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ISTITUTO DI RADIOASTRONOMIA

Towards the Italian VLBI network: first tests and perspectives

Matteo Stagni - EVN Symposium - Cagliari (Italy) 09-10-2014

Italian baselines

- Mc - Nt - Mt baselines for Geodetic experiments
- Mc - Nt - SRT baselines for Astronomical experiments
- Shortest baseline 500 km
- Longest baseline 900 km

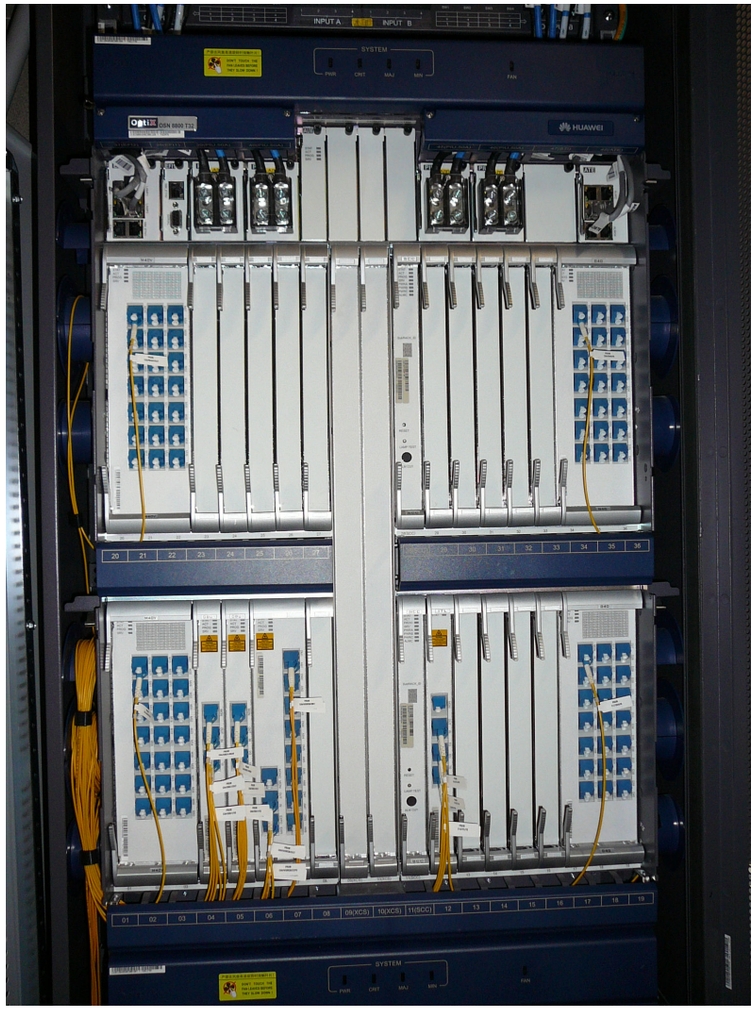
SRT

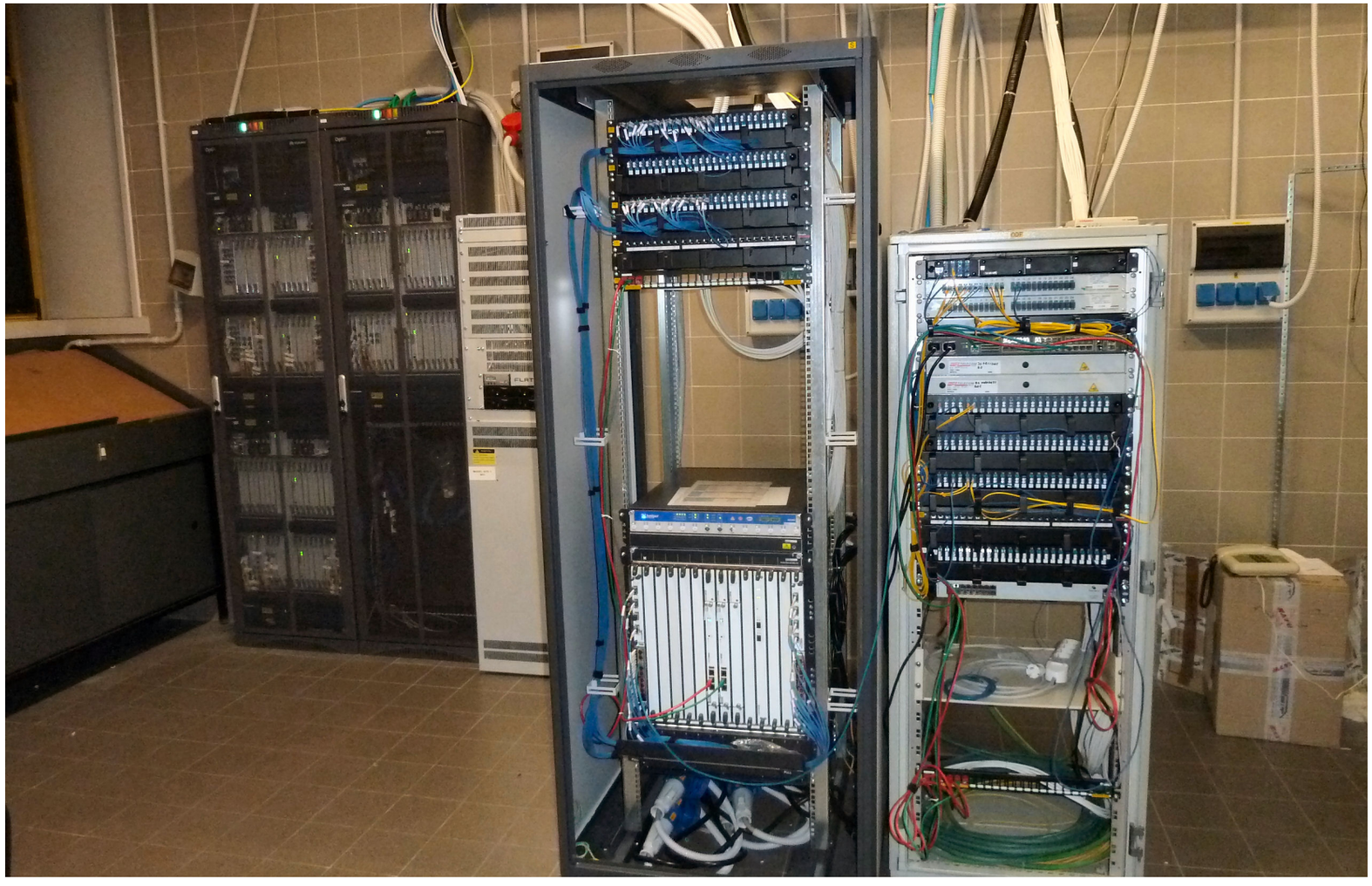
64 mt diameter antenna
Active surface
0.3 -- 100Ghz
high tracking speed

cm	GHz	Resolutive power (arcsec)			
		Medicina	Noto	SRT	VLBI - IT
18	1,6	1474	1474	731	0,02
6	5	472	472	234	0,007
5	9	262	262	130	0,004
2.4	13	181	181	90	0,003
1.3	23	103	103	51	0,002

