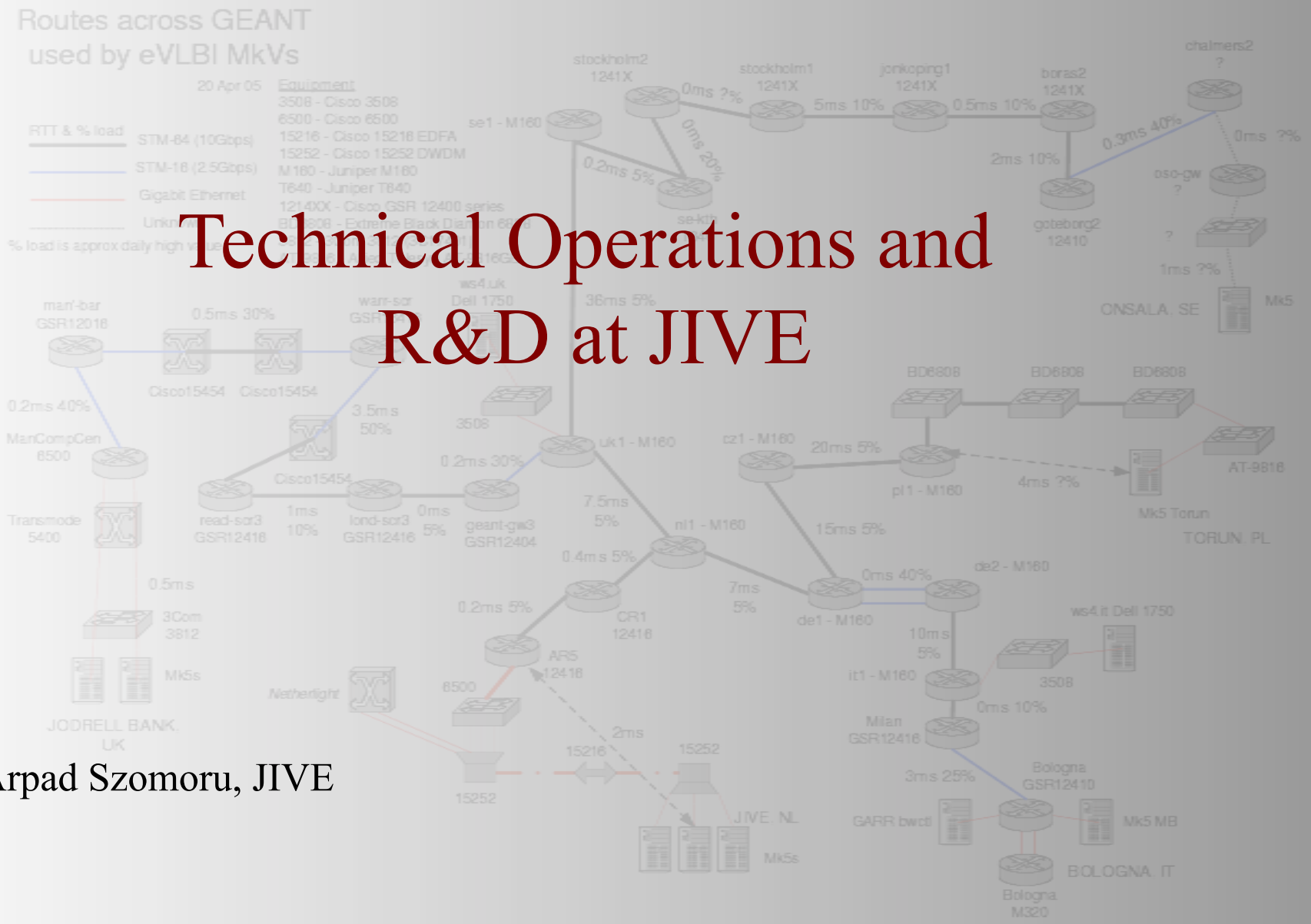


Technical Operations and R&D at JIVE

Arpad Szomoru, JIVE

Feedback from TOG vice-chair

Mark5 and SUs

- Mark5, general
  - All units equipped with 10G cards
  - All A have been converted to A+
  - Debian Etch, Sdk 8.1 on (nearly) all units
  - Sdk 8.2 to be rolled out soon (SATA!)
- Mark5B
  - 2 units permanently converted to B, more as needed
  - 1 extra unit currently B+, C possible
- SU
  - Donation of SU by MPIfR has helped!
  - As has the conversion of 2 Mk5s to B
- At stations:
  - FS/Sdk/OS versions listed on TOG wiki
  - Should all move to 8.2

