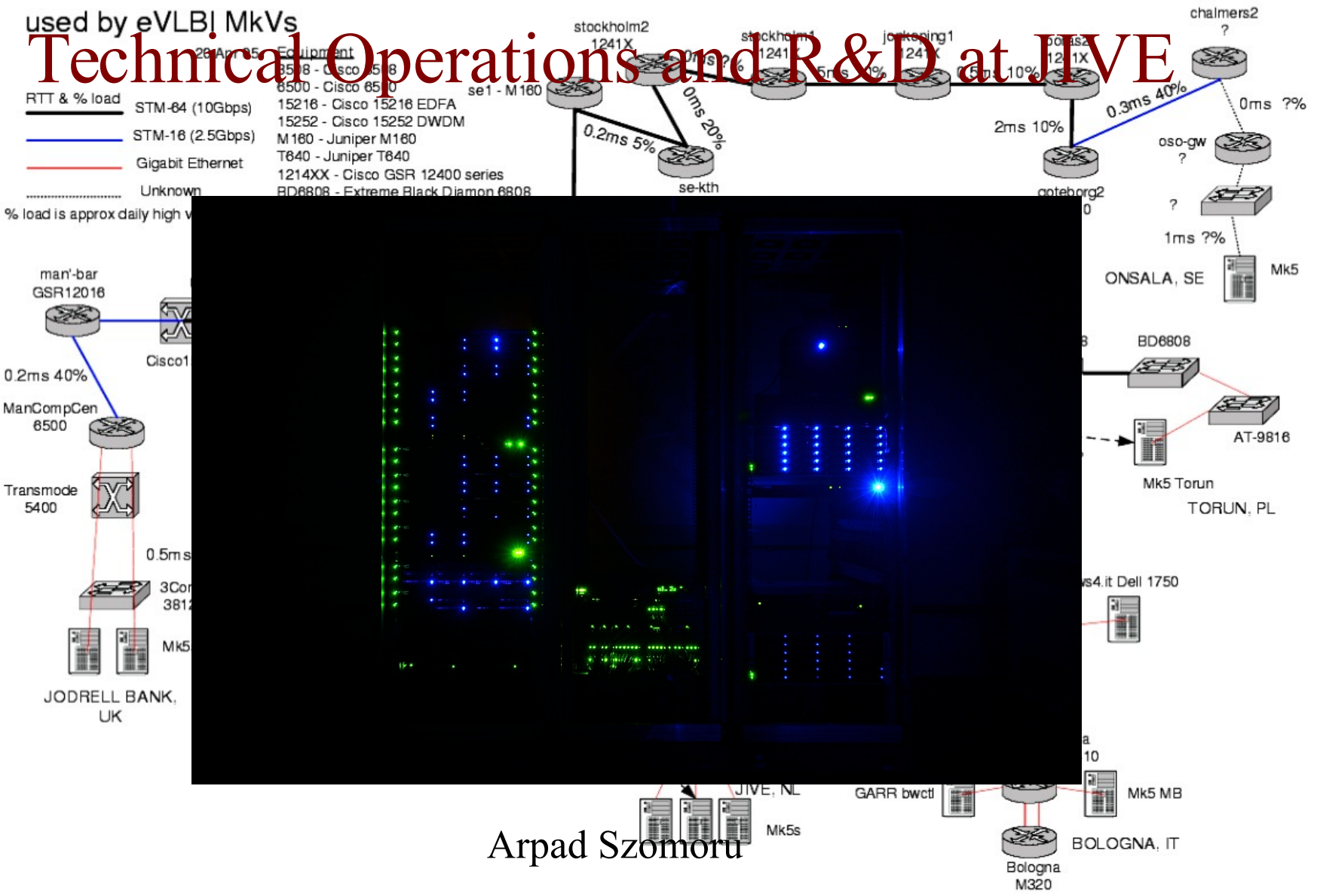
Technical Operations and R&D at JIVE



Arpad Szomoru

What do we do?