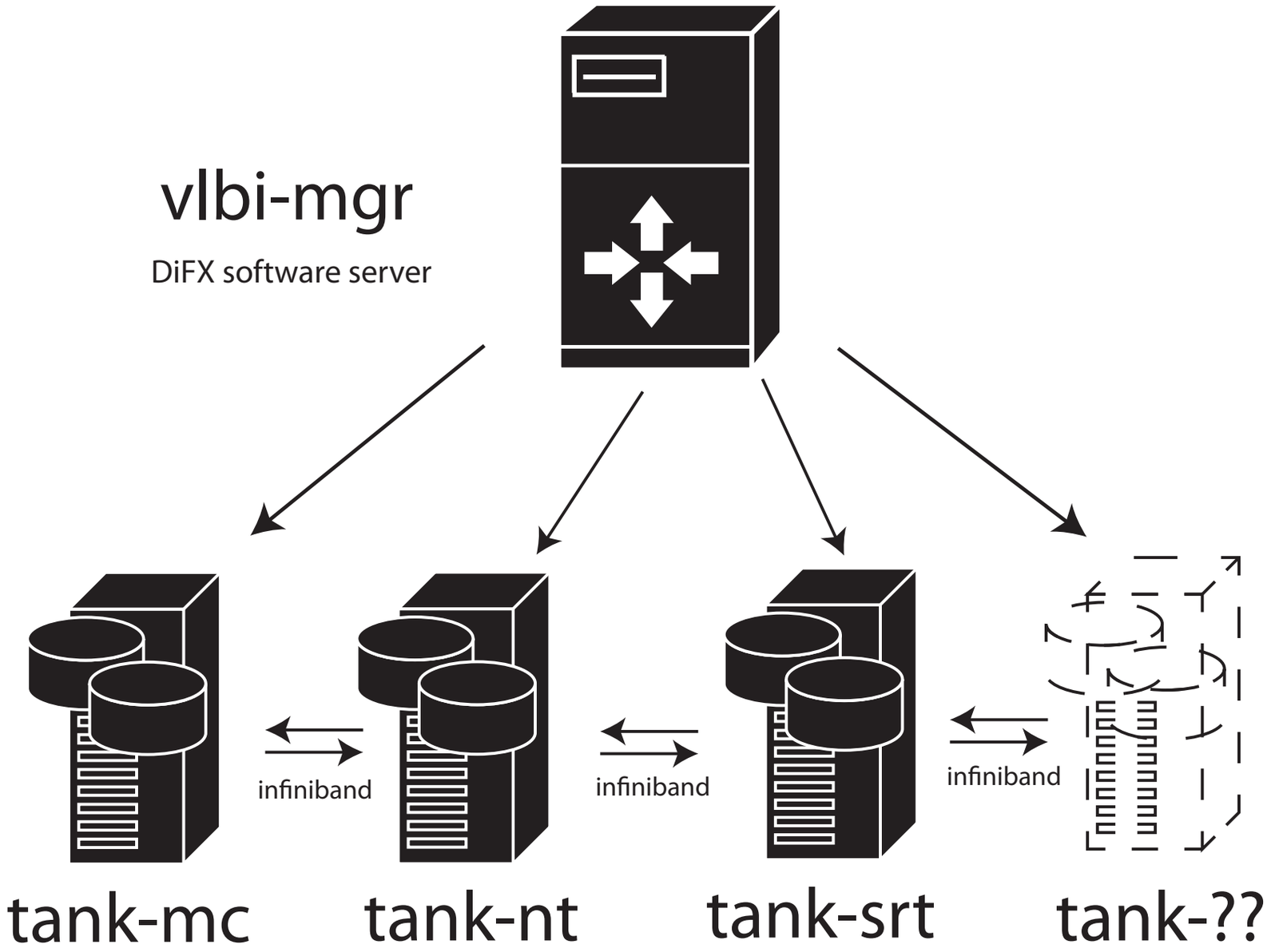
	Antenna	Now	2015	2016
	Mc - 32 mt	10 Gbit/s	10 Gbit/s	10 Gbit/s
	Nt - 32 mt	10 Gbit/s	10 Gbit/s	10 Gbit/s
	SRT - 64 mt	-	-	10 Gbit/s (**?**)
	IRA - HQ	3 x 10 Gbit/s	3 x 10 Gbit/s	3 x 10 Gbit/s

