

# hackerspace global grid

world domination - one measurement at a time

hadez@hgg.aero, @hdznrrd      armin@hgg.aero, @rel0c8



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!
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- "Let's do it!"
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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
    - If you have multiple, then each one
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  - Long term: Add something so we can also send signals

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  - Both sides immediately notice the similarity in his DGSN and our HGG idea
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– *Stuttgarter Zeitung*
- "Hacking im Weltraum - Hacker arbeiten an eigenem Satellitennetzwerk"  
– *Golem*
- "Hackers send internet into space"  
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- "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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hgg in a nutshell

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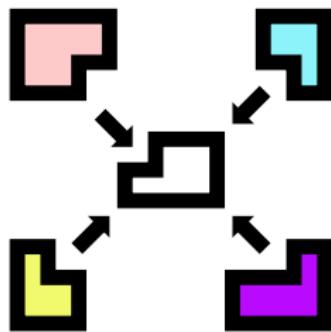
## 2 What we're actually doing

- The core idea
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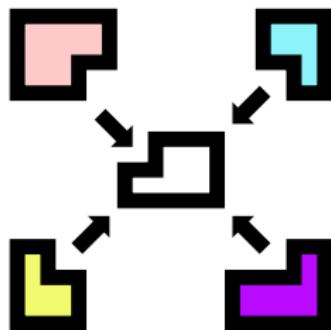
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## Build a modular system



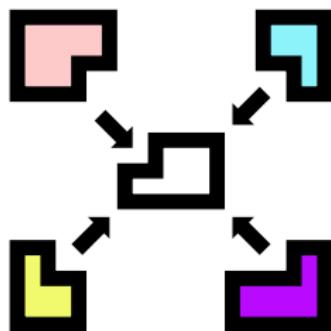
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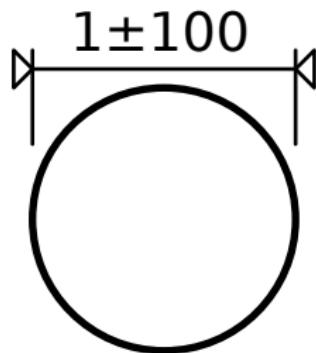
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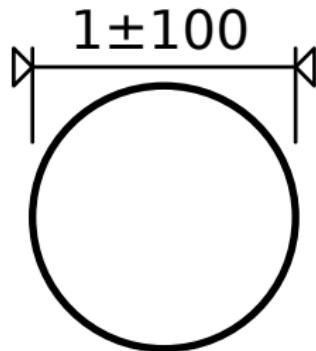
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# Make it as accurate as possible



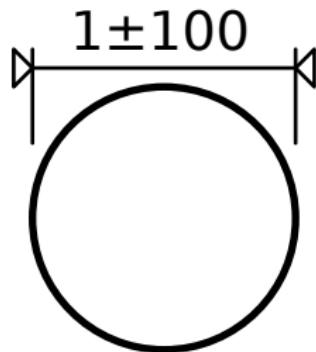
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## Measure stuff



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

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- Many simple measurement stations
  - networked together
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  - Realistic: assemble a kit
  - Lazy: buy it, plug it in, forget about it

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# 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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# 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

• Monitoring atmospheric conditions

• Monitoring space weather

• Monitoring orbital debris

• Monitoring solar activity

• Monitoring ionosphere

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  - Predict orbital decay and atmospheric reentry
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  - Accurate, geo-referenced time
  - Basis for assisted GPS solutions
  - and many, many more

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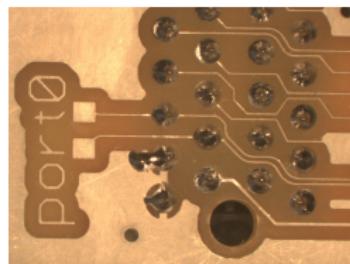
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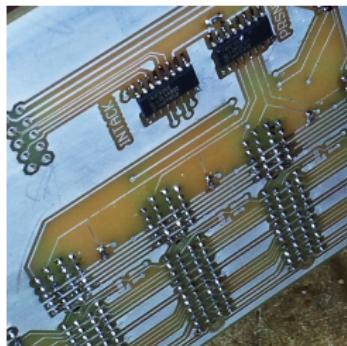
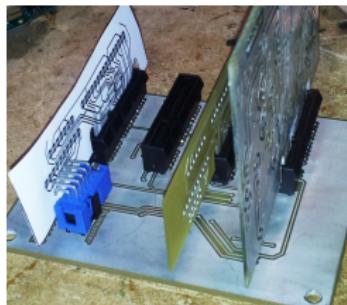
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# Specification of physical interface between modules