- Correlators
  - More capacity, new telescopes, development of AVN, new features, MeerKAT VLBI
- Data recording/playback/transport
  - Real time/near-real time, higher bandwidths, 2, 4, 32 Gbps (??)
- Automated operations
  - Get rid of disk shipping
  - Monitoring, automated fringe checking
  - Triggered observations, multi-messenger astronomy
  - Fringe checking for BlackHoleCam
- Software
  - User software, VLBI with CASA
  - CASA in Jupyter notebooks, containerisation
  - Simulations for BlackHoleCam
  - SCHED re-factoring
- Time and frequency transfer
  - SAT architect in SaDT consortium
  - Transfer over public networks: demo involving Wb, Dw, LOFAR, SURFNet

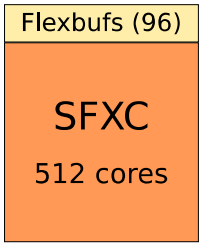
JIVE R&D

- Possible future developments of Jive5AB
  - Talk by Harro Verkouter
- Used expertise for creation of file transfer tool
  - Part of Cleopatra WP in Asterics
- Which fed back into Jive5AB again

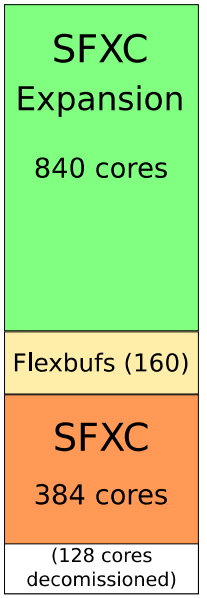
- FlexBuff recording still expanding
  - Many new machines
  - 10 TB disks now in general use
  - SSDs still expensive
    - But prices going down (?)