Garr -> Geant now 2 x 40 Gbit/s	Band on Demand to EVN





Juniper POP and Huawei Lambda DWDM devices



Cluster Architecture

A dedicated storage node for each antenna

Cluster view

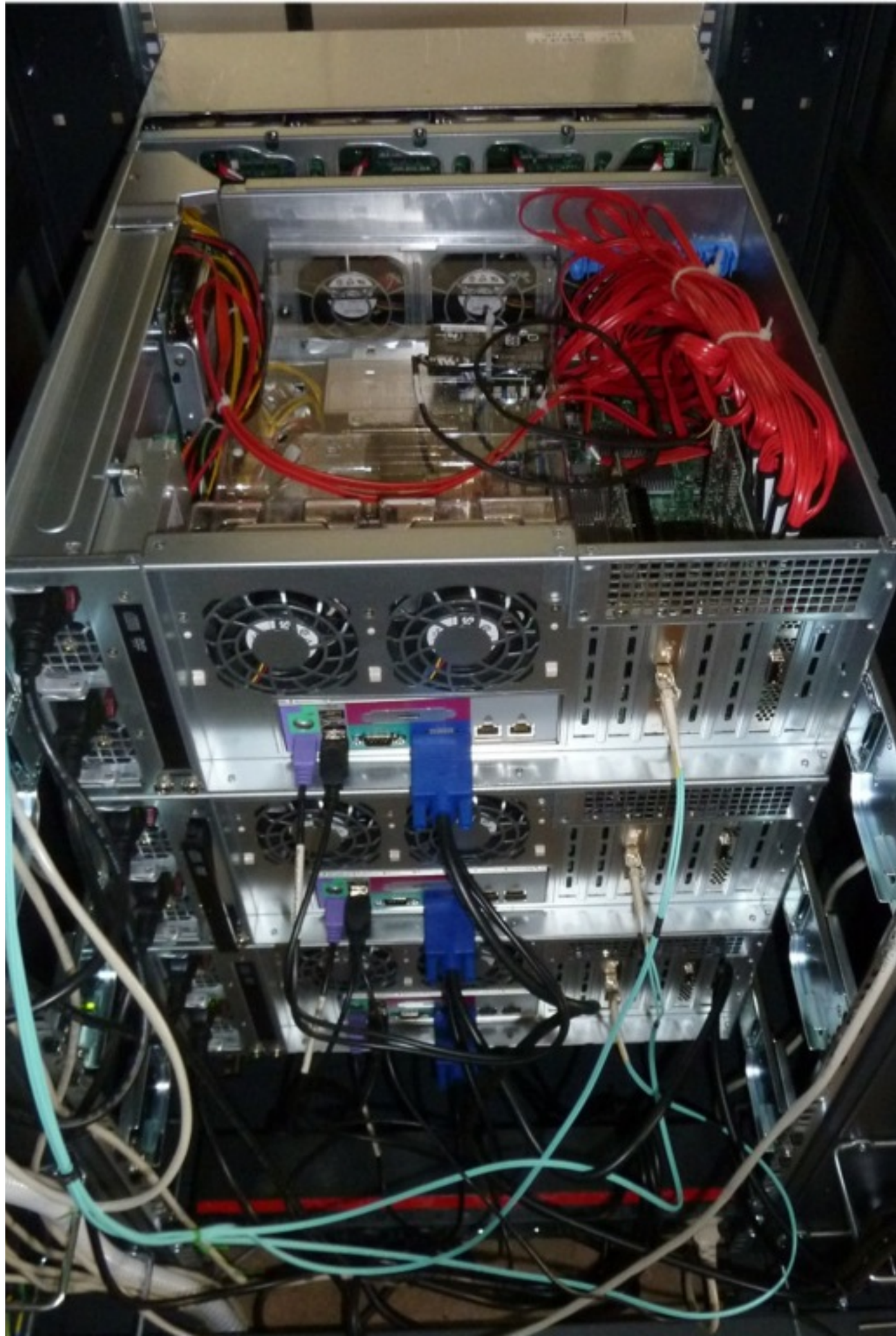
Infiniband connection

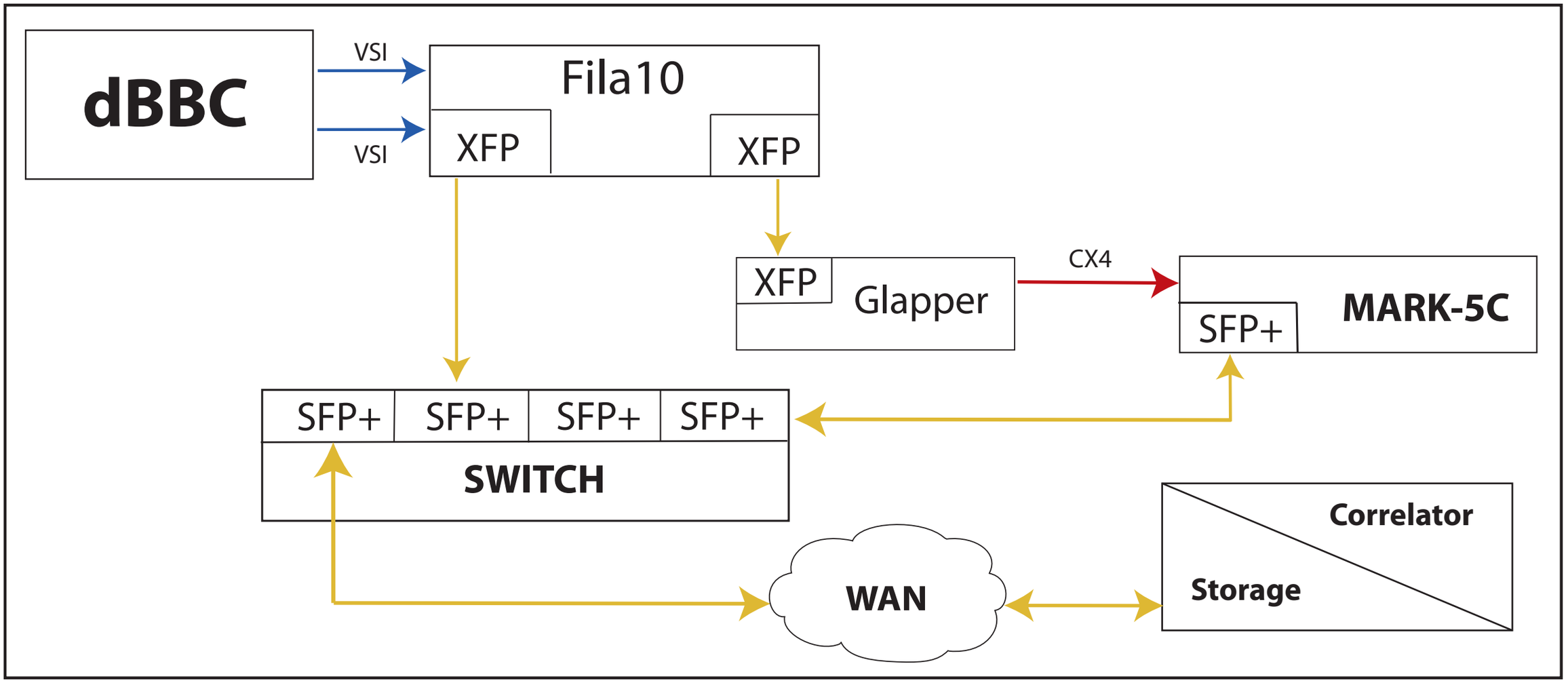
10 Gbit network

24 disks bay

Now 150 TB available

(20 TB SATA + 30 TB SAS each)

