

hackerspace global grid

world domination - one measurement at a time

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shackspace - devision for aerospace research and space exploration

10. Mai 2012

1 What is hgg

2 What we're actually doing

3 On the horizon

Caveat

- hgg is, at its heart, a *very* technical project
- Fear not! This presentation will give you a general overview and keep technicalities to a minimum

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1 What is hgg

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

2 What we're actually doing

- The core idea
- Status quo

3 On the horizon

- Roadmap
- How to help

CCCamp 2011

- Nick Farr, Lars Weiler, Jens Ohlig propose a *Hacker Space Program*
 - Ambitious goal: 23 years to put a hacker on the moon!
- Three hackers from shackspace immediately brainfart
- "This is awesome!"
- "Let's do it!"
- P.S.: hgg is a small part in the bigger scheme of the *Hacker Space Program*

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The first idea

- Short term: Understand how satellite communication works
- Mid term: Setup something so we can receive sat comm
 - Make it simple. Each hackerspace should have one.
 - It should be a low cost solution.
 - It should be a low power solution.
- Long term: Add something so we can also send signals

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Joining up w/ Constellation

- Andreas Hornig of AerospaceResearch.net ends up giving a talk on Constellation at shackspace
- Both sides immediately notice the similarity in his DGSN and our HGG idea
- We join forces

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"Call to arms" talk at 28c3

- After the initial research and proof of concepts we thought it would be nice to have 3 to 5 more folks helping us
- So we handed in a talk for 28c3
- Press feedback was never the same...

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- "Hacker aus Stuttgart - Mit dem Lötkolben ins Weltall"
– *Stuttgarter Zeitung*
- "Hacking im Weltraum - Hacker arbeiten an eigenem Satellitennetzwerk"
– *Golem*
- "Hackers send internet into space"
– *UK Metro*
- "Hackers plan space satellites to combat censorship"
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What hgg definitely isn't

- The *Hacker Space Program's* aim is to have communication infrastructure in place at some point
- *Hackespace Global Grid / hgg* is working on the very basics of this (distributed ground station network)
- However, we (as in hgg) are *not* building an alternative internet at the moment
- We are working on getting something out there which can be used as a platform and starting point to seed other projects and ideas

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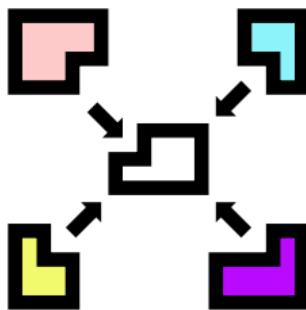
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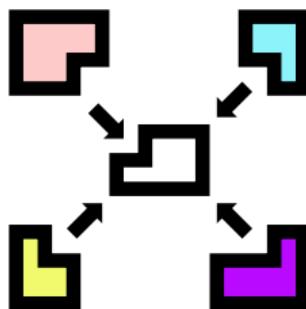
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Build a modular system



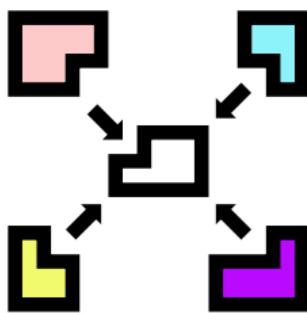
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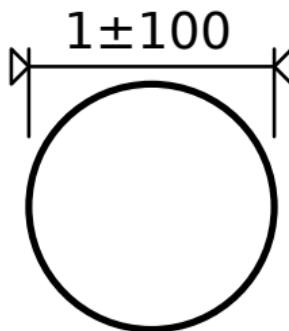
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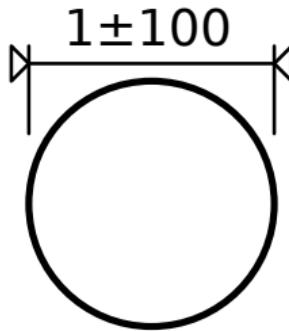
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Make it as accurate as possible



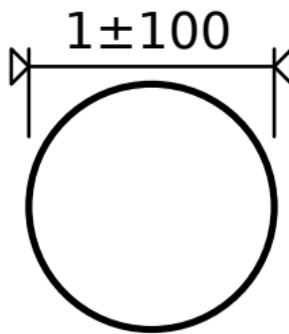
- One second resolution is "boring"
- Let's aim for 100 ns
- Allow scaling up to "ridiculous"

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Measure stuff



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

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Make it a distributed system



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

Make it a distributed system



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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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- Roadmap
- How to help

Who's behind it?