More…

- New SFXC hardware, network, more FlexBuffs



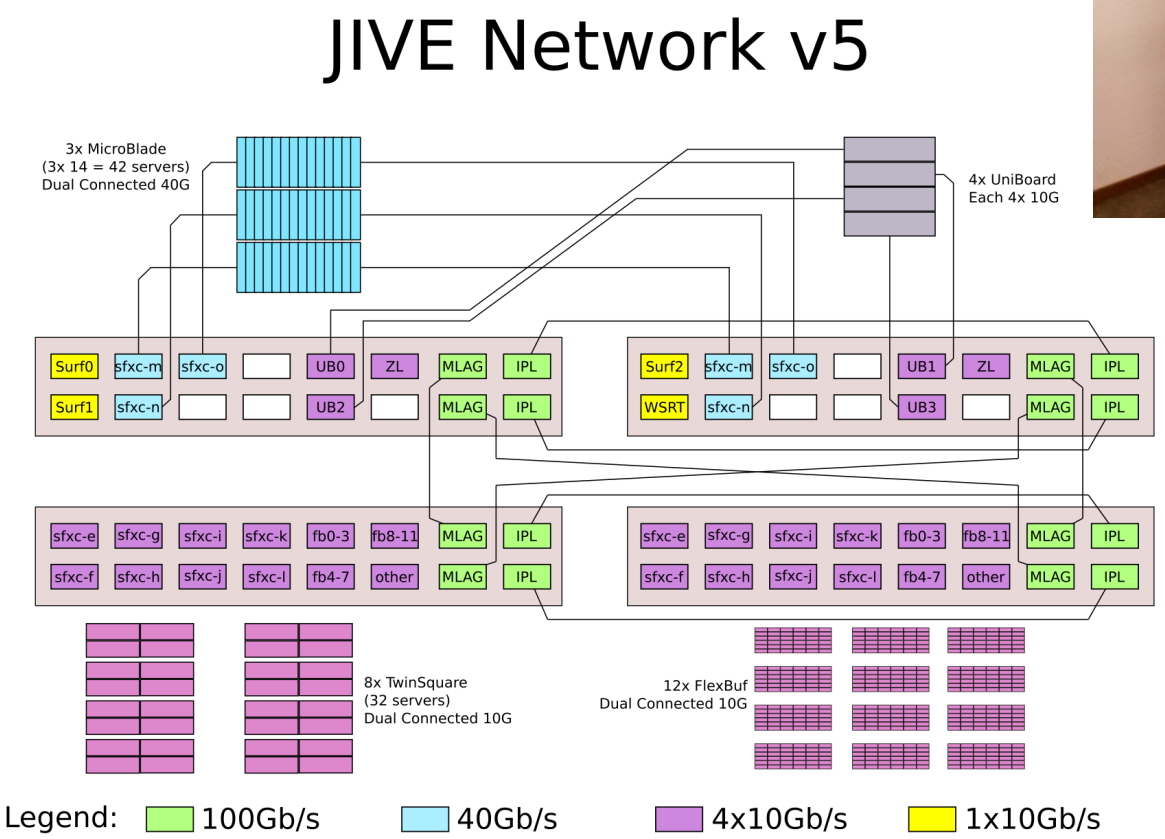
Before



After

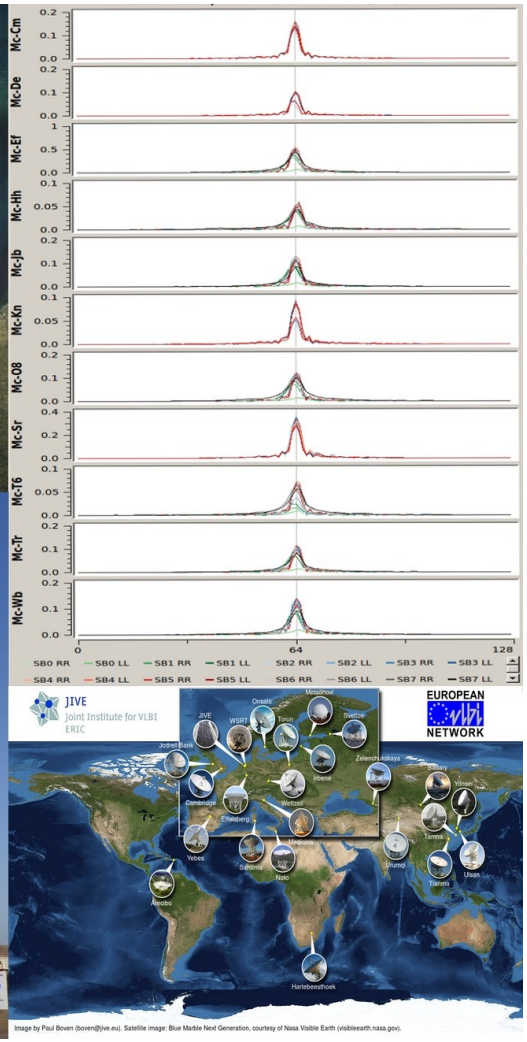
More…

- Complete overhaul of local network
  - Interesting problems during e-VLBI resolved



More…

- 2 Gbps e-VLBI was operational
  - But went back to 1…..
- First tests of 32 Gbps considered
- E-Merlin stations really back!!
  - Still some issues
  - But fantastic result anyway!



JIVE UniBoard Correlator (JUC)

- JUC validated for e-VLBI
  - Minor issues
  - Easy to switch between SFXC and JUC
  - Still some minor control software bugs

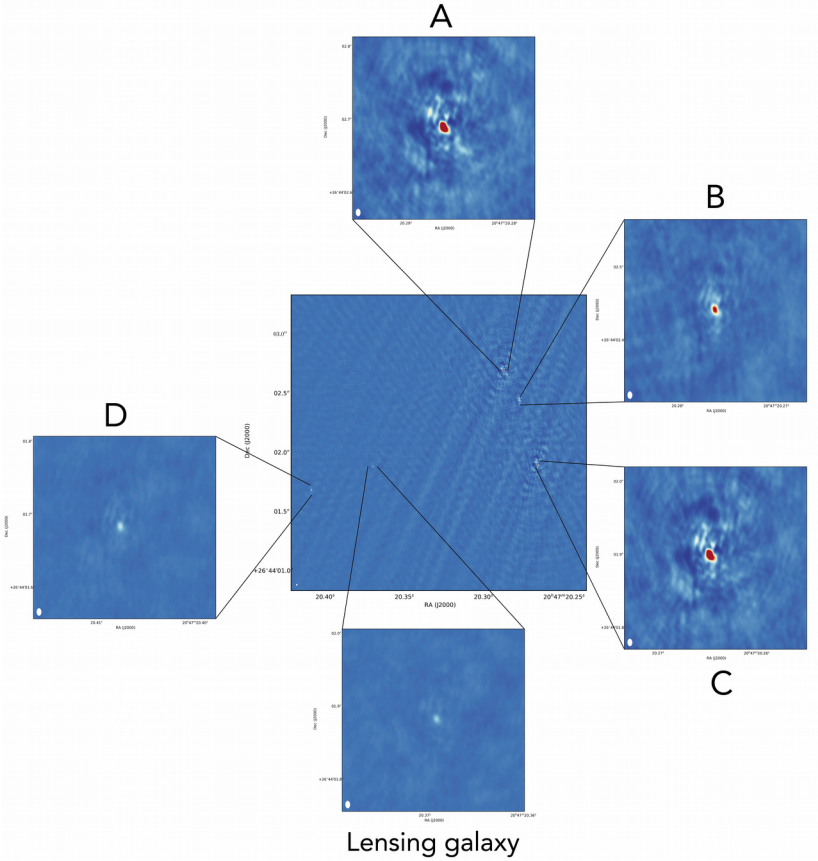
  - Per board:
    - 32 stations at 64 MHz
    - Dual pol
  - 4 boards: 16 stations at 4 Gbps