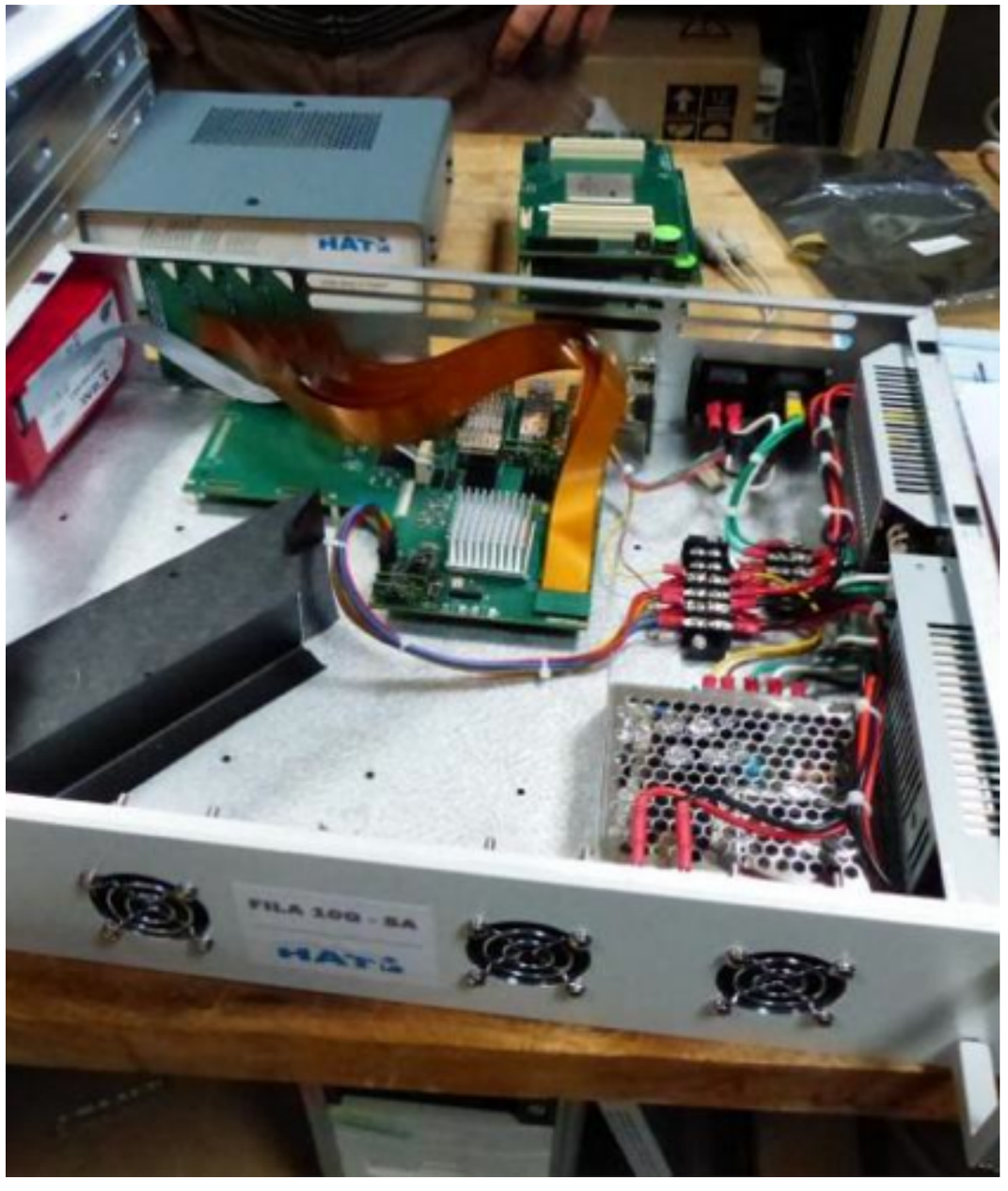




Network layout at stations

Fila 10 G

- The Fila board (**Fi**rst - **La**st) is connected to the dBBC backend through a VSI cable and transfers the data onto an optical fiber adding a Mark5B or VDIF header



