NPR-VSAT

New Packet Radio over QO-100 WB

http://f4hdk.free.fr/
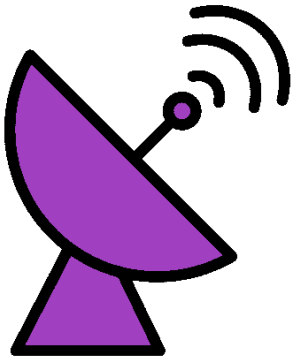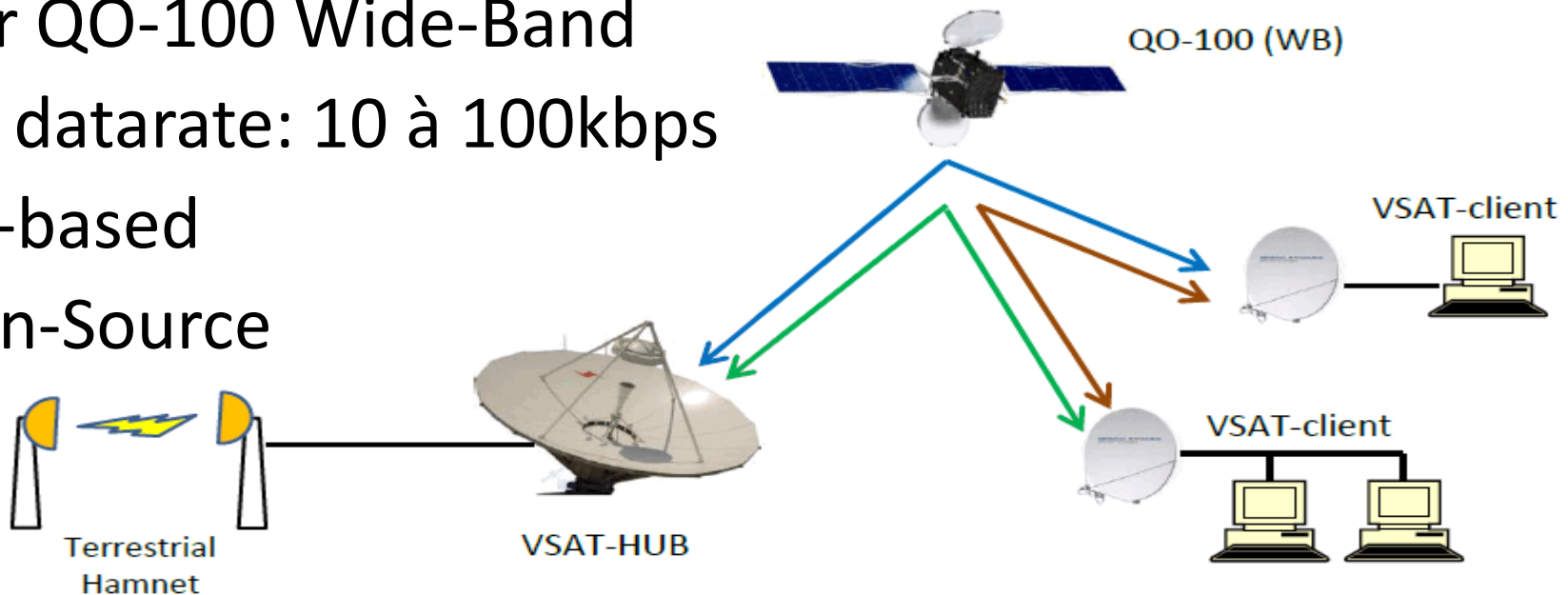
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New-Packet-Radio VSAT

1) Goals / principle

- Data-IP access, multiple-users (dozens)

