Expanding the Bonn Correlator for VGOS and summary of recent activities

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Introduction

- Bonn correlator operated by
  - MPIfR
  - BKG
  - IGG
- Highlights since last meeting
  - CONT14
  - Rebuilding of correlator room for Mark 6
  - Procurement of new cluster in Q3/2015
  - RadioAstron correlation
  - 1mm VLBI correlation

Present status I

- DiFX 2.4
  - trunk available (also others)
  - RadioAstron branch
    - Developed by J. Anderson (MPIfR, now GFZ)
- Database for exp status and disks
- Archive server of MPIfR
- Data export in HOPS and FITS format
- PIMA fringe fitting
  - With support from ASC and L.Petrov
- Planned: playback native Mark 6 mode
  - Multiple data streams/dual thread per station

Present status II

- Experiment preparation and postprocessing
  - Alessandra Bertarini, Laura La Porta, Simone Bernhart (geodesy)
  - Scheduling of IVS Euro/Int/T2: Arno Müskens
  - Alessandra Bertarini, Helge Rottmann, Gabriele Bruni (astro)
- Software and Cluster maintenance
  - Helge Rottmann, Walter Alef
  - Rolf Märtens, Heinz Fuchs
  - Support from MPIfR computer division

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Present status III

- Cluster erected in 2007/2008
- Cluster w/ 58 nodes (464 cores)
  - 484 TB disk space
    - + 10 TB correlation, 20 TB backup
  - 20 Gbps Infiniband
- 15 Mark 5 units
  - Playback all of 5A, 5B, 5C
- 1 Mark 6
  - Playback with VDIFuse

Correlator usage I 2013/14

- Geodesy:
  - 94 R1
  - 12 EURO
  - 6 T2
  - 10 OHIG
  - 81 INT3 (in eVLBI mode)
  - 1 CONT14 (14 days)
  - several additional correlations for DBBC testing (Onsala, Yebes, Wettzell)
  - Note: Only few stations send modules anymore

Correlator usage II 2013/14

- Astronomy:
  - GMVA (3mm-VLBI): 2 session/y 2 x ≤ 5 days
    - ≤ 15 antennas
    - 2 Gbps (~ 500 TB disks)
  - RadioAstron: 9 observations
    - 128/256 Mbps
    - ≤ 20 antennas, full track
    - At least 2 passes
      - search RA clock/scan using big telescopes
      - Normal production (possibly improve satellite orbit)
  - 1mm-VLBI: APEX, EHT @ 16 Gbps
  - Other MPI-based VLBI

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CONT14

- **14 days non-stop** campaign
  - starting **May, 6th at UT 0:00:00**
- **17 stations:**
  - Badary, Fortleza, Hobart12, Hobart26, Hart15m, Katherine, Kokee, Matera, Nyalesund, Onsala, Tsukuba, Westford, Warkworth, Wettzell, Yarragadee, Yebes, Zelenchukskaya
- **set-up:**
  - S- and X-band,
  - 16 channels x 8 MHz bandwidth,
  - 512 Mbps

CONT14 to Bonn

- 20.03.2014 USNO officially announced that the WACO DiFX correlator would not be ready for correlation of CONT14
  - Bonn volunteered to help out
  - IVS requested Bonn to correlate CONT14
- 21.03.2014 held first meeting to organize:
  - storage space in Bonn, TB?
  - bandwidth for e-transfers, < 1 Gbps
  - module shipment
  - correlator schedule
  - upgrade of Mark 5 units SDK to version 9.3a, > 1024 scans
  - semi-real-time fringe test at the beginning
  - correlation set-up
  - post-processing requirements

CONT14 – eVLBI

- 9 eVLBI stations require total of ~ 260 TB
- Total storage space for geodesy at the correlator ~ 138 TB
- Additional storage organised → ~ 590 TB
- 2 weeks before CONT14 suspended e-transfers to Bonn
- Defined and optimised eVLBI schedule
  - Various criteria had to be taken into account

CONT14 – correlation

- First CONT ever to be correlated with the DiFX software correlator!!
  - Up to CONT11 MK IV had been used
- First time: no multi-pass correlation required !!
- Parameters for correlation:
  - No. of spectral channels = 32
  - Integration time = 1s
  - clocks and drifts obtained by linear fitting clock values in station logs over several days
    - Take care of clock jumps!

CONT14 – correlation issues

- 09.05.2014: trial correlation
  - → problem reading data from some modules due to large directories (>1024 scans)
- 15.05.2014: Walter Brisken flew to Bonn and fixed the problem
- Mark 5-units often hanging
  - correlation could not run unattended
    - Night shifts and weekends: Alessandra, Laura, student
    - technical support by Helge and Walter A.