1 hr recording test @ 4 Gbit Medicina -> Bologna

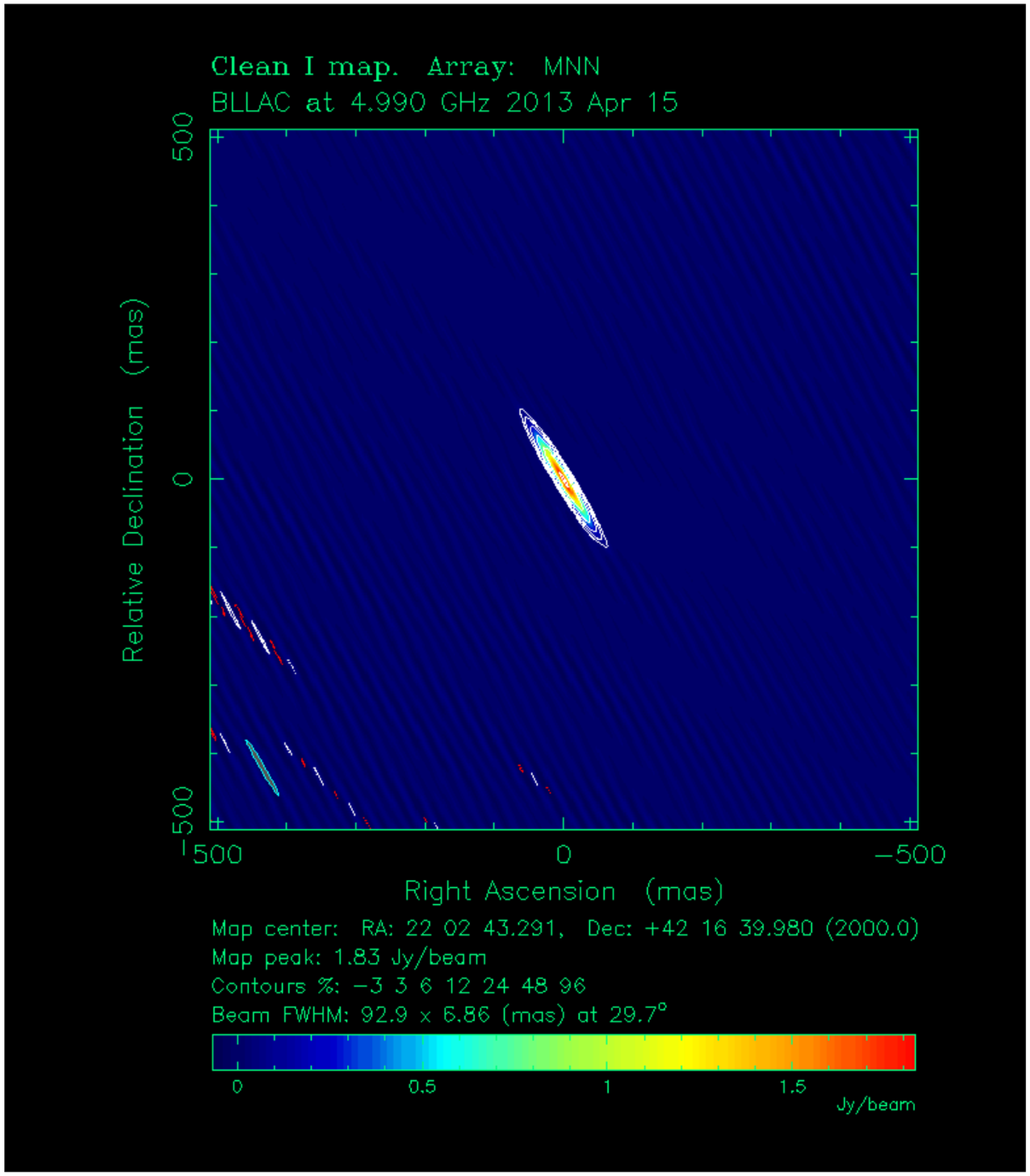
5008 bytes Mark5B - Fila 10 G split packets	SATA RAID 20 TB	SAS RAID 30 TB
Lost packets	5102688	56782
Total packets	363651840	369577856
% lost	**1.4 %**	**0.01 %**

Thanks to Harro Verkouter's **jive5ab**

Name	Band	Date	Result	Rec Speed	Mc	Md	Nt	Nd	SRT	Notes
3C84	L	15/3/2013	**NO**	512	X		X	X		Fringes Nt-Nd
ITVLBI	L	17/3/2013	**NO**	512	X		X			
apr-15	C	**16/4/2013**	**OK**	512	X		X	X		**First Fringes Mc - Nt**
ivlbi	X	12/10/2013	**NO**	512	X	X		X	X	Fringes on few scans Mc-Md-Nd
nov25	K	28/11/2013	**NO**	1024		X		X		Clock problems Md
dec5	X	7/12/2013	**NO**	1024		X			X	Clock problems Md-SRT
dec17	L	17/12/2013	**NO**	1024		X		X		Clock problems Md
ivlbi	X	3/1/2014	**OK**	512	X	X				
temp2	L	**13/1/2014**	**OK**	1024		X		X		Fringes Md-Nd-Hh / **Nd + 1sec**
test5	K	**27/1/2014**	**OK**	1024		X			X	**First Fringes SRT**
test5	K	**4/2/2014**	**OK**	1024		X			X	**New position SRT**
l128	L	18/2/2014	**OK**	128		X			X	
l1024	L	19/2/2014	**NO**	1024					X	Clock problems Md-SRT
l512	L	19/2/2014	**NO**	512		X			X	Clock problems Md-SRT
test10	X	28/2/2014	**NO**	512		X			X	No fringes SRT
r4620	S/X	**19/3/2014**	**OK**	512	X	X				Strong Fringes CTA26 **streaming from Md to Bologna**
1313	C	28/3/2014	**OK**	512	X	X		X		Australian campaign
ap30b	C	30/4/2014	**NO**	1024				X	X	Autocorrelation Nd-Nd streaming only p_cal
3c161	C	15/5/2014	**OK**	512	X	X		X		Test on 3c161
taurusa	X	**15/5/2014**	**OK**	1024	X	X				Transient test **Md streaming to Bologna**
may23	L	23/5/2014	**NO**	512	X	X			X	Mc-Md streaming only p_cal