- IPv4 – Hamnet

- Over QO-100 Wide-Band

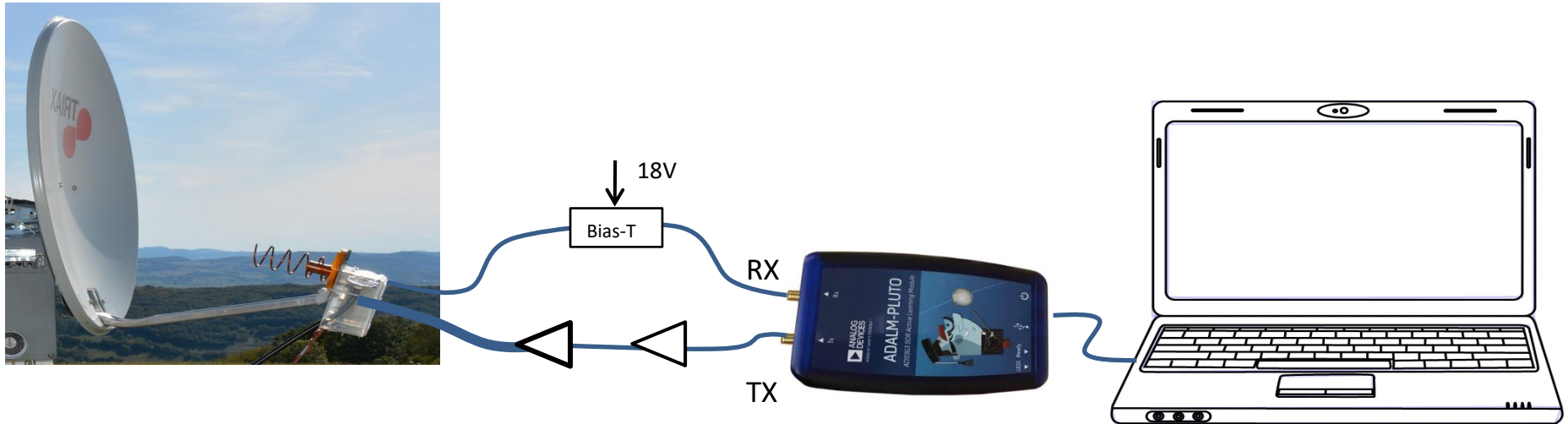- Low datarate: 10 à 100kbps

- SDR-based

- Open-Source

QO-100 (WB)

VSAT-client

VSAT-client

Terrestrial
Hamnet

VSAT-HUB

2) NPR-VSAT station

Hardware:

- PC Windows or Linux

- SDR : Pluto (or Lime-SDR-mini)

- RF : QO-100 Wide-Band Full duplex

2) NPR-VSAT station

Software:

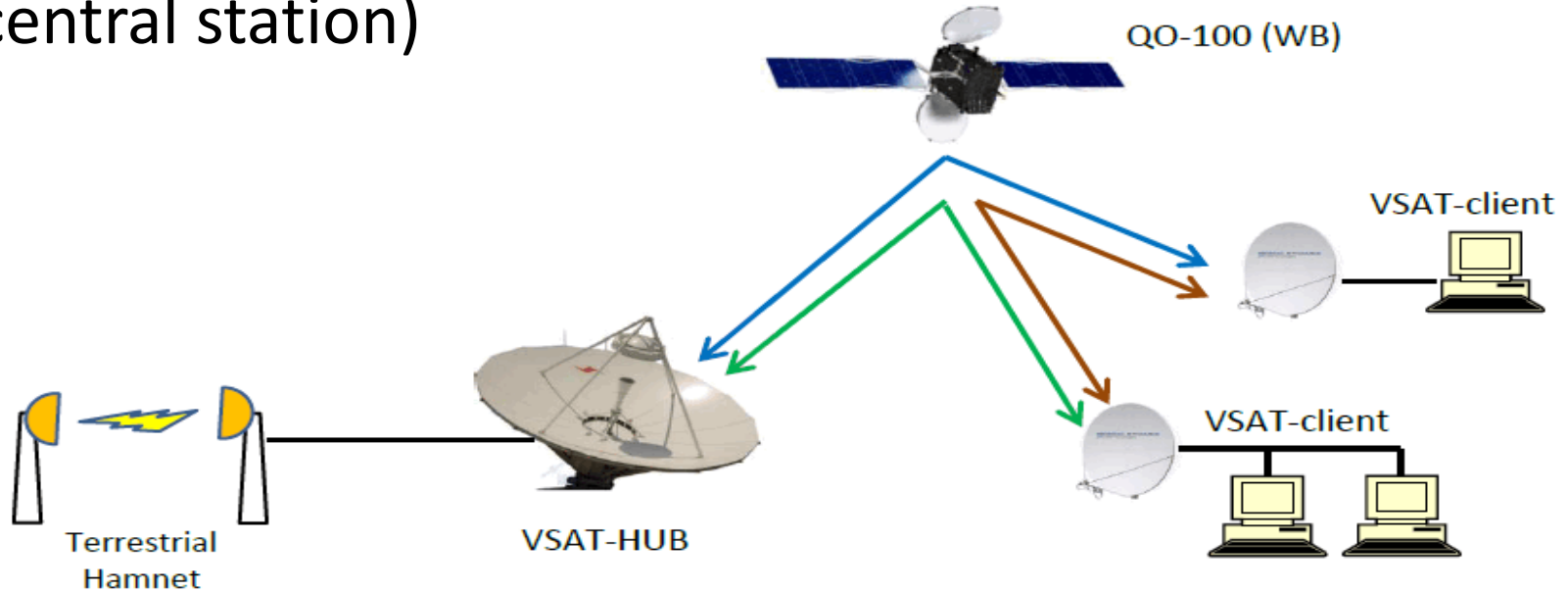- Custop Software open-source
  - Runs on PC : Windows ou Linux
  - Virtual Modem
- Virtual network interface TUN/TAP (TAP-mode)
- Layer-2 emulated network with:
  - ARP-Proxy
  - DHCP server (Client side only)
- SDR interface : SOAPY-SDR
- Modulation and demodulation : custom software

3) The protocol

- Multipoint-to-multipoint = Full-Mesh

- Coordination via the VSAT-Hub
    (central station)

3) The protocol

- ## MF-TDMA:

    Multi-frequencies Time-Division-Multiplexing

- – 1 or several channels (50kS/s, 100kS/s or 200kS/s)

    Maxi 4 or 5 channels.

- – Each channel is split into time-slots

←———— 380ms ————→   → ← 24ms

Time-Slot counter	TDMA frame 1					TDMA frame 2					TDMA frame 3			
	1	2	3	...	16	17	18	19	...	32	33	34	..	48
Channel 1 (100kS/s)	Hub				4	Hub				Client 2	Hub			
Channel 2 (100kS/s)	Client 1		Client 3			Client 1			Client 2		Discovery slot			
Channel 3 (100kS/s)	Client 2					Client 1		Client 3		4	1	3	4	2

3) The protocol

- MF-TDMA

- Variable length data frames 10 to 190 Bytes.

- PSK Modulation : BPSK or QPSK
  - Frame-Header are BPSK
  - Signaling trafic is BPSK (for robustness)
  - Data-IP trafic is BPSK or QPSK,

    decided frame per frame, according to the « TX-Capability » of the station.

3) The protocol

- MF-TDMA

- Variable length data frames 10 to 190 Bytes.

- PSK Modulation : BPSK or QPSK

- Automatic adjustment, at client side, of:
  - Timing-Advance : anticipation of the transmit
    (a client station listens to the return of its own frames)
  - Transmit power (tries to allign with the Hub)

3) The protocol

The VSAT-Hub

- Broadcasts periodically the config of the network:
  - Frequencies & Symbol-Rate (of secondary channels)
  - IPv4 Config
- Manages the connection/disconnections of clients.
- Allocates « fairly » the RF resources, depending on
  - The needs/requests
  - The TX-capability of each station
- Gateway IP with the
  European-Hamnet

4) Using the software

- Configuration file (text)