- Just a bunch of folks, really
 - reloc0 & hadez & saeugetier working on hgg
 - -horn- working on Constellation
 - Paweł, Isaac, and a few others working on various projects
- No company or governments
- By hackers, for everyone

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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
- Try to make it easier to understand where certain details aren't documented well
- 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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What is it actually good for?

- Public access to all measurement results (don't get cheated)
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- Constellation

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 - Live-track background radiation levels
 - Predict orbital paths
 - Determine orbital decay rates
 - Detect orbital anomalies
 - Identify potential collisions
 - And much more...

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- 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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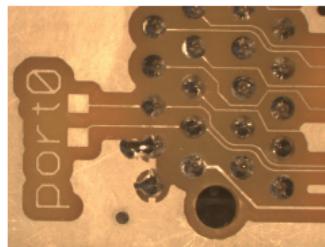
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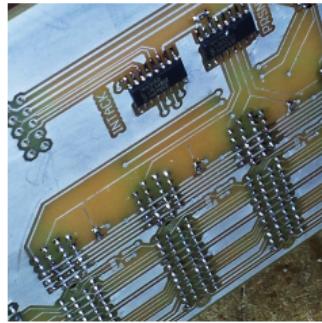
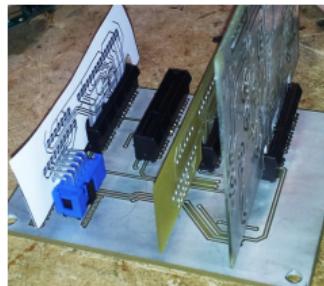
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Specification of physical interface between modules



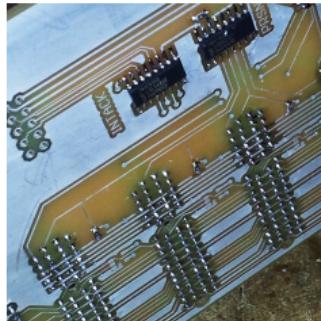
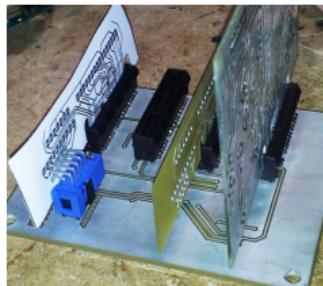
- Modules are connected via a backplane
- PCIe 4x plug w/ custom pinout
- 2x RS485 lanes for inter-module communication
- SPI-ish time broadcast bus
- Differential clock signal for high-res timing signal
- Each module sports storage for calibration data

friendship0 backplane



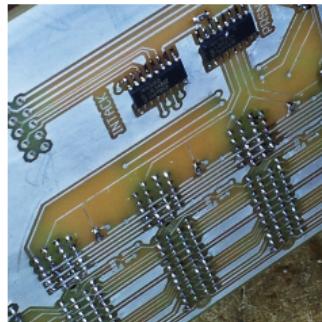
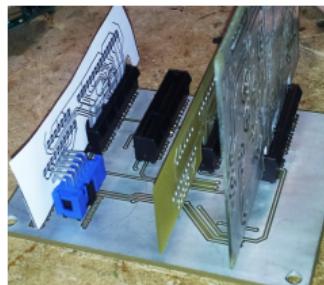
- Four modules slots, one dedicated to bus master module
- ICs for interrupt handling
- Can be easily scaled up, next step eight or nine slots