Mark5B issues

- Mark5A+: works fine with MarkB e- and non-e-VLBI data

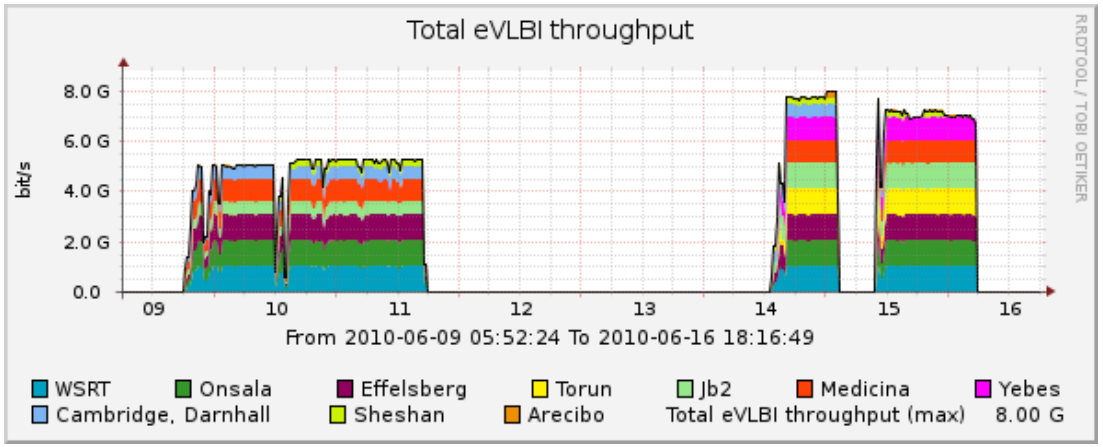
- Native Mark5B, disk-based:
  - Need exact byte number of start of header (at “data good”)
  - Expects perfect data or quits and goes home in a huff
  - Disk recordings unfortunately not always perfect...

- Native Mark5B, e-based:
  - Perfect data problem resolved on the fly
  - Problem with newest correlator control code
  - Culprit temporarily seconded to NRAO
  - Friso Olnon retiring end of July

e-status

- Full 1024 Mbps used operationally
  - through channel bonding, sharing of e-Lofar connectivity and regular switched connection
- Merlincast regularly used in science operations
- channel dropping used from Ys, Mc
- Sh currently limited to 256 Mbps
  - smooth fall-back from lightpath to switched
- Ar at 512 Mbps
- Hh under repair, expected back this year

- jive5A currently under revision
  - Multithreaded
  - channel dropping
  - Added functionality
  - version control
  - B+ capable



NEXPReS: EXPReS follow-up

- Through EXPReS e-VLBI has become a production mode of the EVN
- Follow-up through NEXPReS
- 4 Gbps data acquisition systems being deployed (dBBC, DBE, Mark5C)
  - (barely) doable using magnetic media
  - But easily accommodated on 10 Gbps networking architecture
  - And 100 Gbps Ethernet on the way
- SKA will not use disk packs

