The hn70ap project

PocketQube Workshop, March 23, 2018

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Who am I

- Software engineer and architect (smart cards, embedded, security, transportation business)
- Hardware and software hacker
- F4GRX ham since 2011
- Administrator at the Electrolab Hackerspace in Nanterre, France
- Twitter @f4grx

The Electrolab hackerspace

- Not a fablab, built by members for members
- Focus on open source
- Started as 150 sq.m in a basement, now 1500
- Wide range of facilities
  - Electronic lab, laser cutter, 3d printing, general workshop
  - Trainings (organized by members)
  - Advanced Electronics (RF, etc)
  - Heavy machining, welding, etc
  - Probably (one of) the largest DIY place(s) in Europe

Having fun at the Electrolab

Space at the Electrolab

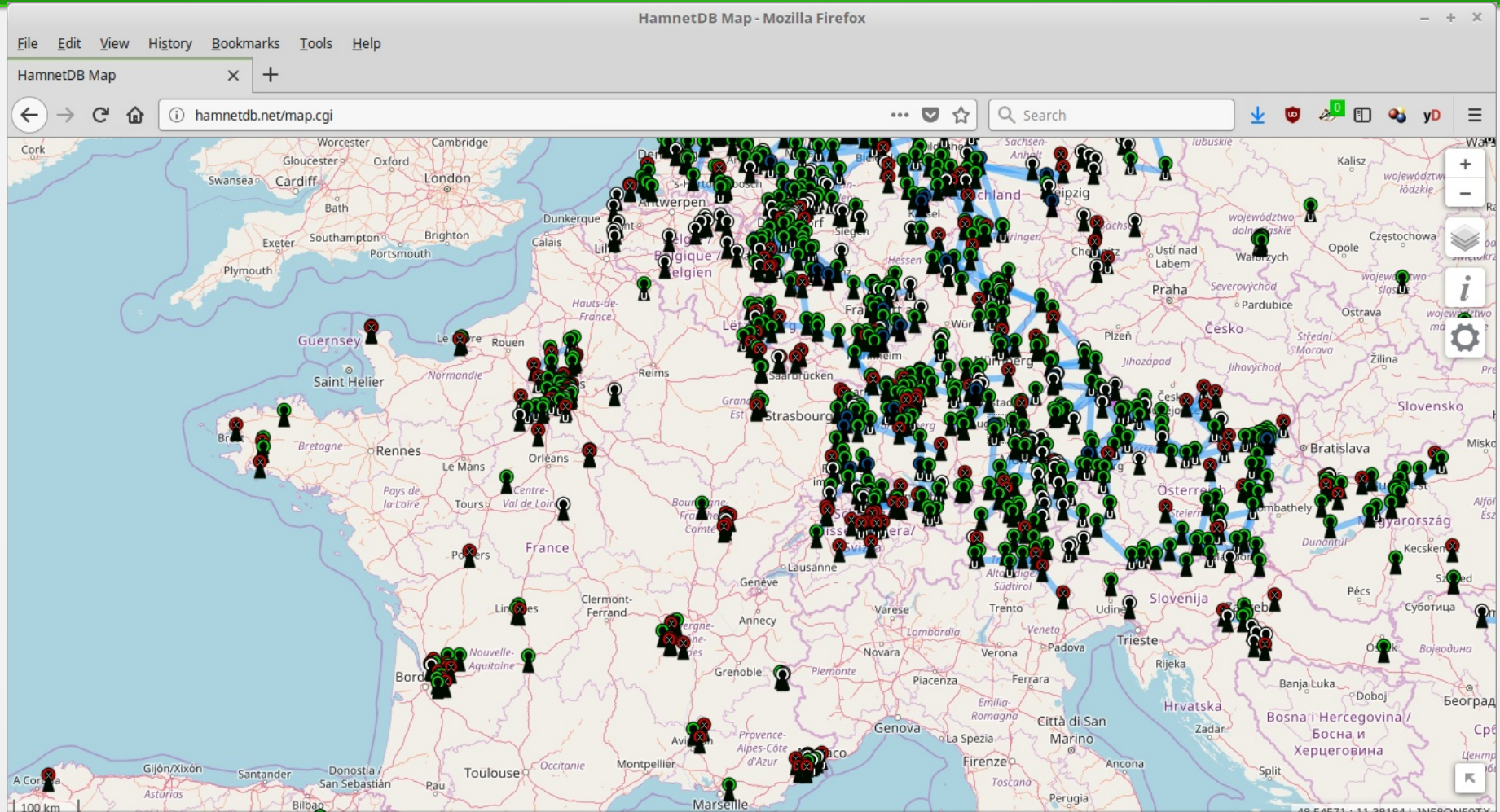
- Electrolab is hosting FEDERATION Open Space Makers, a French non-profit organization.
- It was built to support an initiative pushed by the French space agency – CNES.
- This initiative is to create, support, and motivate a space ecosystem to facilitate the contribution to space projects, via a network of citizens in fablabs / makerspaces / hackerspaces working on space projects.
- The belief is that this initiative should be built around open source values, to promote the creation of open space hardware, savoir-faire and knowledge in a collaborative, openly, responsible manner.