  - Available: 32MHz sub-band version
    - Which can handle 16 MHz as well
  - 64MHz version ready for tests

  - Unfortunately, mixed bandwidth is not possible

R&D User software development

- CASA fringe fitting
  - in RadioNet RINGS
  - Basic version available in CASA 5.3
  - New features in development branch
    - Mainly for BlackHoleCam folks
    - Some new features in next release
    - Dispersive fringe fitting for RINGS
    - Needed for BRAND
    - KVN data set for discontinuous frequency bands
- Continued support for ParselTongue
- OBELICS work package in ASTERICS
  - Minimize re-calculation when changing parameters during data reduction of large data sets
  - Nice results with CASA in Jupyter
    - Containerised: docker and singularity
    - Upgraded to CASA 5.3: actually better
  - Demo environment available: http://jupyter.jive.nl/



R&D User software development

- SCHED re-factoring (pySCHED)
- Using f2py to create Python main loop
  - All fortran routines appear as Python functions
  - Can add new Python functionality
- VEX2 writer done
- QT and Matplotlib available instead of PGPLOT
- Keyin reader re-written
- Allows the use of a templating language to generate and run KEYIN files
- Scheduling of different firmware versions of the DBBC
- Building of system still a bit clunky
  - But will get better
  - Let the whole thing loose on our support scientists

System Status Monitor

System Temperatures

Phase Cal Monitoring

Error/Log

Web-interface

System Status Monitor

WETTZ13N		2018.148.11:49:17		UT		TEMP	24.6	0552+398		TRACKING	
MODE	RATE		11:53:11	NEXT		HUMID	61.4	RA	05h 55m 30.81s		
		SCHED=	none	LOG=	station	PRES	947.3	DEC	39d 48m		(2000)
		TSYS:	IFA	IFB	IFC	IFD	CABLE	0.000000	AZ	130.3863	EL 76.8702
			40	36	21	23	WIND	12.60	DIR	242	

NO CHECK: rx

Mark 5 Remaining Capacity

		VSN	Time	GB	%	Check UT
>	A	BKG+0146	06h29m	2989.675	74.7	07:58:00
	B					07:58:00

System Temperatures

Tsys	39.95 (IFA)	36.17 (IFB)
	20.56 (IFC)	23.35 (IFD)

BBC	Freq	Ts-U	Ts-L
01	132.99	52.3	49.1
02	172.99	50.9	
03	272.99	47.4	
04	432.99	52.5	
05	652.99	59.7	
06	772.99	56.0	
07	832.99	63.4	
08	852.99	66.0	64.1
09	205.99	26.8	
10	225.99	25.6	
11	245.99	25.0	
12	275.99	24.0	
13	325.99	24.3	
14	345.99	24.8	
15	0.00		

Phase Cal Monitoring

	Amp	Phase	Time
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			

Antenna Monitoring

TTW1 ([2018].148.11:49:17:287 (Offset: 0 msec))

Azimuth		Elevation
90.4813	Actual Pos.	15.0887
	Pos. Graph	
90.4813	Commanded Pos.	15.0887
130.3890	NASA FS Pos.	76.8707
0.0000	Com. Pos. Offset	0.0000
STOP	Status	STOP

