TOG web pages

EVN pages: http://www.evlbi.org/

Radionet wiki: https://radiowiki.mpifr-bonn.mpg.de/doku.php?id=na:sustainability:tog:2018_10:tog-agenda-2018-10

Radionet indico:https://events.mpifr-bonn.mpg.de/indico/event/72/

MPIfR Deki: https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG

Agenda

Action Items

- **All: Beam-maps** at L- and C-band and send them to Keimpema. https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Beam_maps (last updated Nov 2017: Bd, Sv)
- **Szomoru:** ask Keimpema to re-send email to stations requesting beam maps
- **All:** Upgrade to **SDK9.4** first at the correlators then at the stations. (Mark5 stations!!)
- **All:** 80 Hz **continuous calibration**. Update the table: https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Continuous_calibration_%2880_Hz%29 (last updated April 2017!!)
- **All:** Provide frequency information of the stations to de Vicente
- **All:** If a station is not buying a FlexBuff, purchase disk packs (Stations were contacted)
- **All:** Pay attention to autocorrelation plots
- **Blanchard:** Collect cases of bandpass dips to present to G. Tuccari
- **Rottman:** define proper release policy for release of firmware versions

Action Items

- **Vicente:** Talk to Himwich possibility to inject opacity information in FS logs.
- **Jung**: write down instructions for high frequency/opacity corrections. Circulate among EVN.
- **Blanchard**: come up with a method to use correction solutions of good stations for bad stations
- **Blanchard**: compare amplitude calibration results from both continuum calibration scripts.
- **All**: everybody to switch to DBBC Fila10G firmware
- **All**: everybody to use last Fila10G firmware
- **Bach:** schedule 43 GHz test in May
- **Vicente:** Contact stations and work out how to ship RFI equipment (BRAND project)
- **Szomoru**: contact KVAZAR network when the next e-VLBI session date is known for possible participation.
- **Bach**: find out which stations can match the observing band for 4 Gbps observing.
- **Blanchard:** setup EVN Github.

Action Items

Tables with current status at stations:

https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Continuous_calibration_(80_Hz)

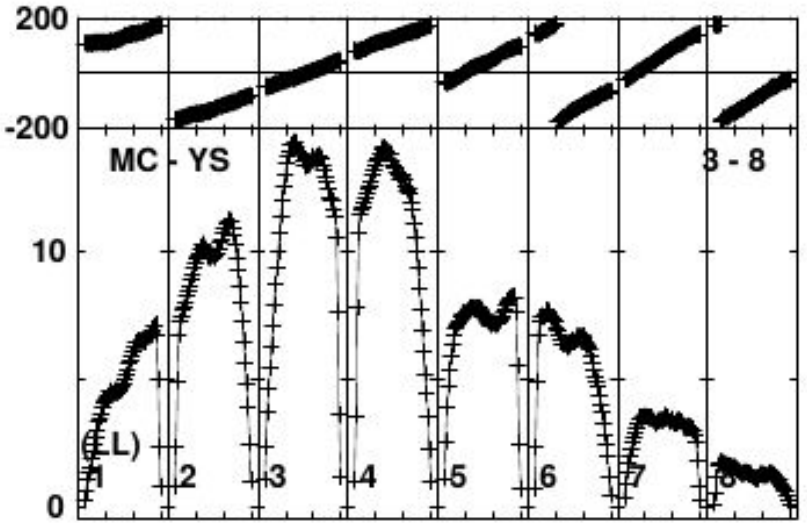
https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Beam_maps