hn70ap
« HamNET 70cm Access Point »

- Rooted in ham radio activities
- 44.0.0.0/8 are belong to us
- « Global » network, independent from the Internet infrastructure and providers (eg, for experiments, disaster recovery, etc)

- Mostly backed by wifi hardware in the 5 GHz band

French deployment is far from ideal...



But there’s more than ham radio

- What can you do with Ethernet + UHF ?
- Domotics (ISM)
- Open source Digital Voice (still ham)

- What about space ? We’re in a PocketQube workshop after all...

hn70ap as a small sat base station

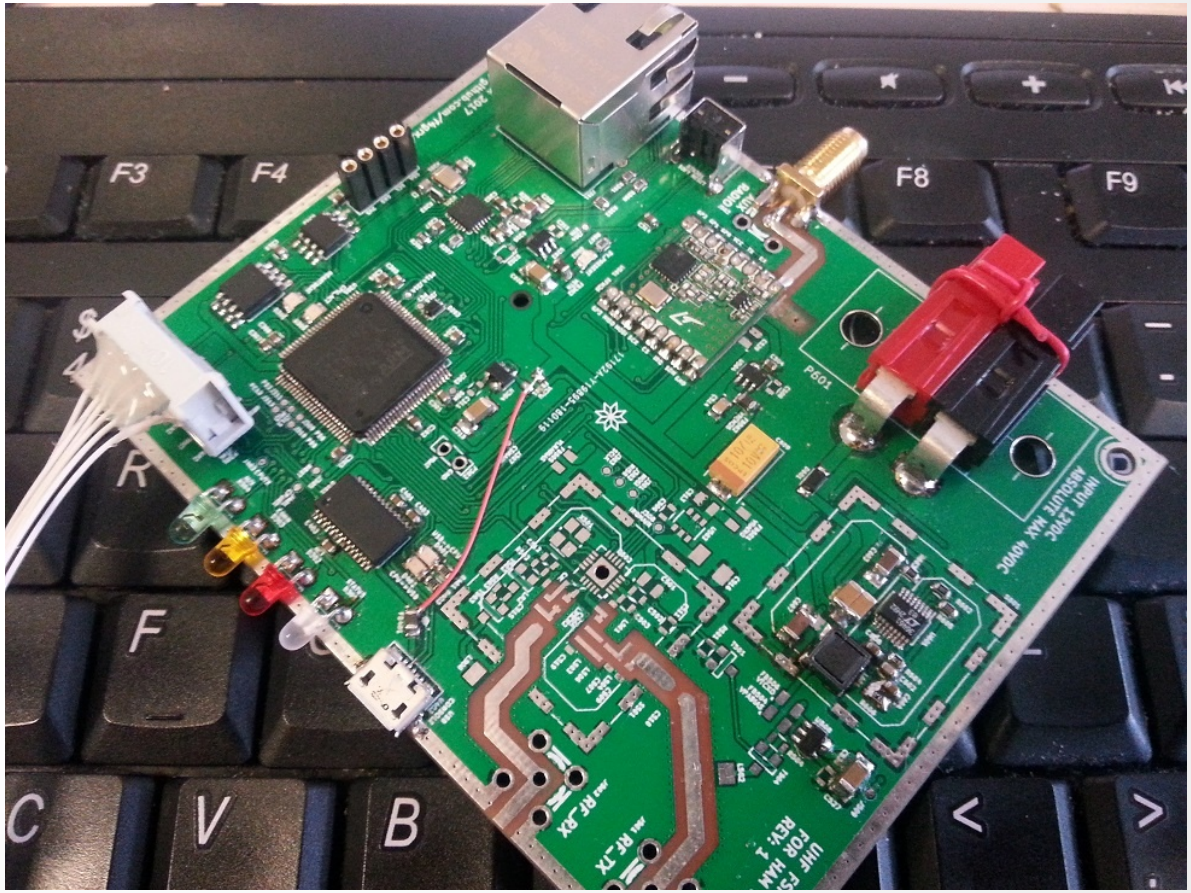
- The usual way to acquire satellite tlm on the ground : SDR
  - Flexible, Reconfigurable
  - Expensive and good performance (USRP)
  - Inexpensive and below average performance (RTLSDR, etc)
  - Requires many DSP skills (or use of blackboxes provided by others)
  - OR : standard modulations !