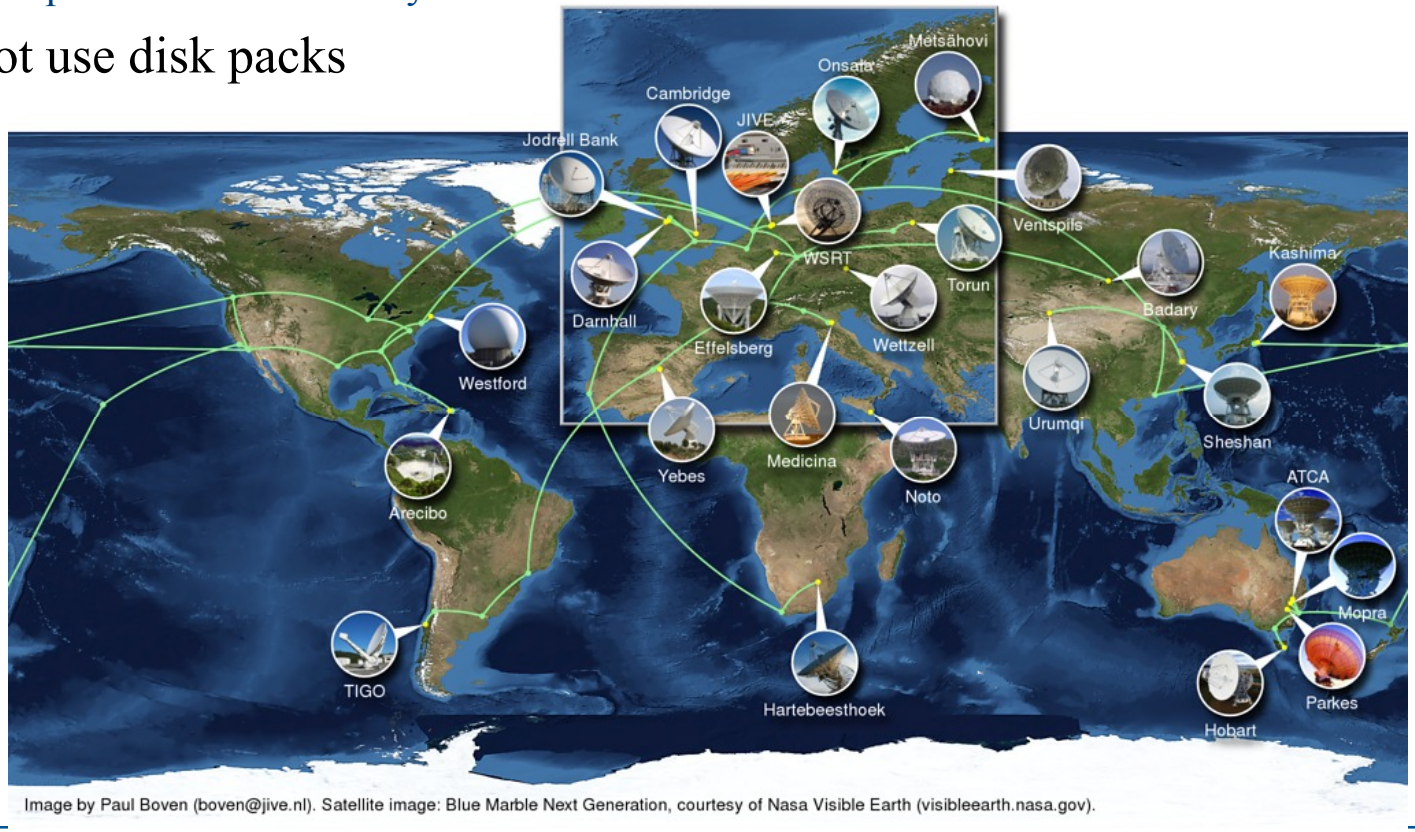


Image by Paul Boven (boven@jive.nl). Satellite image: Blue Marble Next Generation, courtesy of Nasa Visible Earth (visibleearth.nasa.gov).

NEXPReS: EXPReS follow-up

JOINT INSTITUTE FOR VLBI IN EUROPE

- Bring increased sensitivity, flexibility and robustness of real-time VLBI to all EVN experiments
  - Build on successful interdisciplinary collaborations
  - Deploy a high-speed, flexible caching system
    - allow transparent re-transmissions and/or re-correlation
- 4 Network Activities:
  - similar to EXPReS, NA1:Management NA4: Outreach
  - continuation of highly successful eVSAG and EVN-NREN fora
- Service Activity 1: Cloud correlation:
  - flexible buffering at stations and correlator, automated network-dependent correlation, continuous quality monitoring and remotely controlled operations
- Service Activity 2: High bandwidth on demand:
  - integrate e-VLBI with existing BoD, investigate on-demand access for large archives, establish international multi-Gbps on-demand services, position EVN to take full advantage of emerging 100 Gbps technology