friendship0 backplane



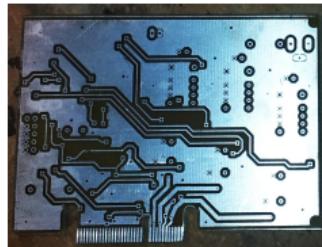
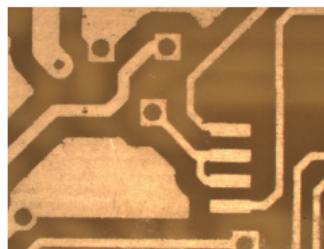
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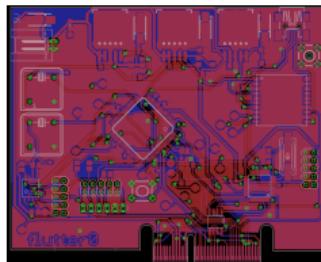
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braeburn0 & 1 power supply module



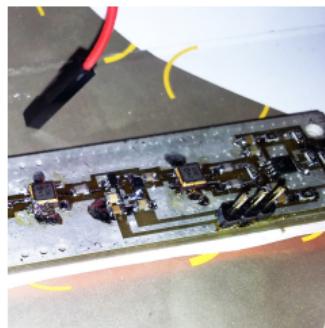
- Single external power source
- All voltages generated on-board, stabilized
- In-system voltage level monitoring
- braeburn1 using PC power supply

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

dash0 proof of concept



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

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celestia0 bus master module

- Manages interrupt requests by modules
- Arbitrates resources
- Enumeration of available modules

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dash0 ADSB receiver module

- Built around the proof of concept
- Most likely CPLD-based decoding of Manchester-encoded signal
- Contributions by Paweł
- Perfect to test pseudo-ranging because ADSB signal contains GPS location data already (ground truth)
- Your own flight tracking radar at home? Hell, yeah!

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- Most likely CPLD-based decoding of Manchester-encoded signal
- Contributions by Paweł
- Perfect to test pseudo-ranging because ADSB signal contains GPS location data already (ground truth)
- Your own flight tracking radar at home? Hell, yeah!

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Testing timing accuracy

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Calibration

- High accuracy measurement requires diligent calibration
 - Receiver, decoder, communication lags
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Deploying 5+ systems

- Test pseudo ranging and timing
- This will decide whether tracking would already work with our timing resolution
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Quality tests and review

- Review everything
- Make improvements where necessary
- Manufacture pre-series
- Hand ground stations out to other hackerspaces and interested subsectionies

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More modules

- Arduino module

- Probably the easiest way to prototype
- Make it available to an already large community

- Environment sensors

Temperature, humidity, light, motion, ...
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- Environment sensors

Environment sensors can be used to monitor the environment around the house or office. This can be used to trigger actions based on the current state of the environment.

More modules

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- Environment sensors

- Measure ALL the things

Temperature, humidity, light, motion, sound, air quality, water level, ...

... and many more, depending on your needs

More modules

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 - Measure ALL the things
 - Temperature, humidity, barometric pressure, seismic waves, radiation, tectonic drift, time, wind, ...

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Satellites!

- Not impossible, though not really *our* goal

1 What is hgg

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

2 What we're actually doing

- The core idea
- Status quo

3 On the horizon

- Roadmap
- How to help

Why we have not asked for donations, yet

- Offers from heartwarming to ridiculous
- Still doing research and feasibility studies
- No guarantee that it'll ever work (chances are good, though)
- No money asked, no one disgruntled if it fails.

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Keep in touch

- Wiki

- Edit away at <http://hgg.aero/>
- There's a list of open tasks. Pick one or add one!

- GitHub

Check out our GitHub organization for code, documentation, and other projects.
https://github.com/hackerspace-global-grid

- Public mailing list

Join the mailing list to receive updates about the project and the community.
info@hgg.aero

- twitter

Follow us on Twitter for news and updates.

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- All source code, schematics and layouts available at github.com

- Pull requests welcome, or just drop us a line if you have questions

- Public mailing list

- mailinglist@hgg.aero

- You can also join the mailing list via the [hgg.aero](http://hgg.aero/mailman/listinfo) website

- If you're not sure what to do, just drop us a line

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- [@hgg_aero](https://twitter.com/hgg_aero)

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Questions!

Pretty please :)