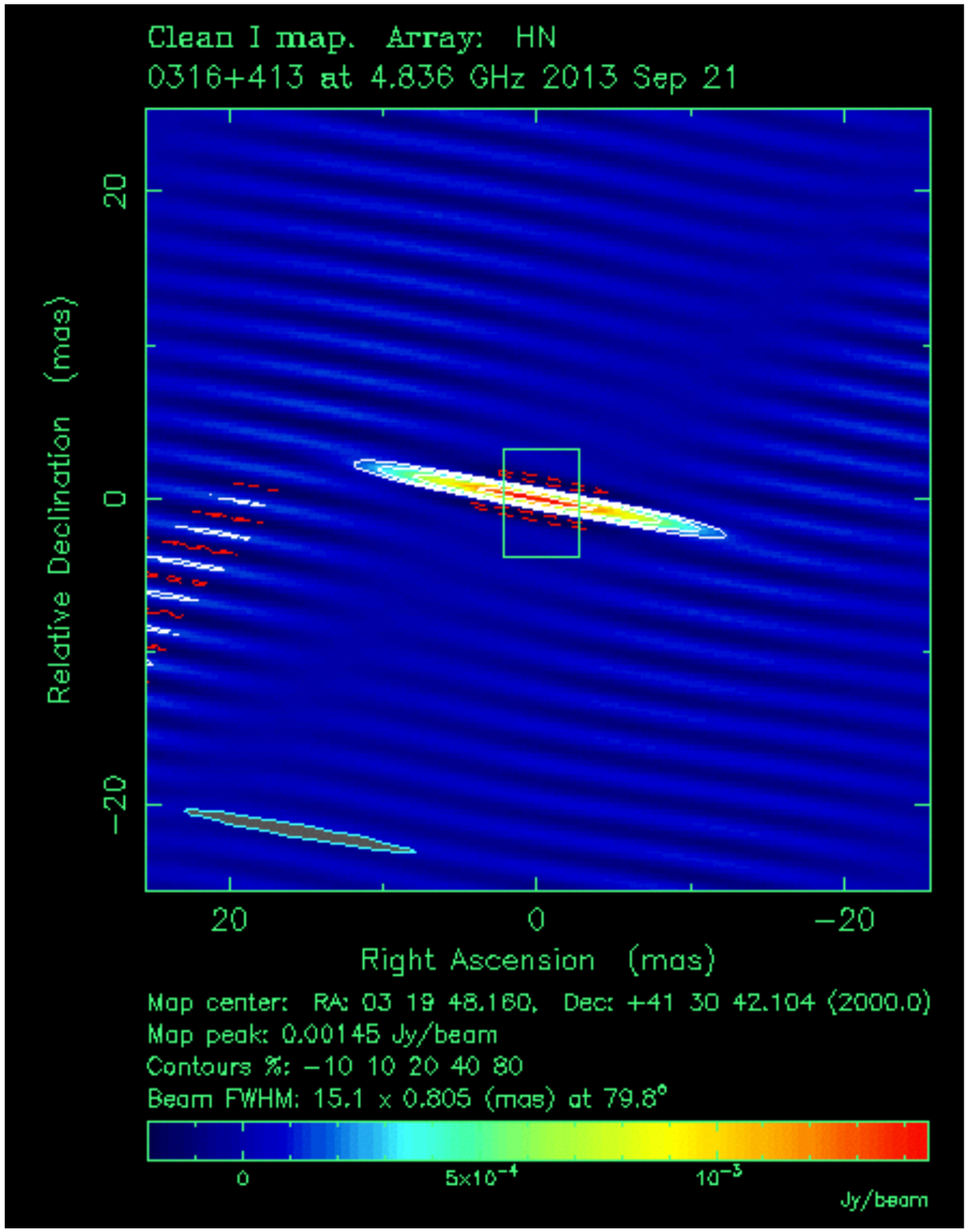
First test

- Medicina - Noto baseline
- 15-04-2013



Noto - Hart (South Africa) baseline

~ 430 GB data
correlated in
Bologna
sent @ 250 Mbit/s



Transient tests

- Medicina - Noto baseline

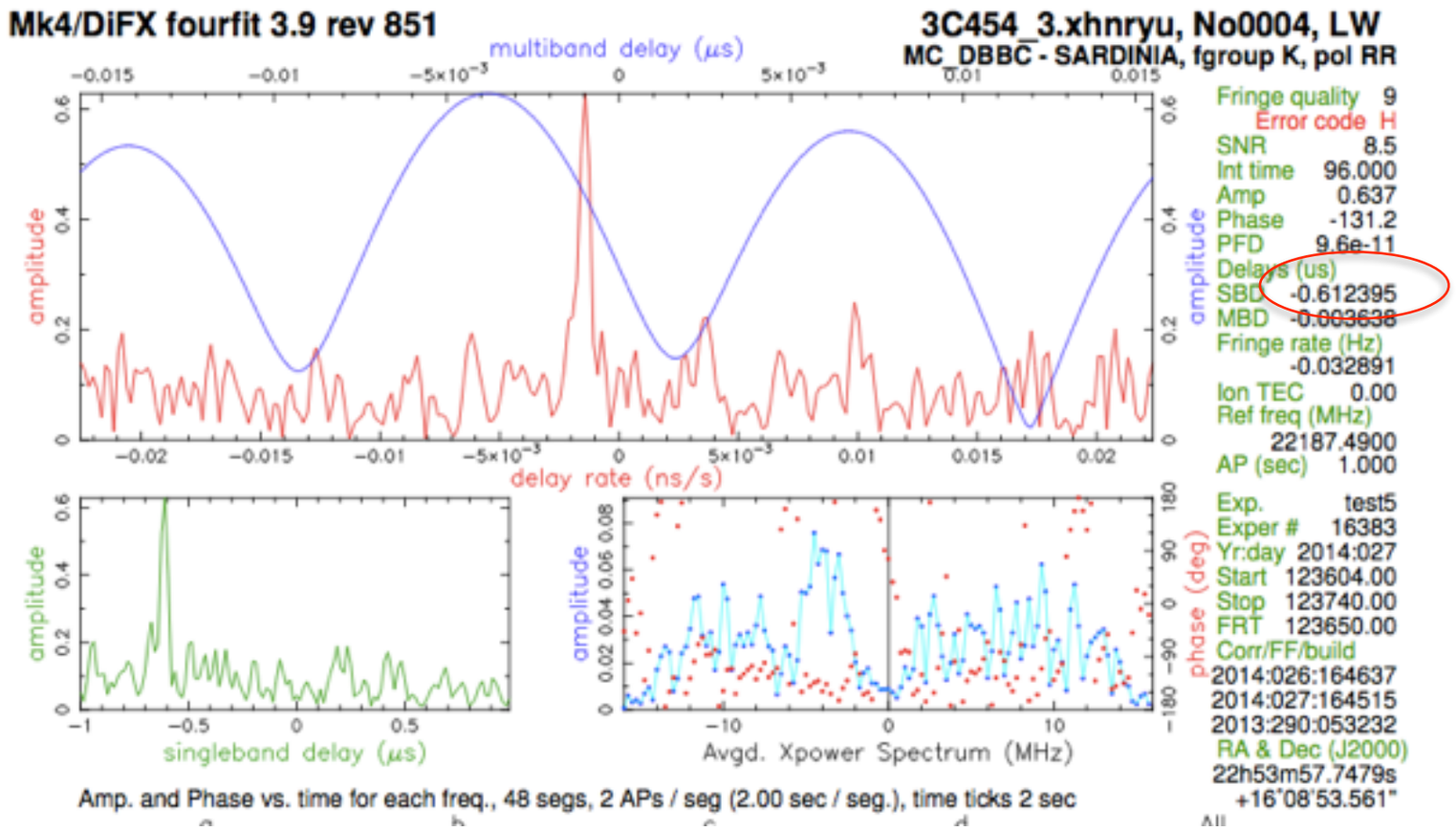
- SN2013ej - IIP Supernova detection on 12-08-2013