- Can be edited live

```
NPRVSAT_...

Fichier  Edition  Format  Affichage
Aide

CALLSIGN:F4HDK
TUNTAP_NAME:tap_01
PLUTO_IP:192.168.4.1
CENTER_TX_FREQ:2408.25
CENTER_RX_FREQ:2408.25
RX_LO_FREQ:1660.472
TX_FREQ_OFFSET:0.046
TX_MAX_GAIN:87
RF_TX_CAPABILITY:3


Unix (LF)              UTF-8
```

4) Using the soft

Status displayed in the term window :

- For both upstream and downstream
  - Error rate
  - TX/RX gain
  - Frequency compensation
- Connection status
- Who:
 - Connected clients (callsign
  - Their IP-address

```
File  Edit  View  Terminal  Tabs  Help
+---------------+-------------+-------------+
              |   from Hub  |   from ME   |
+---------------+-------------+-------------+
     SDR-Gain  | RX: 67.5 dB| TX: 82.0 dB|
  amplitude RX |    322.0    |    385.6    |
 Timing-Advance|             |  314.187 ms|
Freq Offset(MHz)| RX:1660.466 | TX:   0.046 |
+---------------+------+------+------+------+
              | BPSK | QPSK | BPSK | QPSK |
+---------------+------+------+------+------+
 frame TX count|  --  |  --  |    5|    0|
