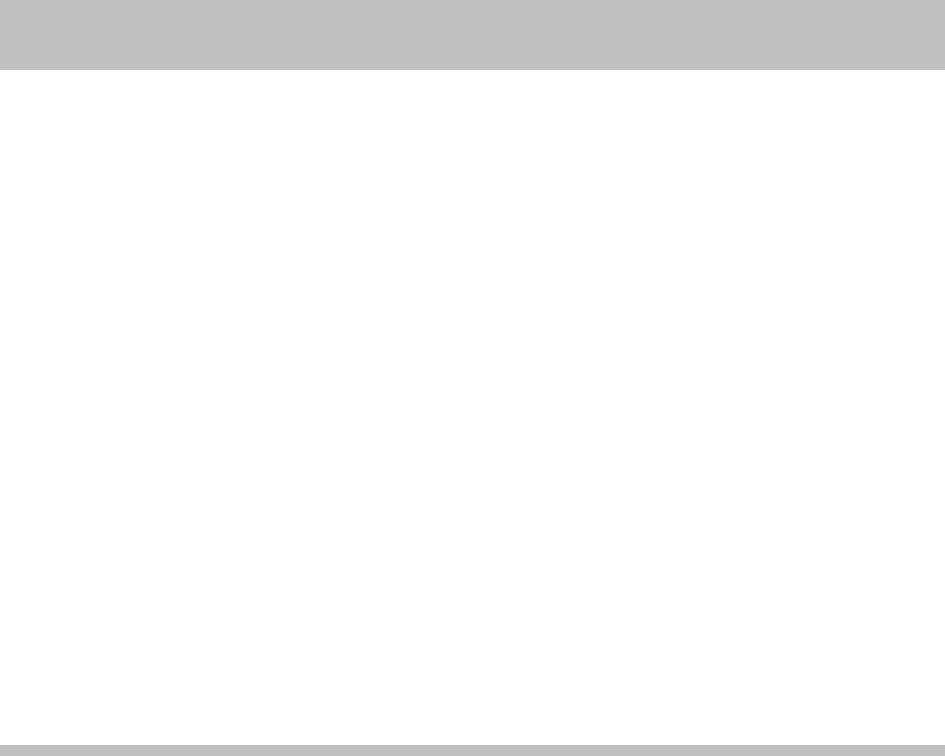
- Many simple measurement stations
- networked together
- providing geo-coded data

Make it easy to use



`./pic/easytouse.pdf`

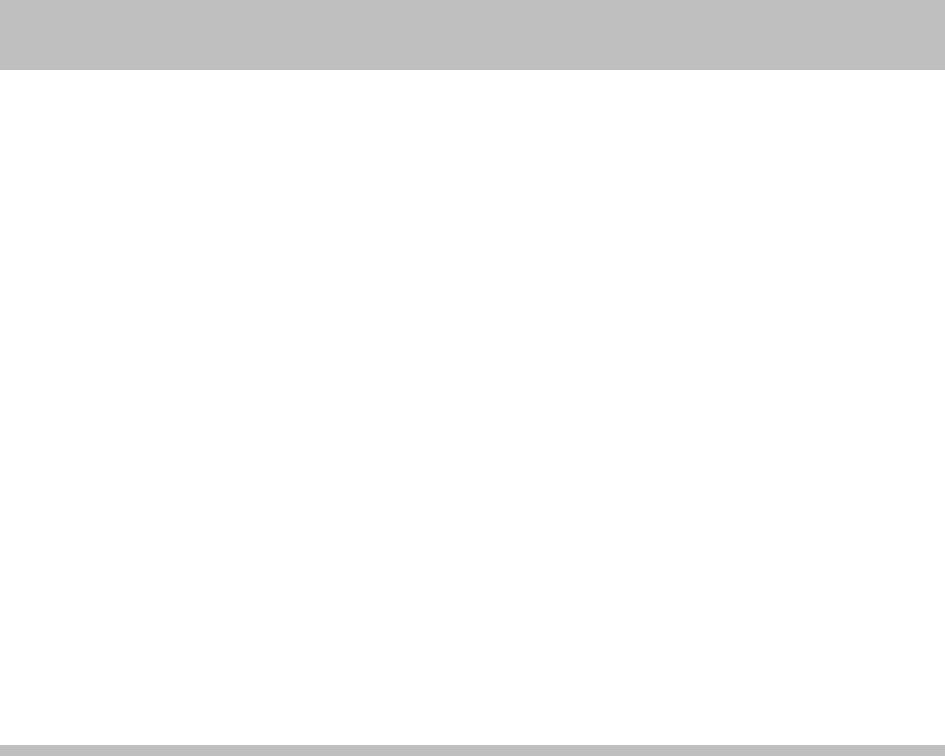
- Ideal: build your own
- Realistic: assemble a kit
- Lazy: buy it, plug it in, forget about it