NEXPReS: EXPReS follow-up

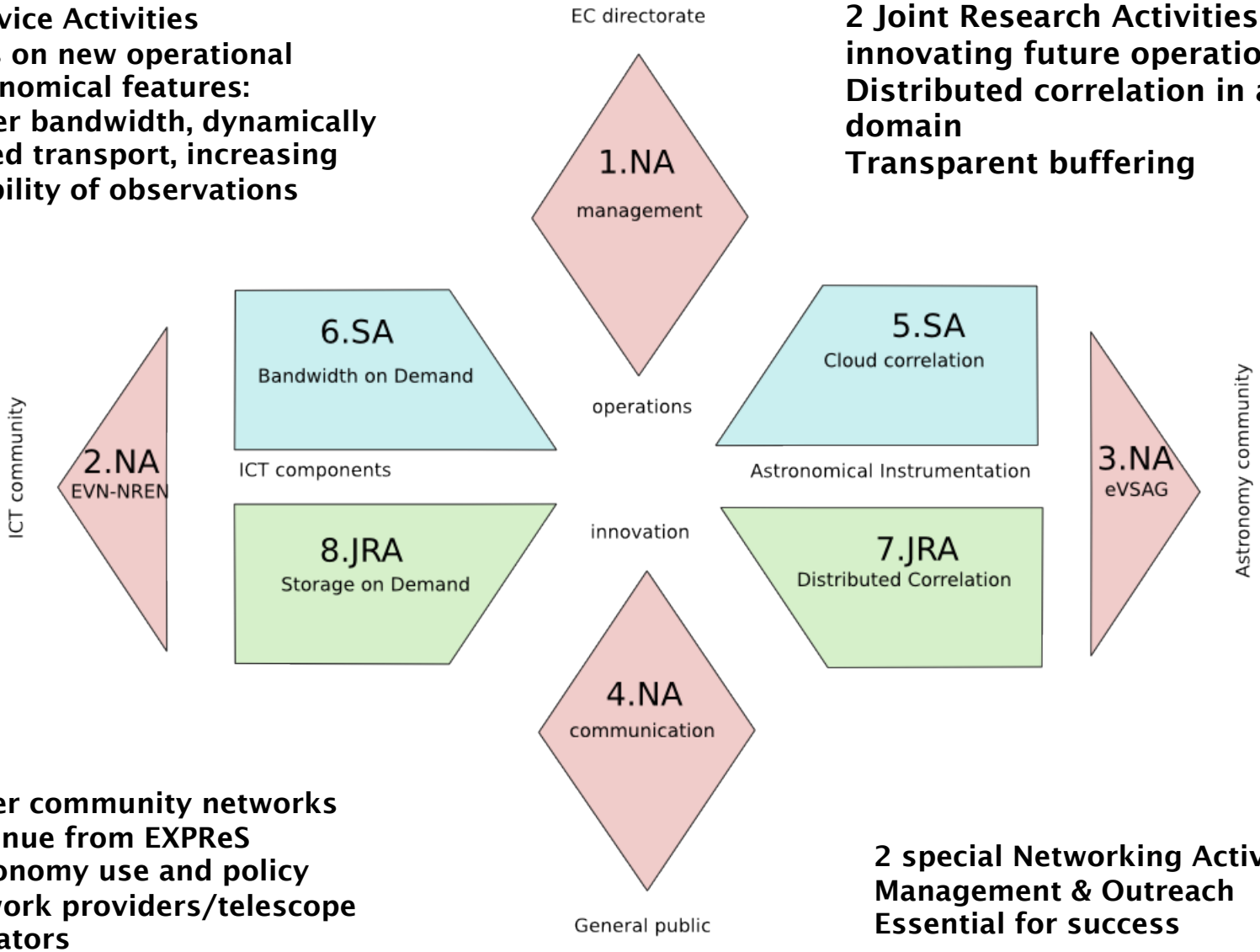
JOINT INSTITUTE FOR VLBI IN EUROPE

- Joint Research Activity 1: Computing in a shared infrastructure
  - Use existing network and computing resources within EVN for distributed correlation, real-time stream processing, develop generic Grid alternatives
- JRA2: High-bandwidth, high-capacity networked storage:
  - Develop multi-Gbps storage elements with simultaneous I/O streaming, investigate use of such elements as LTAs, investigate allocation methods
- 15 partners (cf. 19 in EXPReS)
  - Of which 3 will not receive funds from EC
  - Good mix of astronomy-networking-HPC communities
  - High level of partner-contributed effort
- Negotiations completed
  - nearly 3.5 M€
- Will allow us to keep key personnel
  - And assures continued connectivity in collaboration with SURFnet