- So, why not use dedicated FSK hardware
  - Limited abilities, but flexible radio chip
  - Portable and cheap : Can be deployed easily
  - ALREADY used in space !

How it’s made

- STM32F4 ARM microcontroller
  - Not your usual Raspi : 2MB flash, 256k RAM, 180 MHz
  - Runs the NuttX RTOS (www.nuttx.org)
- Ethernet interface
- USB serial, DC supply

- The Radio : Silabs SI4463 (x2)
  - Integrated radio module (low power)
  - On-board RF circuit with split TX/RX



Silicon Labs si4463

- The « low power Sub-GHz ISM radio »
- Usually found in « Internet of Threats » nodes
- Also in some sats (ESTCube-1, OZQube-1,Nepal-PQ1)
- Low power (100 mW, 20dBm)
- Many configuration options : modulation, data rate, packet handling…
- Requires the use of a Silabs proprietary configuration tool...

Dear Silabs, can you help ?

slorquet
Star

Posts: 4
Registered: 05-15-2017

Setup a si446x without WDS

Options

06-30-2017 02:28 PM

Hello

I want to program a si4463 driver for my RTOS. I need to setup all parameters like WDS is doing, but I cannot use a static pregenerated config. I have to be able to setup all parameters (frequency, modulation, bitrate, deviation, etc)

Is that possible? I am not sure. reading the API spec I could setup most parameters but wds generates more, for example rx filters and vco config.

Do you have formulas to define/select the required parameters instead of just generating them with the wds tool?

Thanks and best regards

slorquet

Message 1 of 4 (832 Views)

Labels: EZRadioPRO Wireless MCUs

Everyone's Tags: wds si446x driver unive… View All (1)

0 Kudos + Reply

tanagy
Hero Employee

Posts: 282
Registered: 02-14-2014

Re: Setup a si446x without WDS

Options

07-03-2017 07:37 AM

Hi slorquet,

The formulas are built in in the modem calculator of WDS. Some of them are simple and are defined in the API document, others are more complex and not published. I think it would not make sense to Implement and run the whole modem calculator in the user application on the host MCU. It would require a lot of computing power and usually the RF input parameters like deviation or datarate are not random values and can be known in compile time.

Regards,
Tamás
Silicon Labs

Let’s ask politely on their forums…

Do you have embeddable code that behaves as your boring windows-only tool ?

TLDR : « Nope. »

Zoom and Enhance !

- « No » is not a valid answer to a hacker.
- Let’s reverse engineer and see what’s under the hood
- C# and precompiled Python ⇒ Hold my beer ! Work in progress.

- The SI4463 has better abilities than just ISM with a fixed config

- External RF hardware (PA, LNA, switches, filters) is possible
- Tuner can operate in the full « 70cm » (430-440 MHz) ham band among others
- Can be used as an intermediate frequency for higher bands (L, S, X bands) with transverters

- Radar bands : L : 1-2 GHz , S : 2-4 , C : 4-8, X : 8-12 GHz, Ku : 12-18 Ka : 18-40

Current status

- Hardware prototype is working, radio hacking in progress
- Rework and BOM optimization needed
  - Fix v1 mistakes, simplify
- Project diffusion
  - Code and Kicad at https://github.com/f4grx/hn70ap
  - Cheap PCB for DIY builders (on demand)
  - Commercial units : it’s complicated...