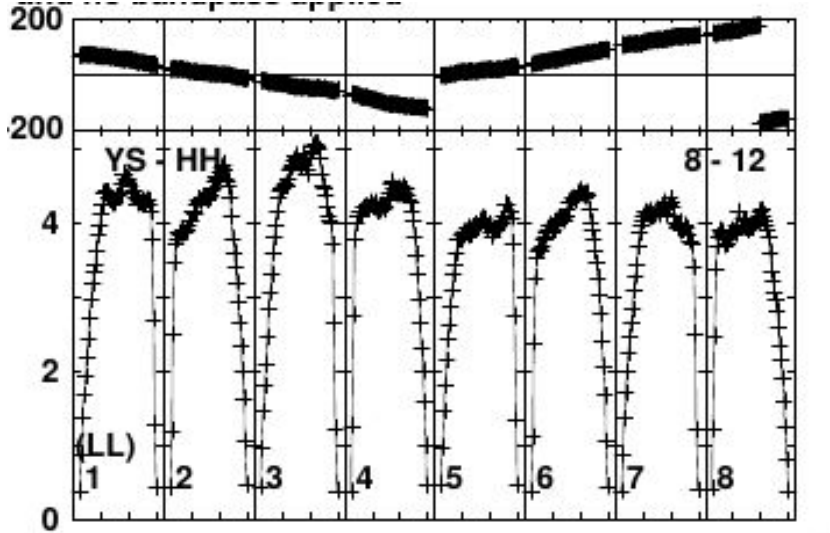
Permanent Action Items

https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Permanent_Action_Items

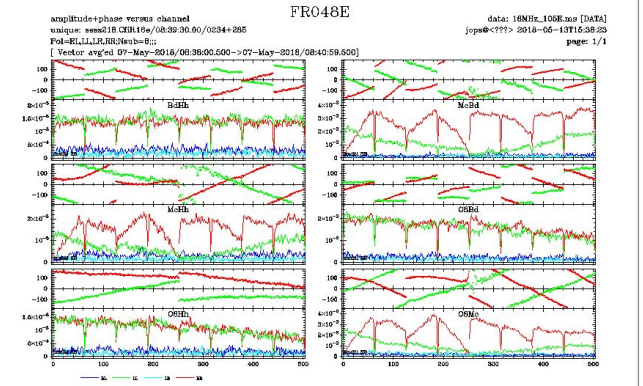
- Contact information
- EVNtech e-mail exploder
- TOG-meetings
- The block schedule
- EVN disk-pack pool
- Disk-pack shipment
- GPS-Maser reading
- In advance of session
- Session preparation
- During sessions
- Post session feedback
- Post-processing
- e-VLBI
- EVN spare parts
- Receiver Frequency Information