NEXPReS: EXPReS follow-up

2 Service Activities
focus on new operational astronomical features:
Higher bandwidth, dynamically cached transport, increasing flexibility of observations

2 Joint Research Activities aiming at innovating future operations
Distributed correlation in astronomy domain
Transparent buffering



2 user community networks continue from EXPReS
Astronomy use and policy
Network providers/telescope operators

2 special Networking Activities
Management & Outreach
Essential for success

NEXPReS impact on EVN

JOINT INSTITUTE FOR VLBI IN EUROPE

- Step towards use of real-time high-bandwidth e-VLBI for EVN
  - Must increase interoperability with other VLBI networks
- Raise level of availability
  - Continuous data quality monitoring
  - Continuous network monitoring
  - More remote control, immediate feedback
- Should consider more frequent, more evenly spaced observing sessions
  - Move to VLBI every Friday... eventually
- Introduction of observations with sub-sets of EVN telescopes
  - semi-automatically generated schedules and control
  - transient response, multi-epoch campaigns

UniBoard

JOINT INSTITUTE FOR VLBI IN EUROPE

JRA in RadioNet FP7, 1.8 M€, led by JIVE

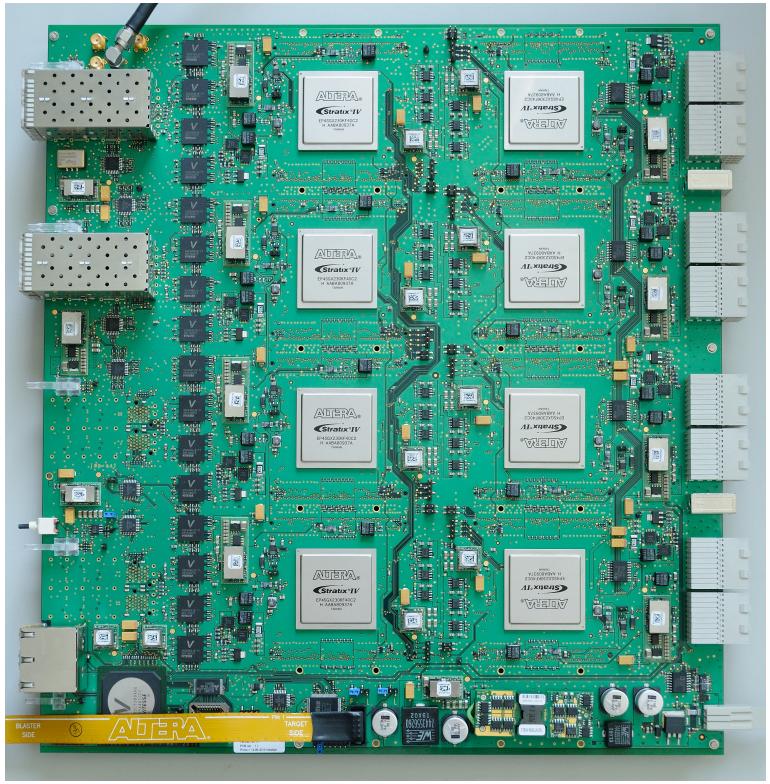
- Participants:
  - JIVE, ASTRON, INAF, BORD, UORL, UMAN, KASI, ShAO, Oxford
- High performance generic FPGA-based computing platform,
- Division of tasks:
  - Jive: project lead, VLBI correlator, interface software
  - Astron: hardware development, Apertif beam former and correlator
  - Uman, Uorl: pulsar binning machine, RFI mitigation
  - Inaf, Bord: digital receiver
  - Shao, Kasi: VLBI correlator
  - Oxford: all-station Lofar correlator