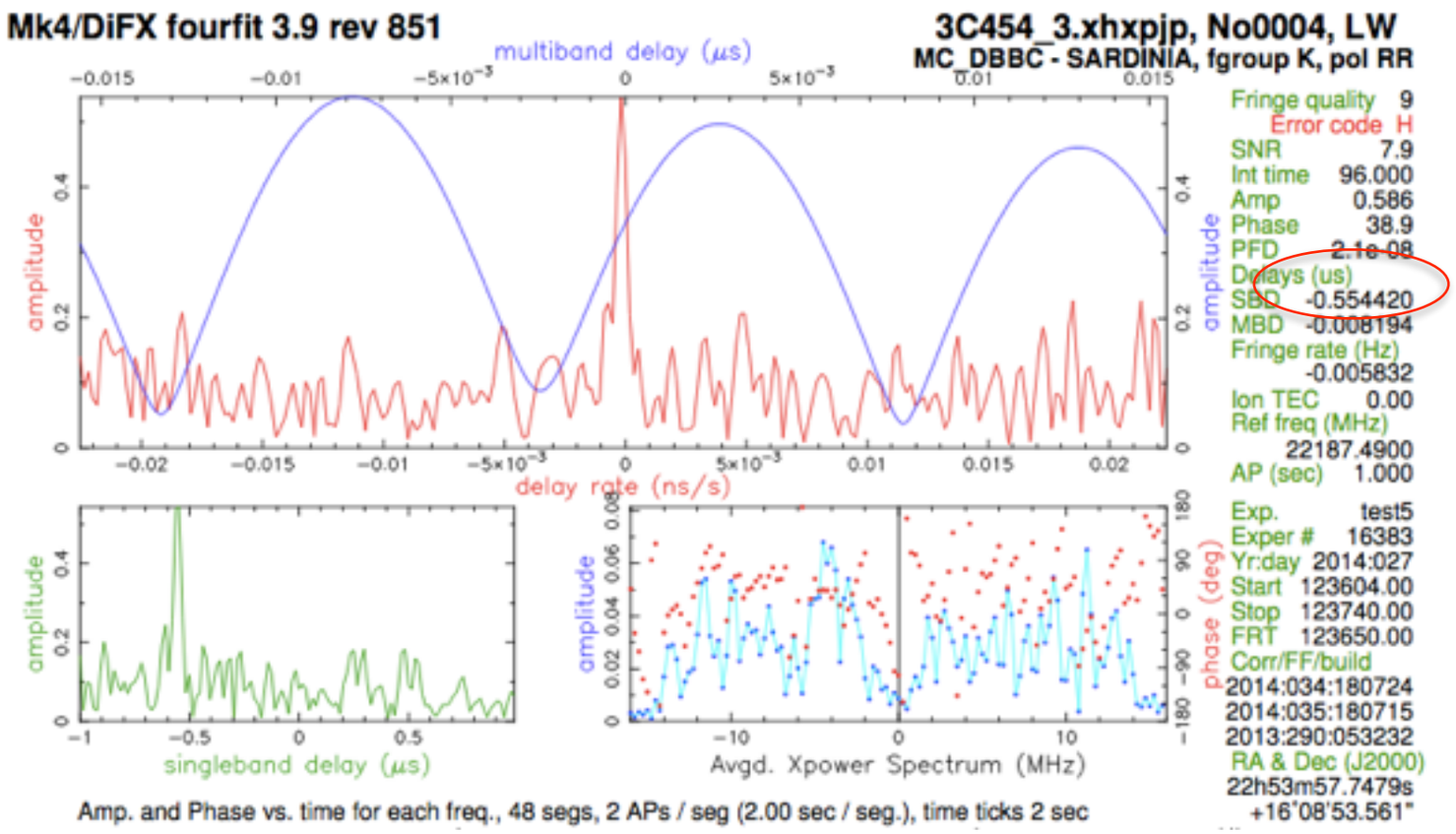
Australian campaign

- Observations on calibrators -> stress our equipment

- 6cm C band Mc(Md)-Nt campaign between 22-03-2014 and 22-04-2014

- 12 Experiments 3 hr each -> 11 successfully correlated





SRT position measured more accurately after the first fringe

Delay reduced by 0.1 μsec

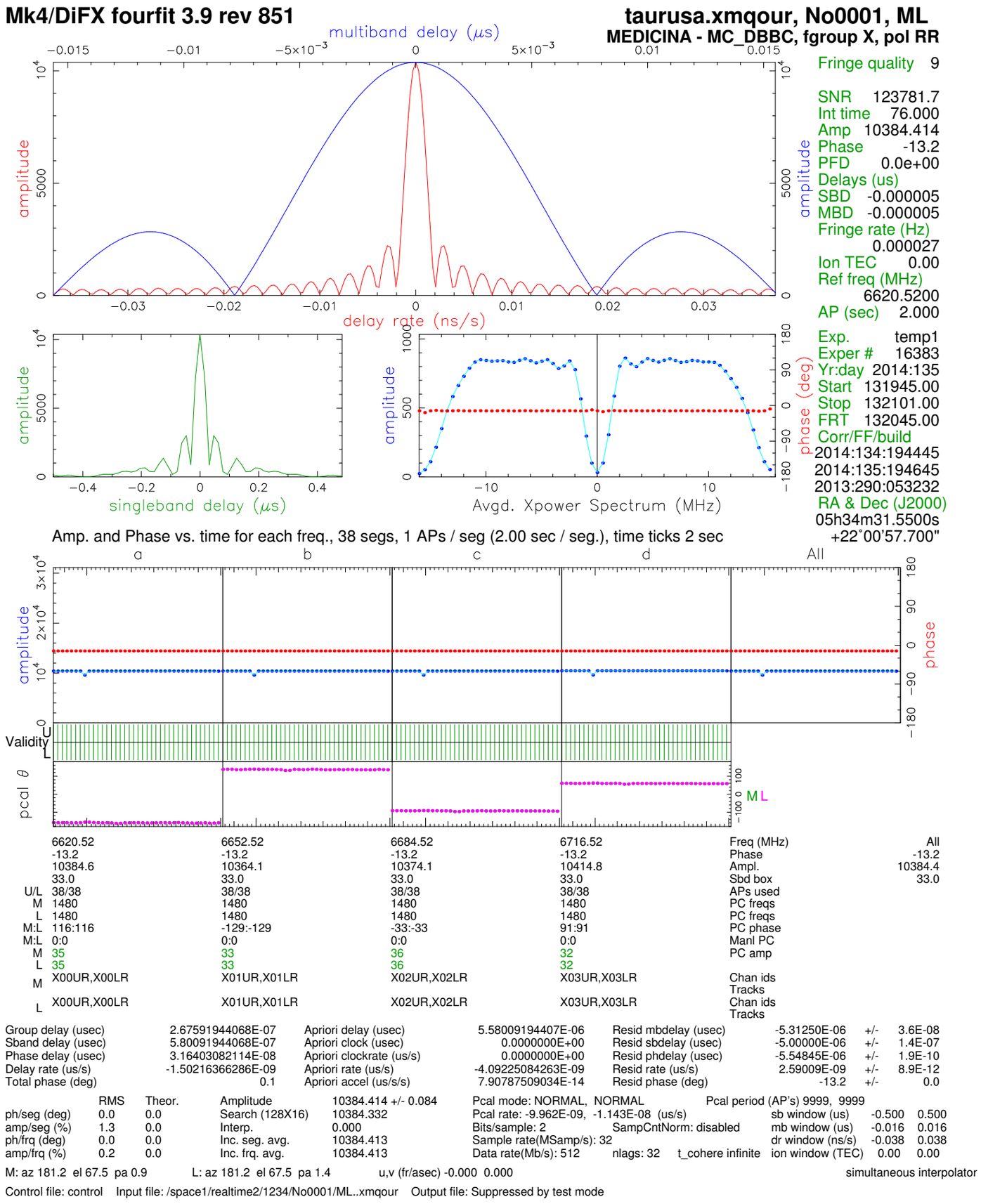
✓

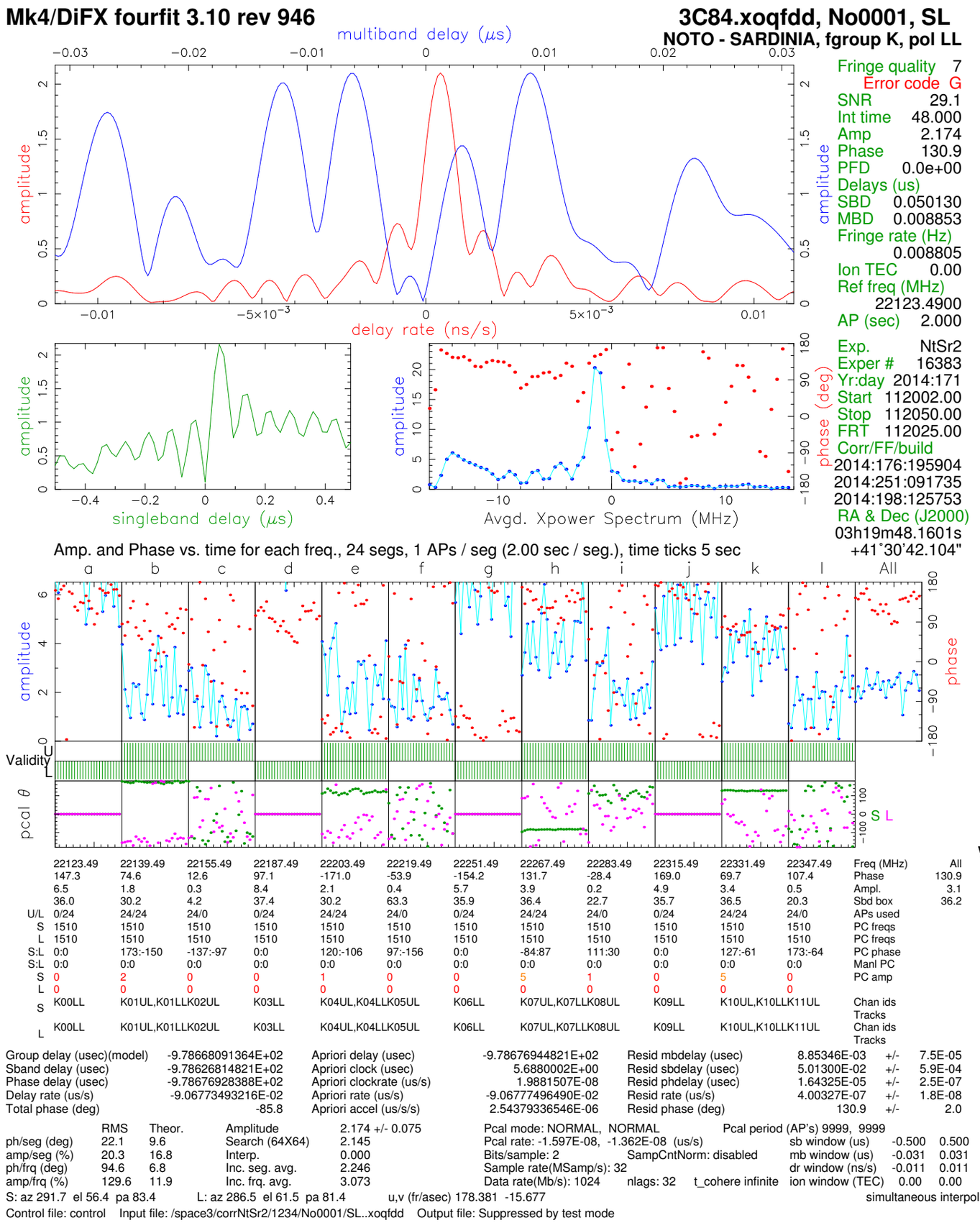
Weather problems in Sardinia

✗

Medicina dBBC streaming to Bologna @ 1 Gbit while recoding with Mark5C at the station

Taurus A passing over a **stopped** antenna…





K Band test
in single polarization
to meet K5 Japanese
format

Low SNR for calibrator!

-

wrong cabling -> missing some IFs

Experiments

- First aim of tests was to verify the network infrastructure and **SRT** equipment

- Evaluate the different dBBC backend pipelines: Mark5B - Mark5C - Fila10G

Experiments

- As of today more than 40 experiments, scheduled by INAF or EVN have been correlated in Bologna

- Half of them have **failed**

Experiments

What we have learned the hard way:

- Human errors (cabling, wrong schedule name…)
- Weather (Snow, wind, fog)
- Hardware errors (Wrong clock setups, failures…)

That’s why they call them experiments!

Correlation experiences

PROS

- Flexibility of Bologna storage facility
- High capacity network infrastructure
- Ability to operate in *almost* any condition
- Possibility of hosting data *and* distributed correlation

Valley of sorrow

CONS

- SRT missing network
- *Sched* doesn't fully support dBBC setups
- VDIF format is yet to be thoroughly tested
- Vex2 is much awaited

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Thank you

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