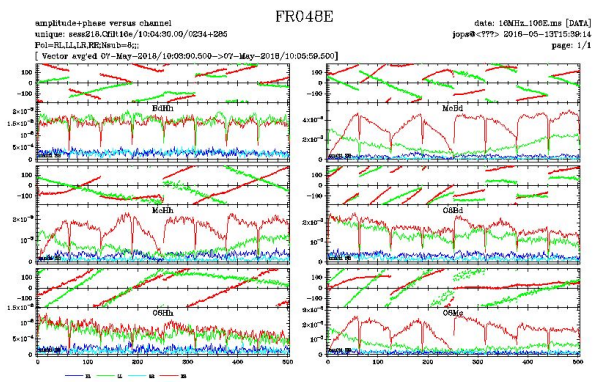
The 2 Gbps DDC problem

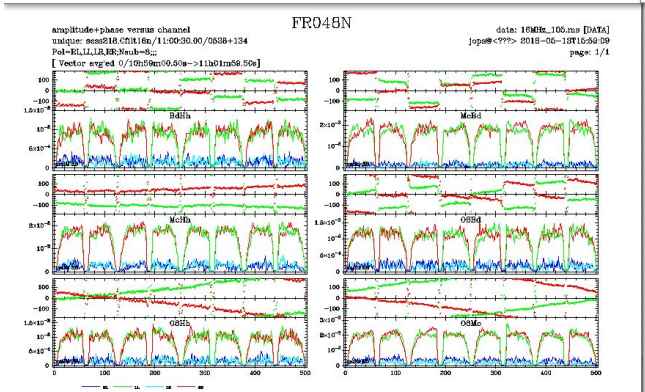


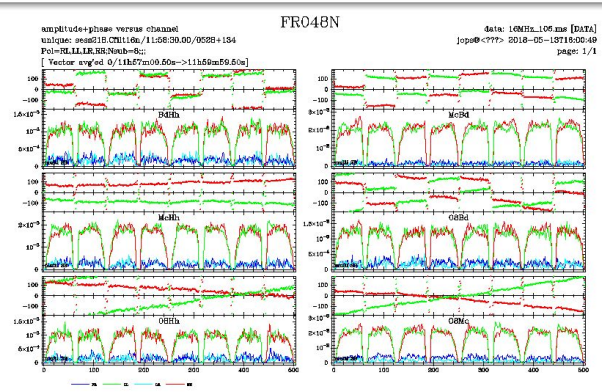


The 2 Gbps DDC problem





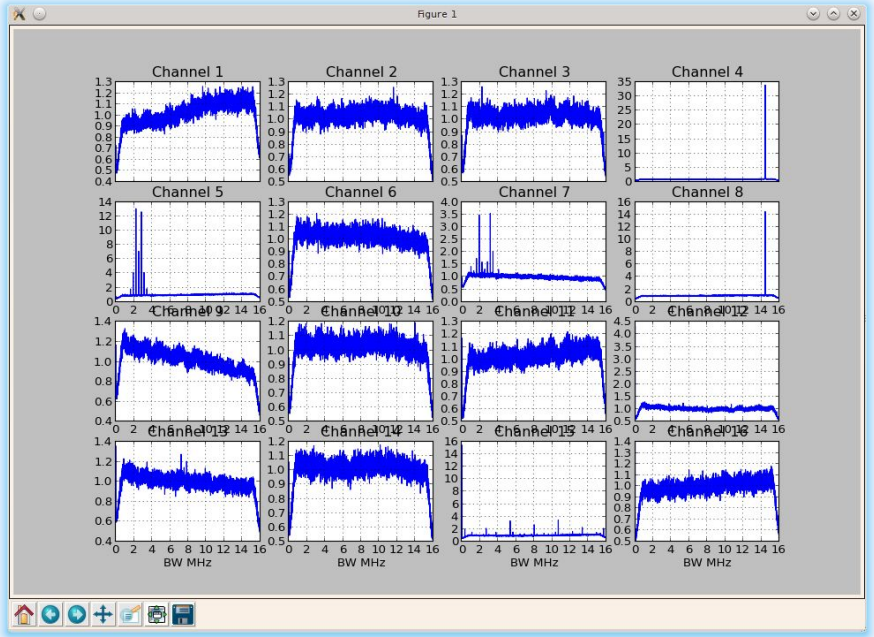


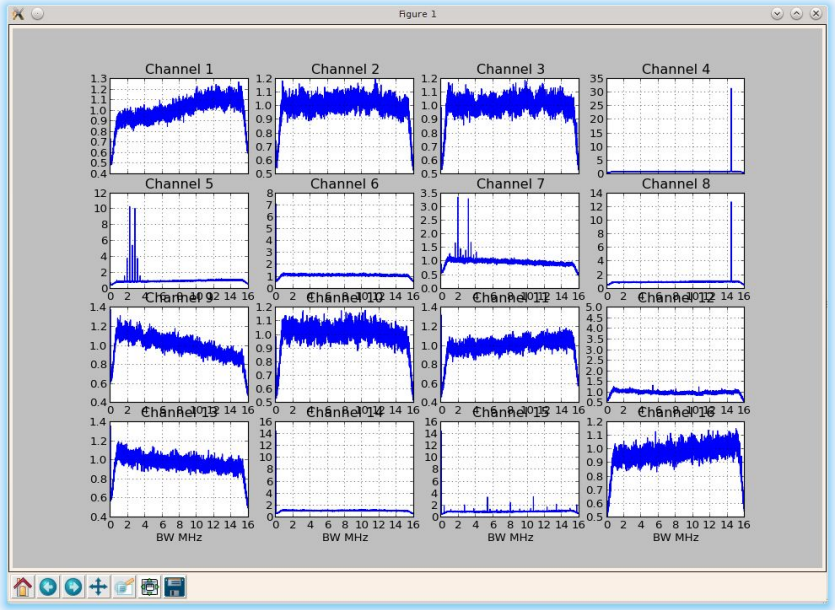


The 2 Gbps DDC problem

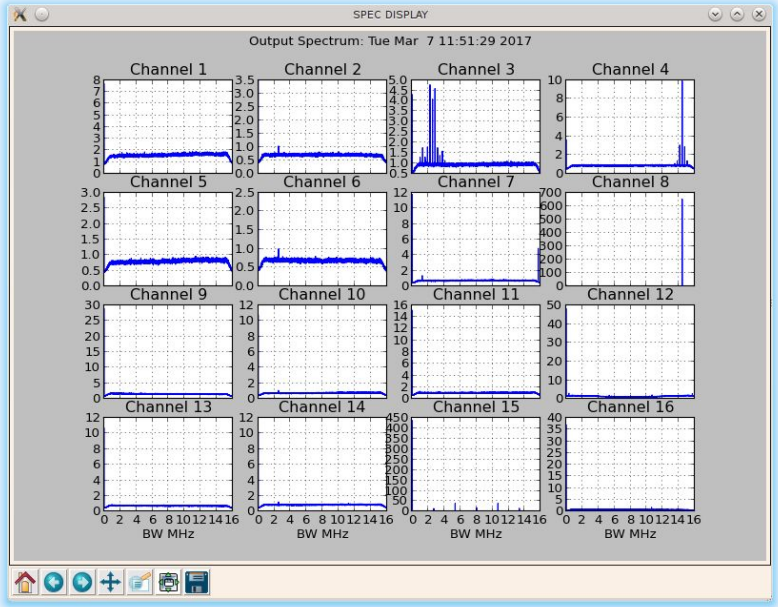
- Lack of amplitude flatness across the band
- Noisy phase
- It appears in DBBC2 stations using DDC versions: v105-e and v106-e
- Apparently v106e is worse than v105e.
- Non uniform behaviour across the stations.
- 2 Gbps uses a 256 MHz clock in the CORE boards.
- Related to the spikes in the autocorrelation plots?