 frame TX rate |  --  |  --  |  2/s|  0/s|
 frame RX count|  462|  384|    4|    0|
 frame RX rate |  16/s|  12/s|  1/s|  0/s|
+---------------+------+------+------+------+
Word err rate(%)|  0.60| 12.25|  0.00|  --  |
  RS err rate(%)|  0.00|  0.77|  0.00|  --  |
Frame err rate(%)|  0.00|  0.00|  0.00|  --  |

STATUS: CONNECTED

 DHCP ENTRIES*******
   0:stat:2 IP:44.168.17.183 MAC:9A:8B:87:F0:16:0A age:1sec

WHO:
ME 1 "F4HDK-client" IP: 44.168.17.183 to 44.168.17.183
  0 "F4HDK-Hub" IP: 44.168.17.161 to 44.168.17.180 Static:0
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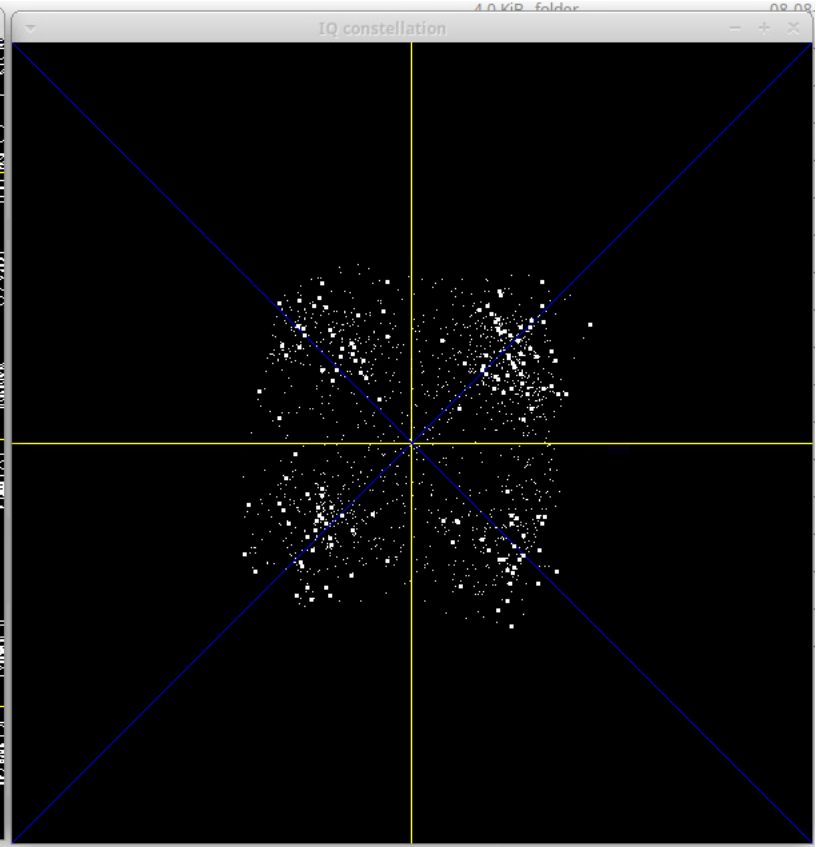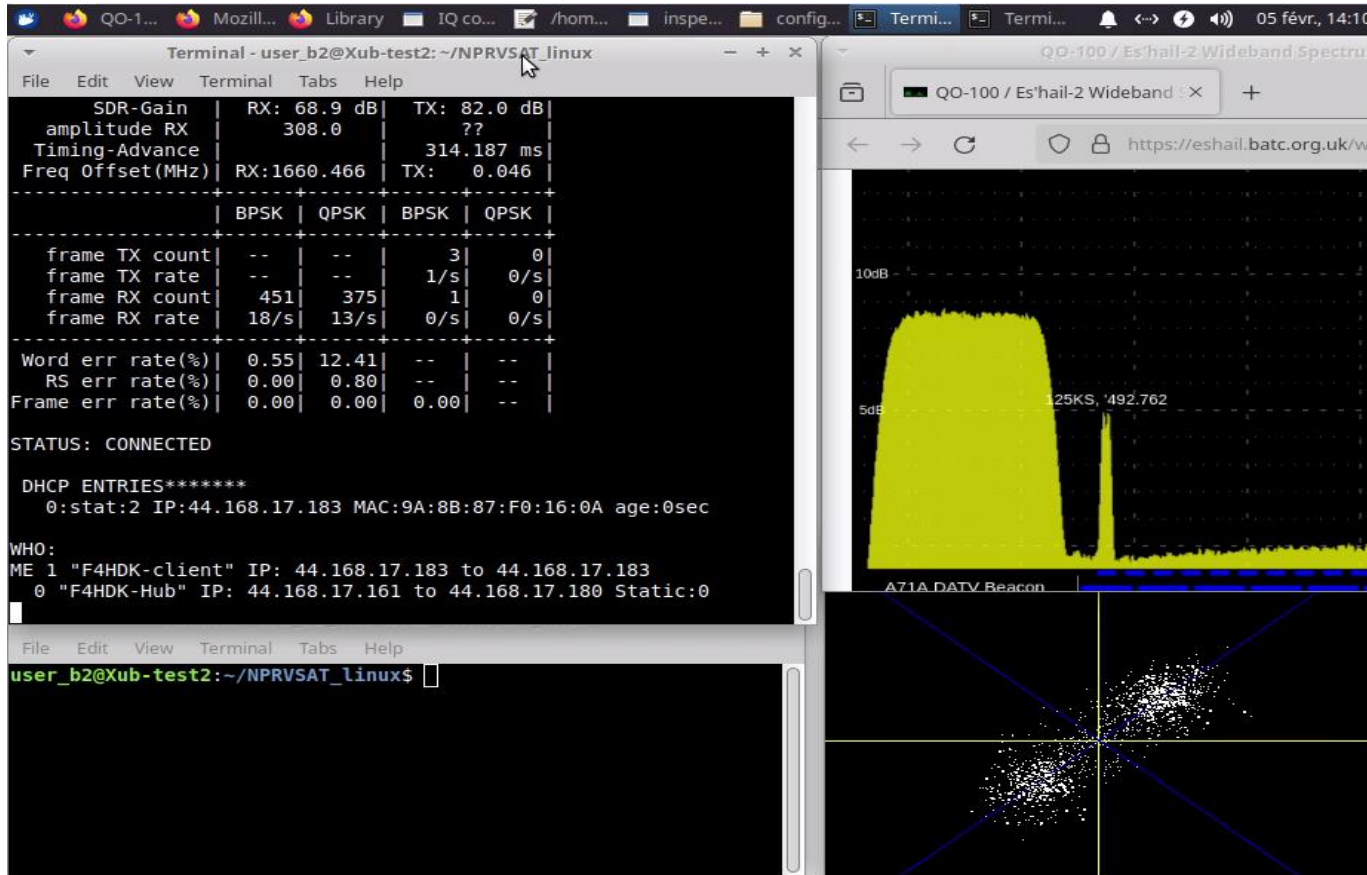
4) Using the software
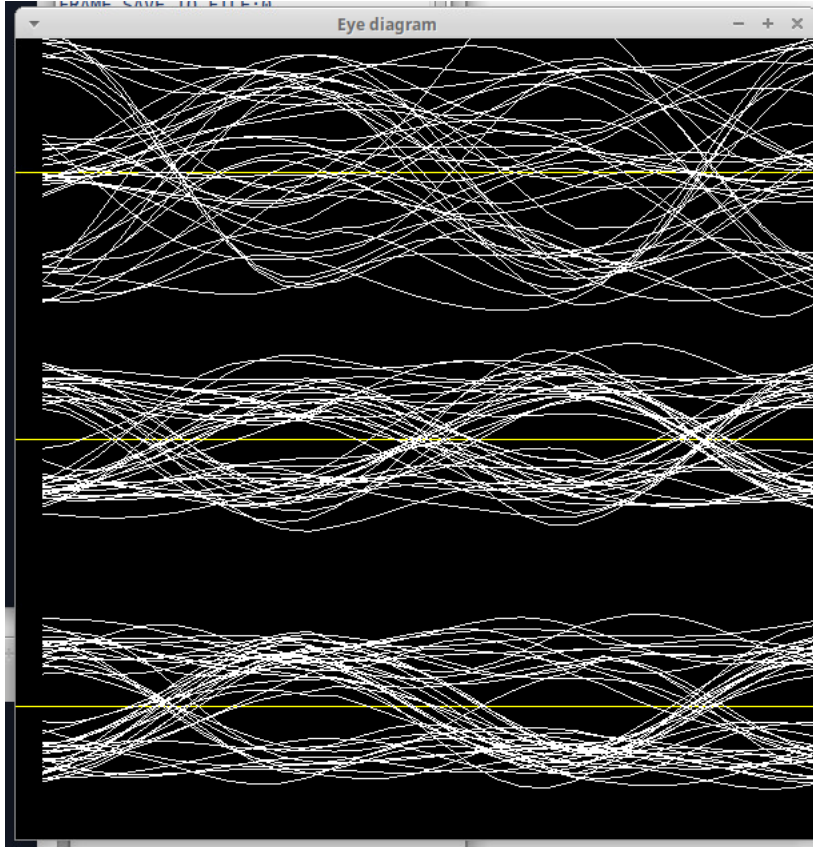
Eye Diagram

IQ Constellation

5) Demonstration

Video : https://www.youtube.com/watch?v=abb2v2c4qdA

6) Possible usage

You can invent the usages!

- All applications based on light web pages

- DX-Cluster

- DX-pedition logging

- Backbone for a word-wide Win-link network

  - Either as a main backbone

  - Or as backup bacbone links

- Etc…

7) Test development environment

- Test on a table
  - 2 SDR for stations
  - 1 SDR simulates the satellite transponder (with latency)
- Software in the loop
  - 10 stations inside linux-containers
  - Modulation/demodulation is volontarilly not simulated.
- Over QO-100-WB:
  - 1 station with 2 SDR in parallel

8) Project progress status

- Software development:
  - Already useable for beta-test (you can ask me for a test!)
  - Demodulation and FEC could be improved.

- Negotiation with AMSAT-DL initiated in March 2023
  - OK for short duration tests
  - It depends on the interest from the community
  - Automatic/unattended stations are currently not authorized over QO-100; only the Hub could be authorized as an unattended station.

- If you want to help, you are welcome…

9) The QO-100 Station at F6KBF

Power-Amplifier 2.4GHz 100W on the roof, in a weatherproof aluminium box.

Thanks to the contributors

- Jean-Michel F1EZG
- Alain F1CJN
- Anthony F4HUY

10) If you are interested

Please read all the documentation.

Contact me.

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