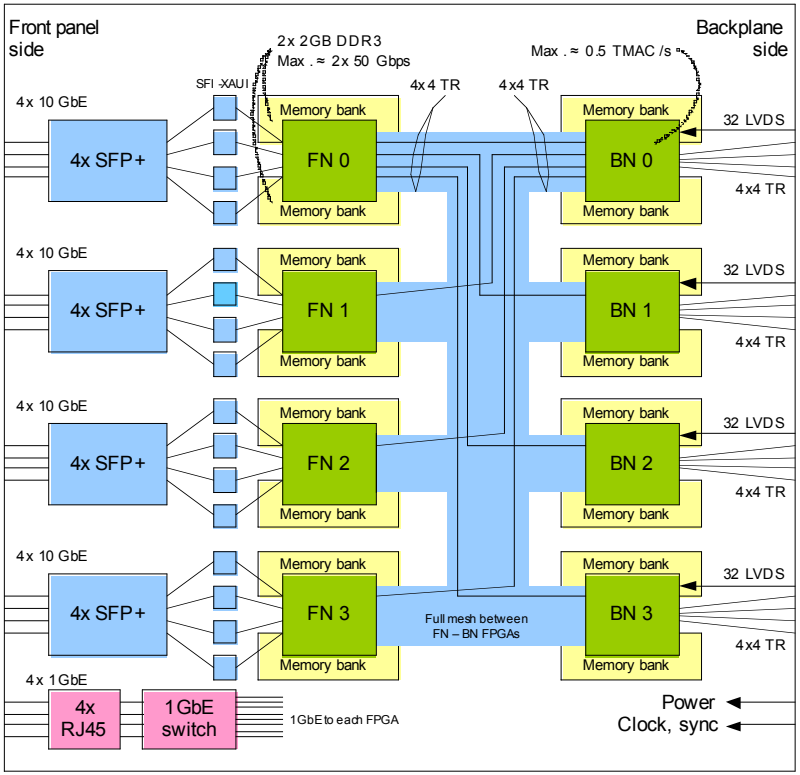
Matching funds through:

- **ExBox**, JIVE/Astron project funded by NWO (400 k€)
- **JIVE-ShAO collaboration**, funded by NWO (720 k€)