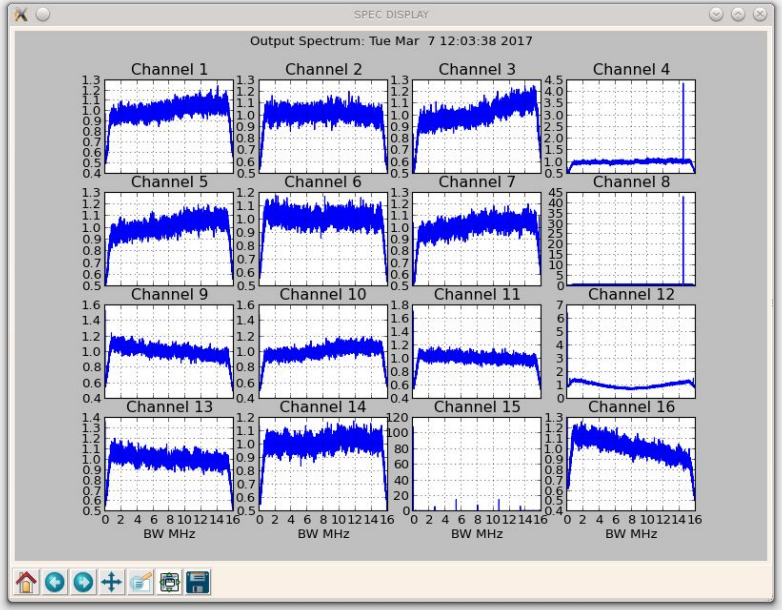
DBBC2 Issues





DBBC2 Issues

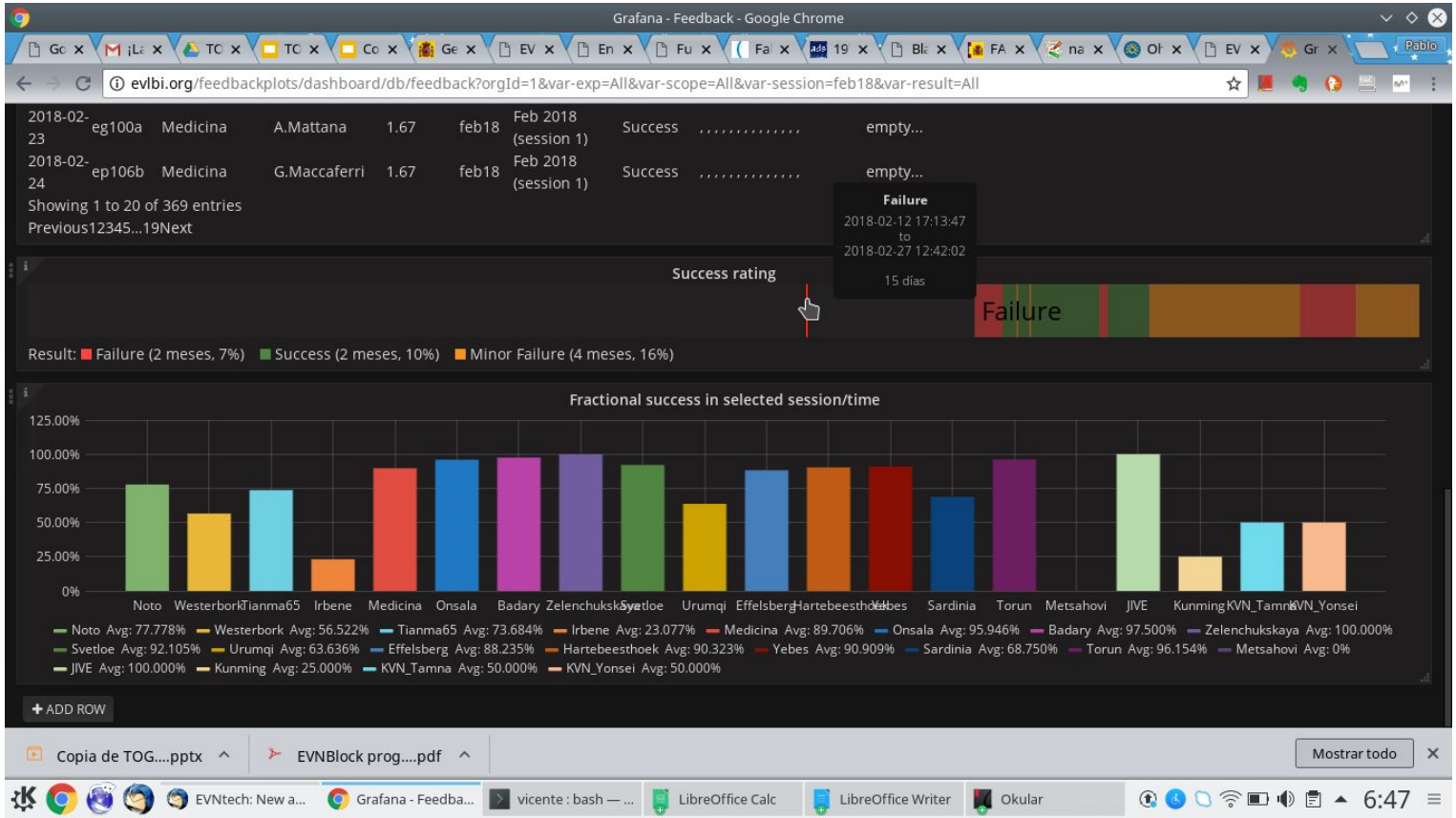




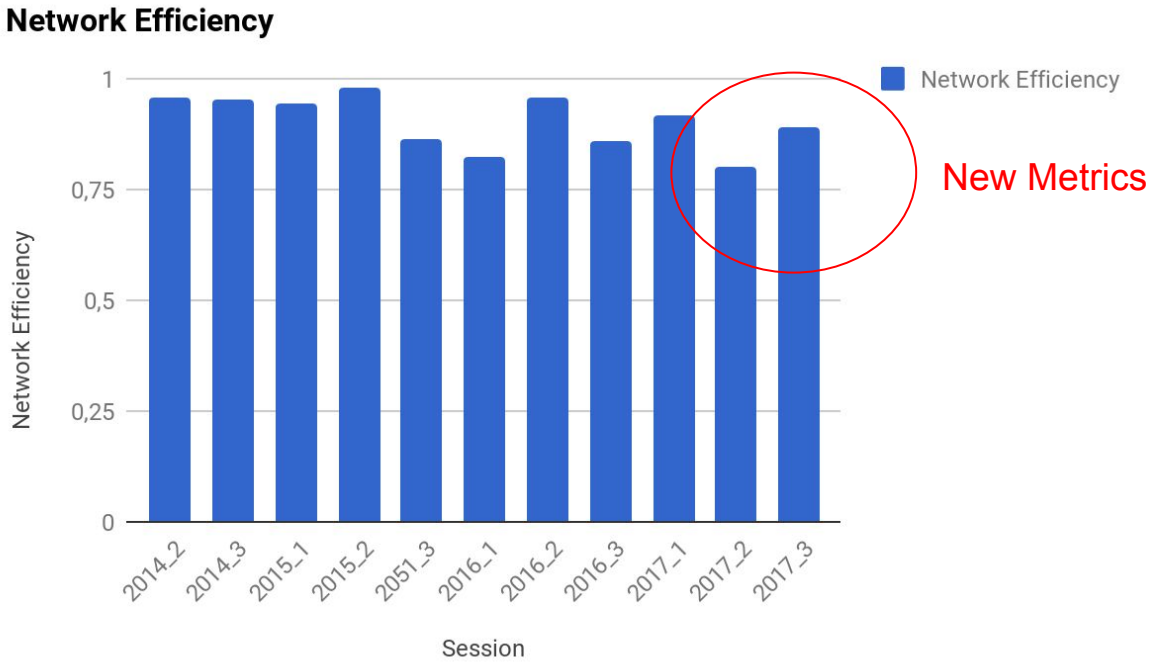
Network efficiency

Information to be get from
Grafana

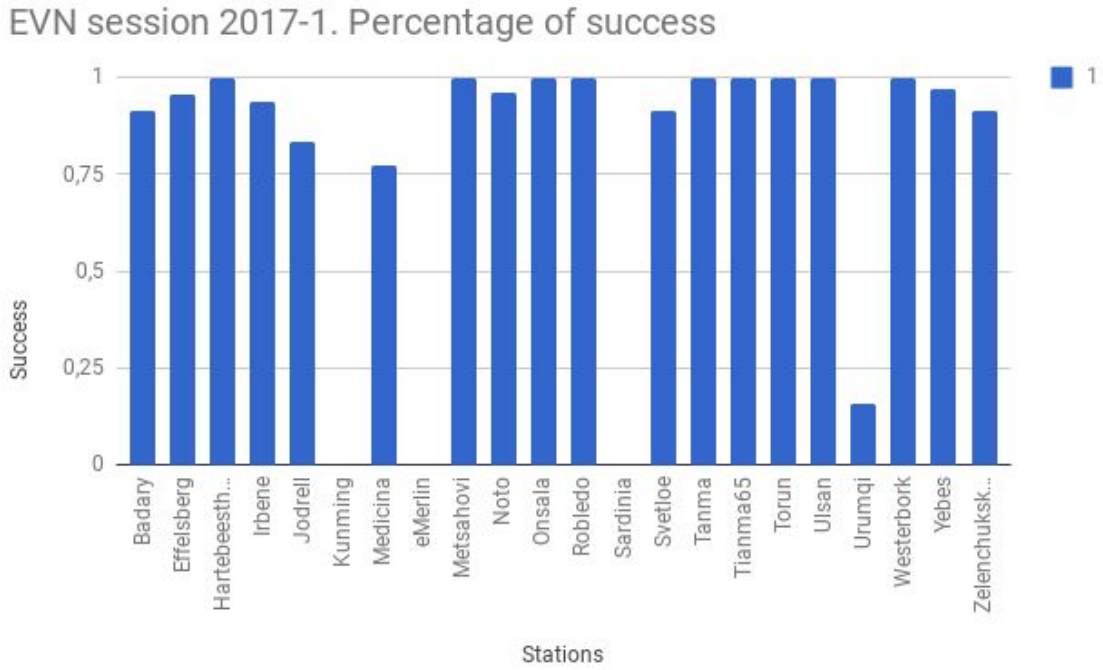
Network efficiency



Network efficiency



Network efficiency



Amplitude calibration

- Continuous calibration
  - Ef, Mc, Mh, Nt, On, Ro, Ys
  - Sr (soon)
- What is required:
  - a switched controlled noise diode
  - a reference signal: 10 - 100 Hz
  - a backend that can detect synchronously the signal:
    - DBBC2, DPV
    - MDBE should support it. CDAS? KVN backend?