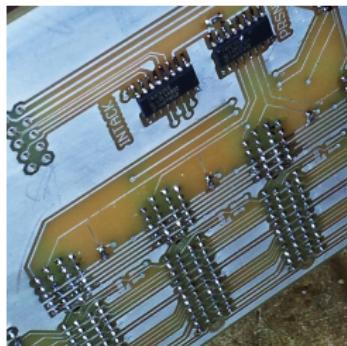
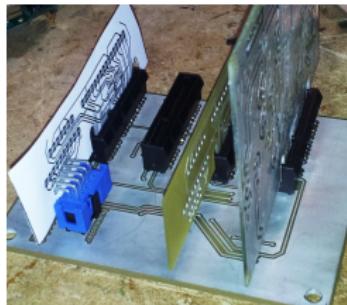
- Modules are connected via a backplane
- PCIe 4x plug w/ custom pinout
- 2x RS485 lanes for inter-module communication
- SPI-ish time broadcast bus
- Differential clock signal for high-res timing signal
- Each module sports storage for calibration data

## friendship0 backplane



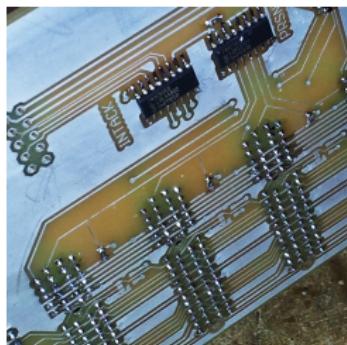
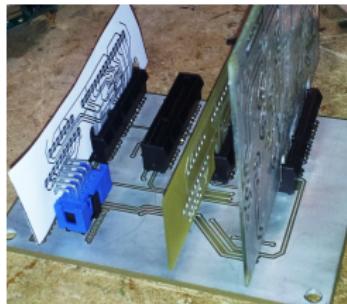
- Four modules slots, one dedicated to bus master module
  - ICs for interrupt handling
  - Can be easily scaled up, next step eight or nine slots

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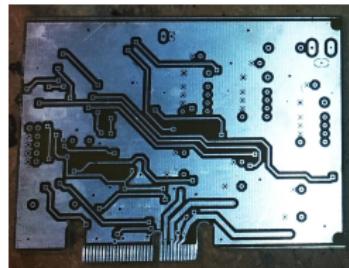
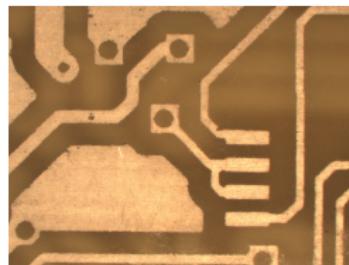
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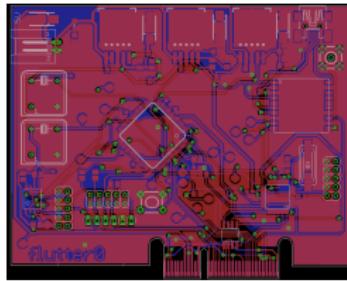
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# braeburn0 & 1 power supply module



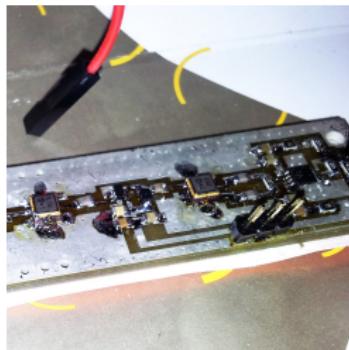
- Single external power source
- All voltages generated on-board, stabilized
- In-system voltage level monitoring
- braeburn1 using PC power supply

# 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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- Arbitrates resources
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# dash0 ADSB receiver module

- Built around the proof of concept
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- 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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- Review everything
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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

Wind direction, wind speed, rain, air pressure, water level, soil moisture

CO<sub>2</sub>, NO<sub>x</sub>, NO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub>, PM<sub>2.5</sub>, PM<sub>10</sub>

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• Sensors for light, temperature, motion, humidity, ...  
• Sensors for doors, windows, ...  
• Sensors for water level, ...  
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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)
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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

<https://github.com/hackerspace-global-grid>  
A public repository for the Hackerspace Global Grid project.

- Public mailing list

[hgg@lists.hackerspace.global.grid](mailto:hgg@lists.hackerspace.global.grid)  
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- twitter

[https://twitter.com/hackerspace\\_g](https://twitter.com/hackerspace_g)

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

Check out the repository for the latest news and developments.

- Public mailing list

[info@hgg.aero](mailto:info@hgg.aero)

Join the mailing list to receive updates about the project and its progress.

- twitter

[@hgg\\_aero](https://twitter.com/hgg_aero)

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  - [lists.hackerspace.de/listinfo/constellation](mailto:lists.hackerspace.de/listinfo/constellation)
  - A place to discuss anything related to the project, the community, the space, the hardware, the software, the tools, the people, the events, the future.
- twitter
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Pretty please :)