Status messages

[Azimuth] Stop; Stow position; Stow pin retracted

[General] ACU type: TTW; Master-Slave-Mode: Off; Reduced internal limits che

[Elevation] Stop; Stow position; Stow pin retracted

Error messages

Log

Error:
2018.145.15:13:03.26?ERROR qo -301 WARNING: ONSOURCE status is SLEWING!
2018.145.15:13:13.76?ERROR qo -301 WARNING: ONSOURCE status is SLEWING!
2018.145.18:43:33.29?ERROR m5 -900 : Can't do calculations
2018.145.18:43:33.29?ERROR m5 -906 MARK5 return code 6: inconsistent or conflicting request
2018.148.06:45:02.01?ERROR 5h -302 background Mark 5 error(s) detected - see below

Log:
2018.148.07:59:43.53;horizon1,0.,10.,360.
2018.148.07:59:43.53;antenna,13.2,720.0,360.0,-90.0,450.0,5.0,115.0,azel
2018.148.07:59:43.53;equip,dbbc_ddc,mk5b,none,none,500.10,3,a/d,101,60,20,none,41,1,in,8bit,cdp,3,return,v105_1,v12,1,1,1,1,15000,15000,15000,15000,32,vsi1-2
2018.148.07:59:43.53;time,0.000,1.000,computer
2018.148.07:59:43.53;flagr,0