V107 firmware version

- New Beta version to solve V105 & V106 issues
- Works with an internal 128 MHz clock (**NO 256 MHz**)
- Backwards compatible. Same commands
- BWs: 4 MHz, 8 MHz, 16 MHz, 32 MHz, 64 MHz
- Clocks: 32, 64 and 128 MHz.
- Slight difference in the cal_on and cal_off commands.
- Allows 8 Gbps!! => 1 GHz = 500 + 500 MHz / polarization

- Test with 3 stations in October 2018.
- Test with more stations in November 2018.
- Implement in EVN session 2018-1

wastro mode

- **Available in V105, V106 and V107 (No E)**
- Internal clock: 128 MHz.
- 16 channels x 16 MHz x 2 bands (V105 & V106). Total: 2 Gbps
- It uses both VSI channels
- Issues:
  - FS Drudg
  - FS amplitude calibration
- Possibly to be supported in next FS release

VLBI Backends

- DBBC2:
  - issues with software/firmware
- DBBC3:
  - Only 2 stations: Ef, Ys
  - On (Geodesy), Tr 2019)
  - Not operative yet. Backward compatible tests to be started soon.
- MDBE: (IAA) new backend. Starting by end of 2018
- OCTAD: (KVN) Ready and being tested.
- CDAS: No news (as far as I know)

2 Gbps versus 1 Gbps experiments

EVN session	2048 Mbps exps.	1024 Mbps exps.	< 1024 Mbps exps.
2016-1	1	11	12
2016-2	1	11	19
2016-3	5	17	6
2017-1	3	30	6
2017-2	4	19	7
2017-3	4	15	9
2018-1	5	12	9
2018-2	0	18	9