CONT14 – summary

- Routine activities at Bonn correlator suspended for about 2 months to process CONT14.
- ~200 TB of data e-transferred to Bonn
- Correlation time per “1 day” of the CONT14:
  - ~ 24h in case of no problems (rare)
  - On average ~48h, sometimes even longer.
- First version of the databases delivered within ~ 2 months.
- Resumed standard correlation 7.07.2014
- Post-processing operations completed January 2015
  - module shipments, free RAIDs on loan, data archiving, re-fringe-fitting by using multi-tone phase-cal extraction

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Rebuilding correlator room

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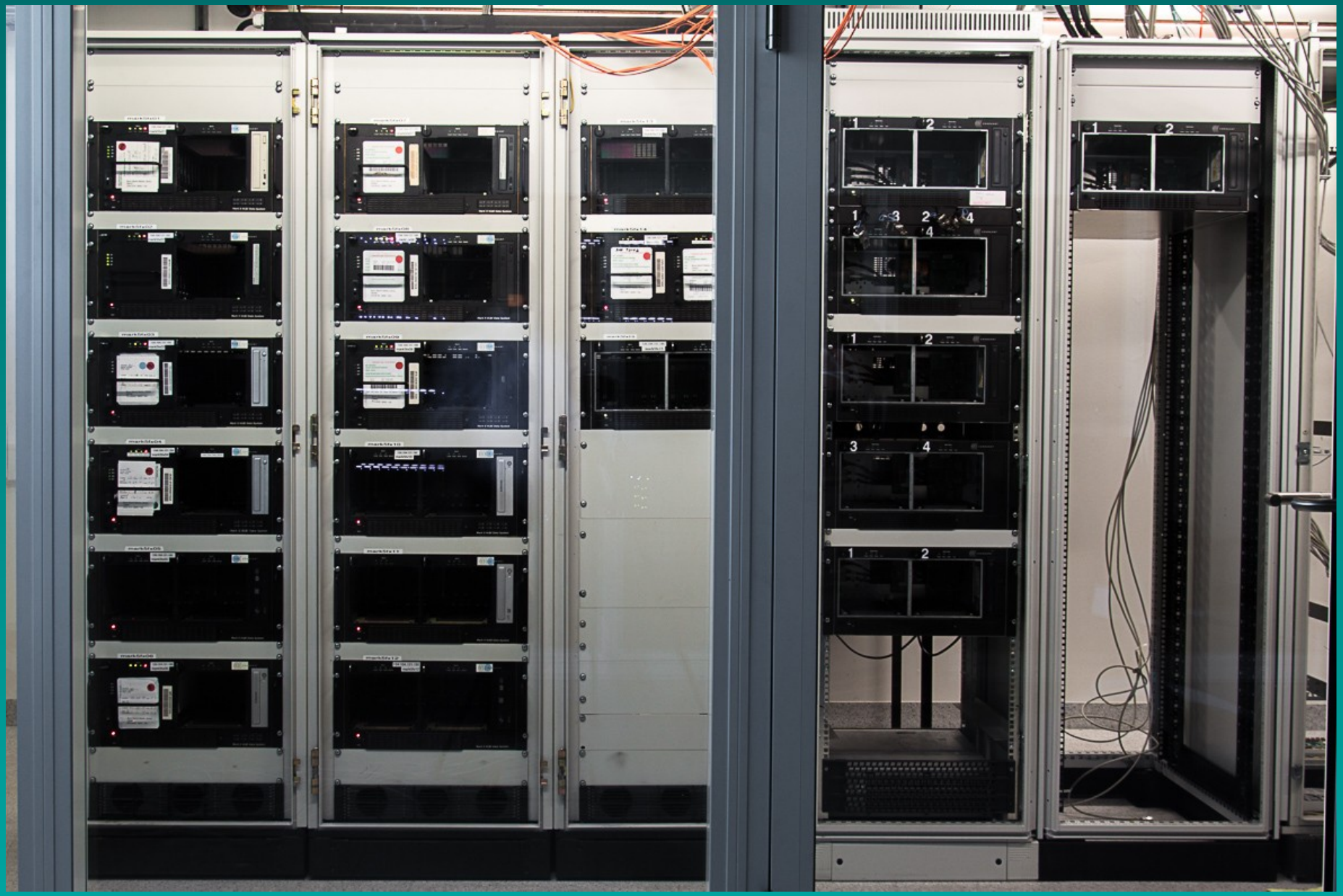
Rebuilding correlator room



New cluster – VGOS-ready

- XXX k€ +VAT granted from MPG
- XXX k€ promised by BKG
- Call for tender ~now
  - 60 nodes with 1440 cores
  - 2 RAIDS with ~ 300TB
  - 2 Head nodes
  - 56 Gb/s Infiniband (FDR)
- From old cluster:
  - 15 Mark 5, 6 Mark 6, some newer RAIDS (~800 TB total)
- **VGOS-ready !**

Cost of Internet lines

Present Internet connection 1 Gbps
- Special deal from 2007 (eVLBI hype)
- Cost 12 k€/y
- Speed 1 Gbps

Price list of DFN (German NREN) from 2014 (+ VAT):

Speed	Cost per year
1 Gbps	41.5 k€
2 Gbps	83.0 k€
4 Gbps	134.9 k€
10 Gbps	249.1 k€

So not VGOS-ready! Have to trust in module shipments
… but there is hope. Time will tell.