Mark 5 Remaining Capacity

Webcam

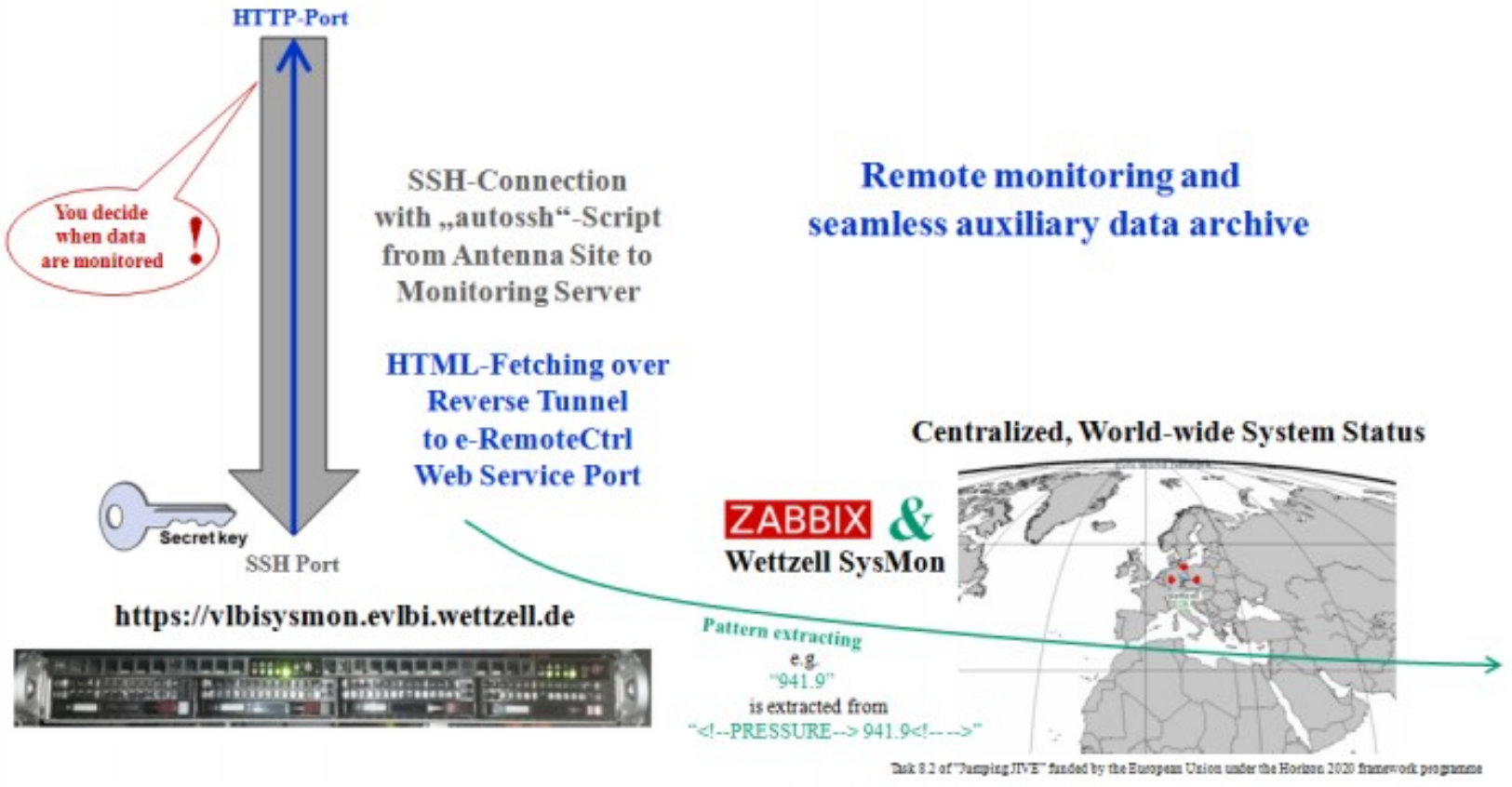
Antenna Monitoring

plus individual **Station Monitoring**

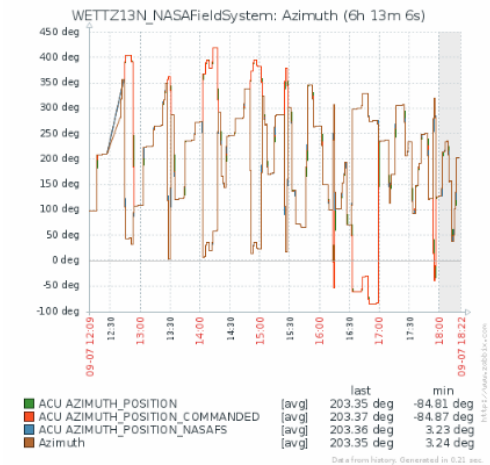
- Field System acts as web server
- Web pages can be used independently and directly at the observatory
- Field system status on a web browser
- Information tagged to be used by scripts and by a central monitoring

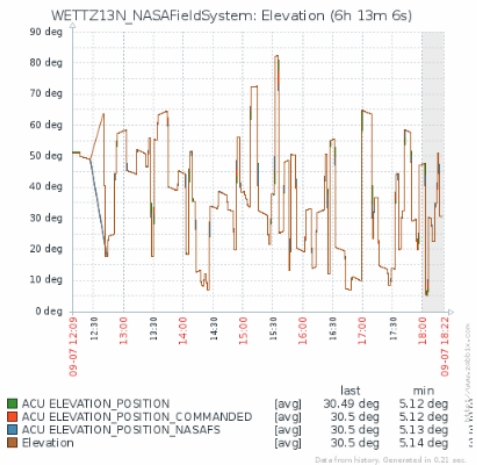
Observatory

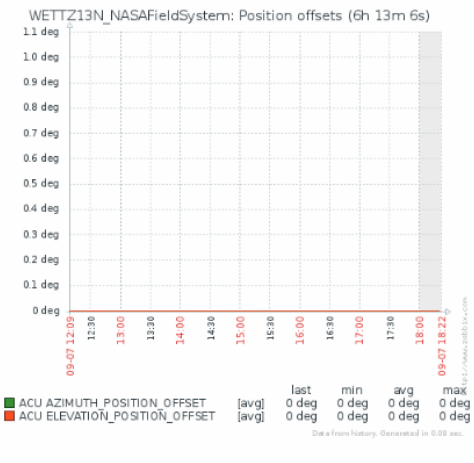
Open an SSH connection with individual reverse tunnels