Estimation of required space
2 Gbps

- Bob Campbell's estimation of required disk space for 2 Gbps observations assuming all continuum experiments are done at 2 Gbps. Units are TB

Session	Ef 2Gbps	Ef aprov.	Ef obs.	All 2gbps	All aprov.	All obs.
2016-3	183	109	103	2609	1547	1481
2017-1	178	91	86	3008	1628	1544
2017-2	174	97	94	2572	1491	1436
2017-3	258	147	135	4282	2359	2166

Disk investment & Flexbuff upgrades

- The budget is 7000 € / year for disk space.
- Ideally for 2 Gb/s there should be: 200 TB x 2 session / station => Upgrade the Flexbuff correlator
- Use 4, 6, 8 or 10 TB disks to populate disk packs.
- Please fill in **both** tables: https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Disk_Inventory

Disk investments

Disk purchases for disk-packs

The directors agreed in 2011 that each station should buy disk-modules for 7000 € per year.

Year	Ef	Hh	Jb	KVAZAR	Mc	Mh	Nt	On	Sh+T6	Sr	Tr	Ur	Wb	Ys	Total (TB)
2011	32	80	48	48		12								24	196
2012	64	40	80	112	32		64	80					32		504
2013	80	64	80		48	32	64	80		16	40	96	32		632
2014	96		150		32	16	72	150		112			152	72	848
2015		160	192		64		32	192					96	96	832
2016					96						64		288*		448
2017	160										40		120*		40
2018													240*	128*	368
Total (TB)	272	344	550	160	272	60	232	502		128	144	96	960	310	**4208**

Disk investments

Flexbuf purchases (disk space)

In 2016 the TOG agreed that the 7000 € per year investment per station could be used either for Flexbuff space or disk packs. The CBD supported this policy

Year	Ef (S+J)		Hh (S+J)		KVAZAR	Ir (S+J)		Jb (S+J)		Mc (S+J)		Mh (S+J)		Nt (S+J)		On (S+J)		Wb (S+J)		Ys (S+J)		Total (1)
2015	128															324						452
2016		144	144	288													(144)			216	144	865
2017	192							186	288	160	120			160	120				288			834
2018					80	288	288	80				103					360				360	
Total (TB)	464		346		80	576		486		244		196		244		684		202		468		2657

Notes:

Disk purchase commitment (TB)

Station/correltor	Disks bought for pool (2014)	To be supplied by mid 2019	Disks to buy for pool and FB (2019)
On	342	261	
Ef	256	321	
Jb+eMerlin	630	500	
Mc, Nt, Sr	216	849	
Ys	168	382	
Wb	536	125	
Hh	160	388	

Disk purchase commitment (TB)

Station/correltor	Disks bought for pool (2014)	To be supplied by mid 2019	Disks to buy for pool and FB (2019)
Ir	0		360
Tianma	0		360
Urumqi	0		360
Torun	104		256
Quasar	0		1080

Flexbuff adoption at stations

Station	Local capacity	Capacity at correlator
Effelsberg	290 TB	101 TB
Metsähovi	95 TB	-
Hartebeesthoek	105 TB	202 TB
Onsala	324 TB	253 TB
Yebes	288 TB	253 TB
Medicina	360 TB	210 TB
Noto	360 TB	253 TB
Westerbork	-	202 TB?
Jodrell	276 TB	202 TB
Irbene	280 TB	253 TB
Tianma	240 TB	-

Flexbuff adoption at stations

Station	Local capacity	Capacity at correlator
JIVE		211 TB
JIVE		253 TB
JIVE		253 TB
JIVE		253 TB
JIVE		253 TB

IAA-QUASAR: 80 TB
KVN: 100 TB

Usage of Mark6

- Mark6 can be used as a Flexbuff but it requires a high speed connection
- No speed connection => Ship packs
- **Km:** will use Mark6. No good internet connection
- **VLBA:** will move towards using Mark6 recorders. No high speed connection
  - Potential solutions:
    - Use mark5C for globals. Short term solution
    - Some high speed internet connections (mentioned at IVS)
    - 1 Mark6 units at JIVE. Shipping packs.