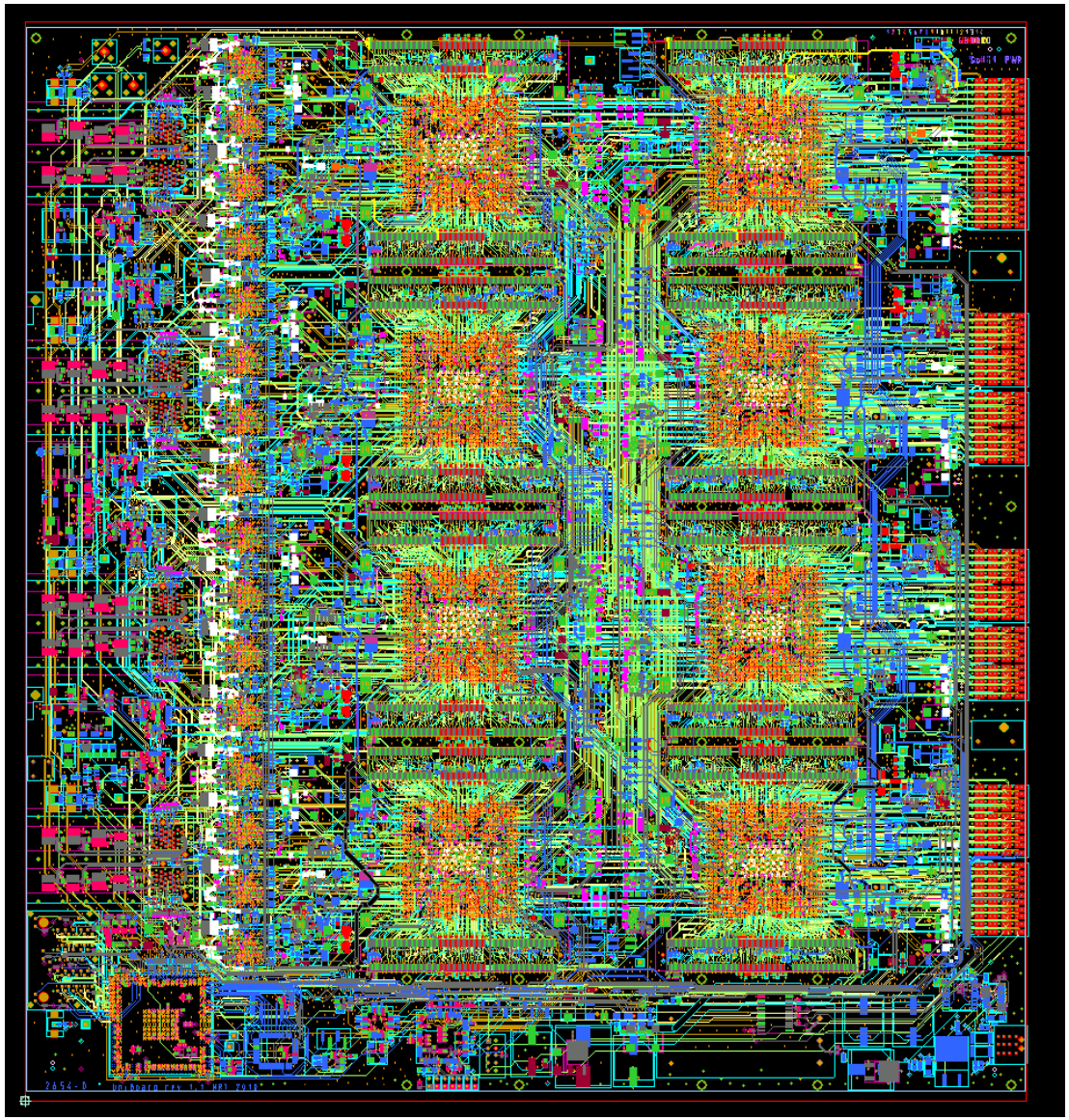
UniBoard, hardware

- First prototype delivered, tests ongoing (blinking LEDs)
- Many blocks of VHDL available through shared repository
- First fringes: end of 2010
- Much interest in community, maps well onto current problems
- Apertif, all-station Lofar correlator already funded
- Will probably turn into Casper-like collaboration





UniBoard, layout



- H x D x T =
  9HE x 340 x 2.4mm
- 14 layers PCB

UniBoard, EVN correlator functionality

JOINT INSTITUTE FOR VLBI IN EUROPE

- It's "only software"....
  - But vast amounts of code needed
  - And lots of developers

- Correlator firmware development:
  - Jonathan Hargreaves, digital engineer at Jive, full-time
  - Eric Kooistra, Raj Thilak, Ruben digital engineers at Astron, part-time (Apertif correlator + beam former)
  - Ying Xiang, visiting researcher at Jive, until November 2010
  - Second full-time digital engineer at Jive, currently under negotiation
  - PhD level engineering student from ShAO, from October 1 2010

- Control code development
  - Des Small, Harro Verkouter
  - Design of control system, high and low level control code, embedded processor code

Fabric and SCARIe

- FABRIC (EXPReS) formally ended
- SCARIe effort ongoing (~2 person years)
  - Software correlator pulsar binning enabled
  - Fits seamlessly into NEXPReS effort
  - SCARIe team will continue in NEXPReS
  - Demonstration with University of Amsterdam group planned for SuperComputing 2010
- Some work continues in NEXPReS JRA4

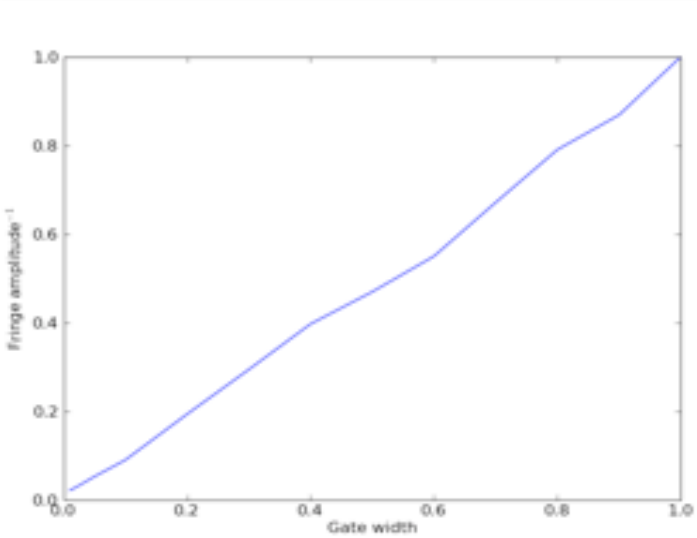
The cluster with no name (ESC@JIVE)(?)