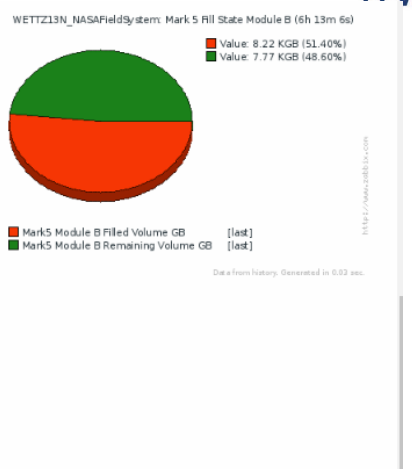


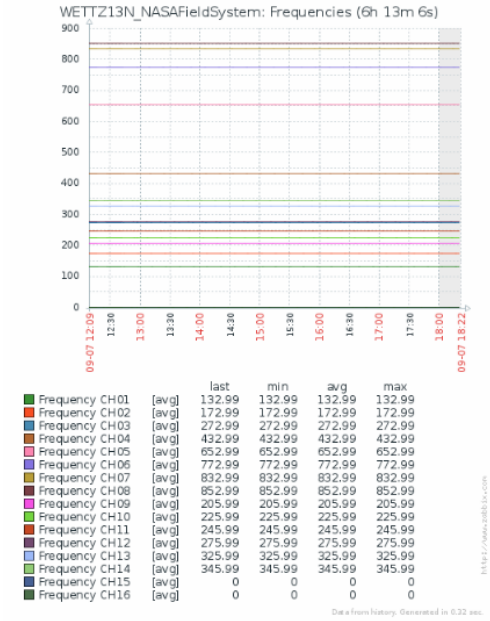
Over 170 parameters from the Field System can be monitored and plotted