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





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

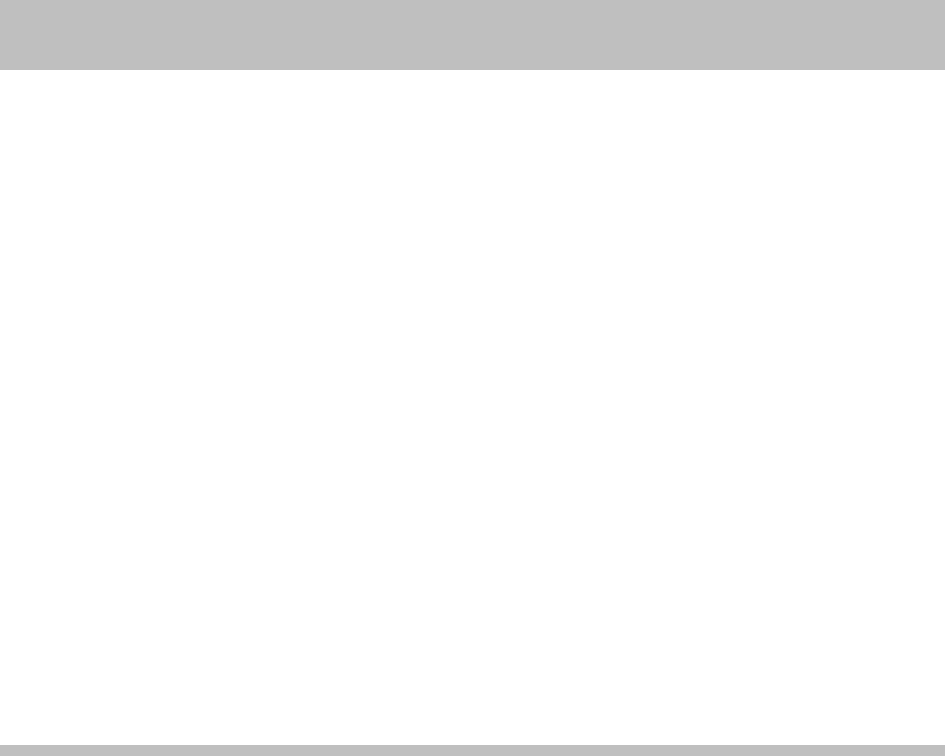
- Code available at github.com/shackspace/hgg
- Documentation and planning at hgg.aero/

What is it actually good for?

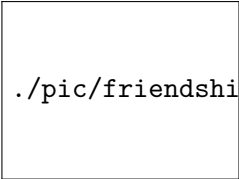
- Public access to all measurement results (don't get cheated)
- Access to infrastructure to deploy your own (measurement) equipment

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



Specification of physical interface between modules



./pic/friendship0.png

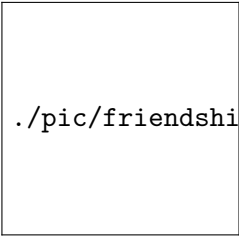
- Modules are connected via a backplane
- PCIe 4x plug w/ custom pinout
- 2x RS485 lanes for inter-module communication
- SPI-ish time broadcast bus
- Differential clock signal for high-res timing signal
- Each module sports storage for calibration data

friendship0 backplane




`./pic/friendship0_assembled.pdf`

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



`./pic/friendship0_assembled_bottom.pdf`

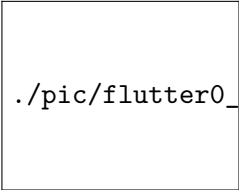
dash0 proof of concept



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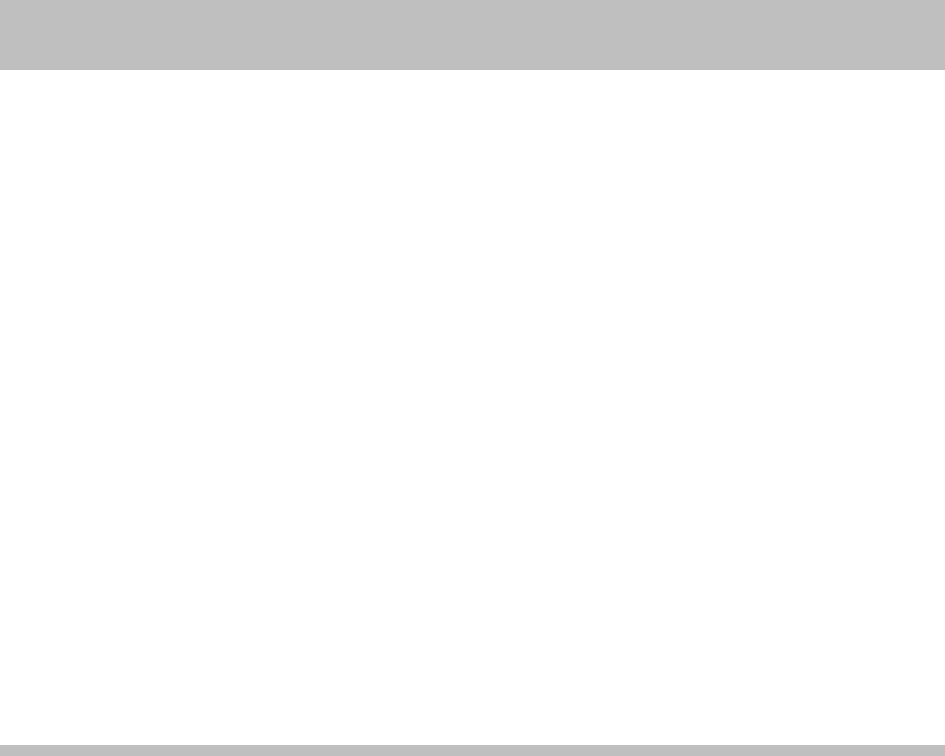
- ADS-B receiver based around miniADSB module
- Easily track commercial aircrafts
- Perfect for verifying pseudo ranging algorithms

flutter0 high precision distributed time source module



./pic/flutter0_layout.png

- 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



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
 - Issue tracking. Find a problem, raise an issue!
- Public mailing list
 - lists.shackspace.de/listinfo/constellation
 - Fairly low traffic at the moment, this might change in the foreseeable future.
- twitter
 - @hxglobalgrid