- 16 cluster nodes
  - each 2 quad core CPUs: 128 cores
  - 1 head node, quad core
- Direct 1GE/2GE to Mark5s
  - 40 Gbps Infiniband between nodes

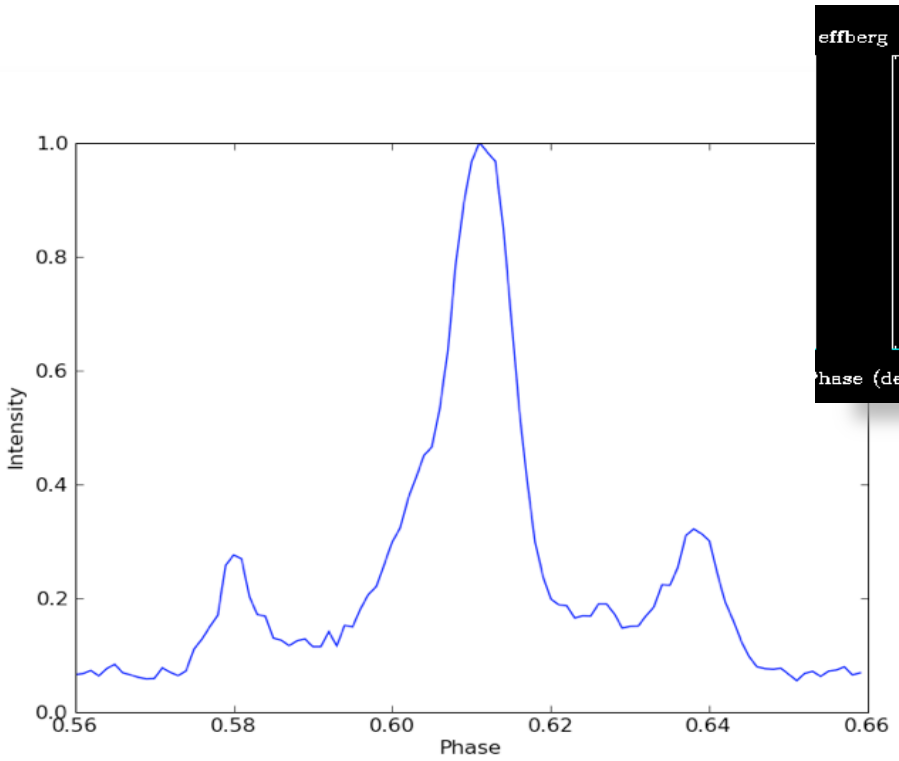
- Software correlation:
- Test: 9 stations at 512 Mbps
  - 1024 spectral points
  - 1s integration
- 10 minutes observations
  - Done in 9m20s wall time
  - Faster than real time!

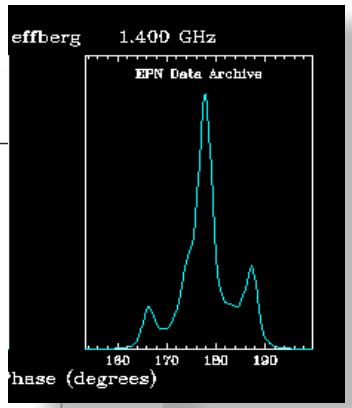
Status of SFXC

New functionality:
- **Pulsar gating/binning is implemented and tested**
- **Preliminary VDIF support implemented**
- **Sampler stats are calculated and reported during FTP fringe tests**



Reciprocal of fringe amplitude as a function of gate width for B0329+54. Ef-Wb baseline, 1396.49 MHz, 4s integration





Pulse profile for B0329+54 obtained from 100 time bins across pulse period