2 Gbps status

Station	Recorded	Limitation	eVLBI	Limitation
Arecibo	2 Gbps	Backend	512 Mbps	Connection
Badary	2 Gbps		1.7 Gbps	Backend/Conn.
Effelsberg	2 Gbps		2 Gbps	
HartRAO	2 Gbps		2 Gbps	
Irbene	2 Gbps		2 Gbps	
Jodrell	2 Gbps		2 Gbps	
Kunming	2 Gbps		?	Backend/Conn
Medicina	2 Gbps		2 Gbps	
Metsähovi	2 Gbps		2 Gbps	More tests needed
Noto	2 Gbps		2 Gbps	
Onsala	2 Gbps		2 Gbps	
Robledo	2 Gbps		?	Connection

2 Gbps

Station	Recorded	Limitation	eVLBI	Limitation
Robledo	2 Gbps		?	Connection
Sardinia	2 Gbps		1 Gbps	Connection
Svetloe	2 Gbps		64 Mbps?	Never tested
T6 (Shanghai)	2 Gbps		2 Gbps	Backend
Tamna	2 Gbps		2 Gbps	Not tested
Torun	1 Gbps	Backend	1 Gbps	Backend
Ulsan	2 Gbps		2 Gbps	Not tested
Urumqi	2 Gbps	Not tested	1 Gbps?	Connection
Westerbork	1.6 Gbps	frontend/backend	1 Gbps	Backend
Yebes	2 Gbps		2 Gbps	
Yonsei	2 Gbps		2 Gbps	Not tested
Zelenchukskaya	2 Gbps		1.7 Gbps	Backend/Conn.

Towards 4-8 Gbps operations

- **Hardware requirements**:
  - 512 MHz x 2 pols
  - DBBC2 (2/4 COREs) + Fila10G (2 COREs > no cont. cal)
  - **PFB firmware**
  - Common LO at the stations (Please fill in the table at the TOG wiki)

  - **DDC firmware**
  - DBBC2 4 COREs + Fila10G
  - DDC V107 mode

Towards 4-8 Gbps operations

- Schedule a new 4 Gbps test in November 2018.
- Schedule a new 8 Gbps test in December 2018.
- Changes at the FS and/or or DBBC2 procedures to adapt to
  - 16 channels x 32 MHz
  - 16 channels x 64 MHz
- Changes at the correlator?

32 Gbps test for 2019

- A request from the EVN CBD to explore the feasibility
- Requires: DBBC3. PFB or DDC or DSC
- Frequency band:
  - 4-8 GHz (1st option)
  - 20-24 GHz (2nd option)
- 3 stations: tose with DBBC3
- Correlator implications
- Disk space (but only to demonstrate the feasibility)
- Scheduling and FS
- Plan with incremental steps:
  - 4 Gbps (DDC & PFB)
  - 8 Gbps
  - 16 Gbps (1 recorder x 2 optical fibers, 2 recorders x 1 optical fiber)
  - 32 Gbps (2 recorders x 4 optical fibers, 4 recorders x 1 optical fiber)

Developments. Long term plan

Overall EVN goals need to be adapted to each individual station

- Possible goals for **2018**:
  - All EVN telescope capable of doing e-VLBI at least @ 1 Gb/s
  - Upgrades at the correlator. Using Uniboard
  - RFI studies at stations
  - Start first DBBC3 tests (high recording rates) at some telescopes

Developments. Long term plan

- Possible goals for **2019**:
  - All EVN telescopes capable of doing e-VLBI @ 2 Gb/s
  - VDIF implementation at all telescopes.
  - Non DBBC backends: RAS, CDAS & KDAS
  - Continuum cal at all EVN telescopes
  - Recorded VLBI at 4 Gb/s
  - Storage: 400 TB / station (2 sessions)
  - Tunable LOs to be able to use PFB mode

Developments. Long term plan

- Possible goals for **2020**:
  - 4 Gb/s eVLBI
  - 32 Gb/s recording rates at as many EVN telescopes as possible (DBBC3)
  - Optical fiber high bandwidth IF transmission at the telescopes

- Possible goals for **2021**:
  - Low frequency Broad band Receiver (prototype): 2-15 GHz
  - High frequency broad band receiver: 22/43 GHz

EVN Science document.
Technical chapter

- Coordinated by A. Szomoru
- Main developments
  - New telescopes
  - Extending e-EVN
  - EVN-light and fast response
  - Wider bandwidths
  - Backends: higher rates and flexibility
  - RFI. Radio Frequency Interference
  - A world network
  - Scheduling, monitoring and the FS
- Goals for
  - next 5 years
  - next 10 years