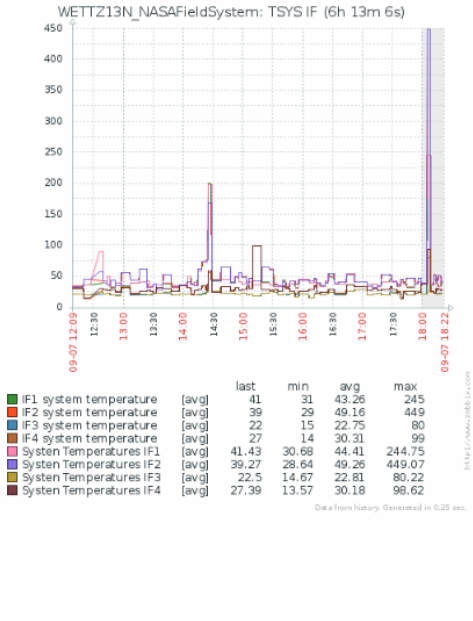


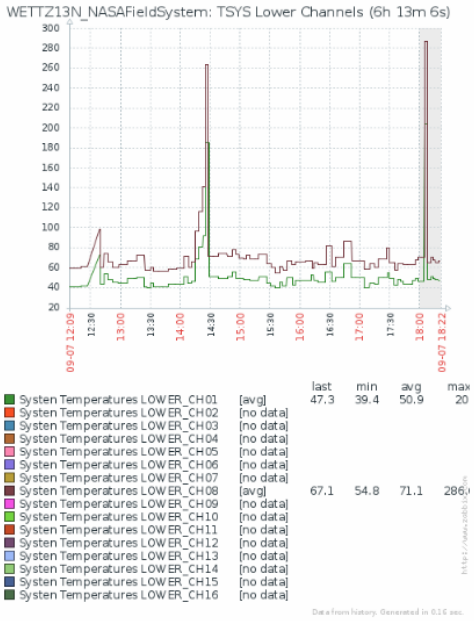


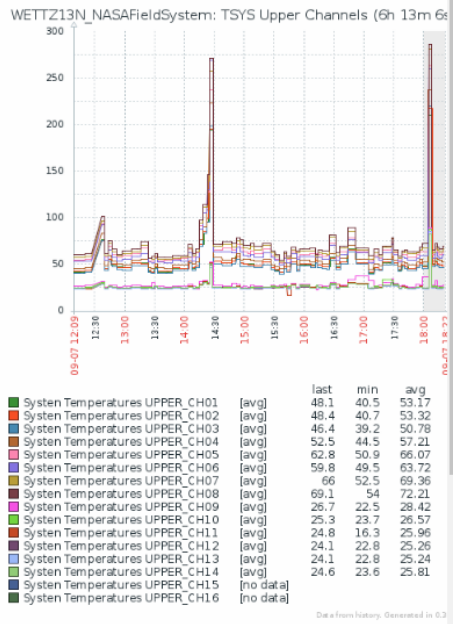












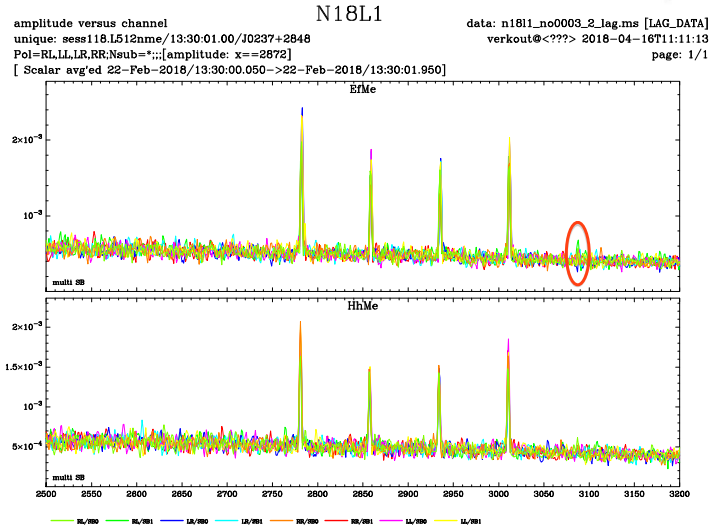
Now: tests with stations

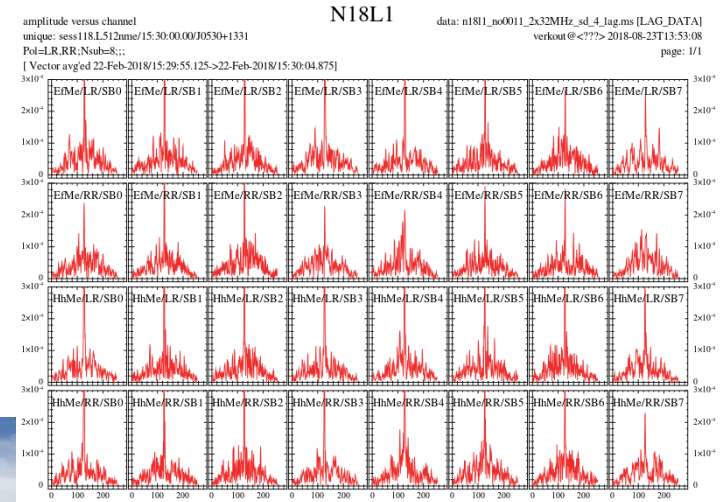
KAT7 VLBI

- Now: MeerKAT VLBI

- Beamformed MeerKAT data:
  - Nice fringes!
  - But, unfortunately, too many….
  - Something fishy with beamformer
- Single dish:
  - Fringes with Ef and Hh!

- Beamformer code has been modified since
  - Will attempt to record some data again during next session





WP5 - CLEOPATRA: Connecting Locations of ESFRI Observatories and Partners in Astronomy for Timing and Real-time Alerts

- Led by JIVE
- Time and frequency transfer
- relaying alerts (warning system for transient events, also in EVN)
- data streaming software (builds on Jive5ab experience)
- advanced scheduling algorithms for complex, large arrays (mainly for SKA, CTA)

- Follow-up project ESCAPE
  - Has been approved: 15 Meuro
  - Deals with European Open Science Cloud (EOSC)
  - ASTERICS partners + ESO, CERN, SKA

PoC1+PoC2

Dwingeloo

CAMRAS

Existing data link

Correlator

Zwiggelte

WSRT

H-maser

WRE Switch LJD

Tx1

Rx2

OSC Tx

OSC band

DWDM node Tx

C-band

DWDM node Rx

C-band

OSC Rx

OSC band

Bidi Amplifier

35 km
-10 dB

Clean-up oscillator

WRE Switch LJD

Tx2

Rx1

Buinen

Lofar

DF

Clean-up oscillator

WRE Switch

Tx4

Rx3

*65 km
-17 dB

Groningen

65 km
-17 dB

OSC Tx

DWDM node Tx

C-band

DWDM node Rx

C-band

OSC Rx

Rx2

Tx1

Tx3

Rx4

WRE Switch LJD

Tx2

Rx1

*Estimated