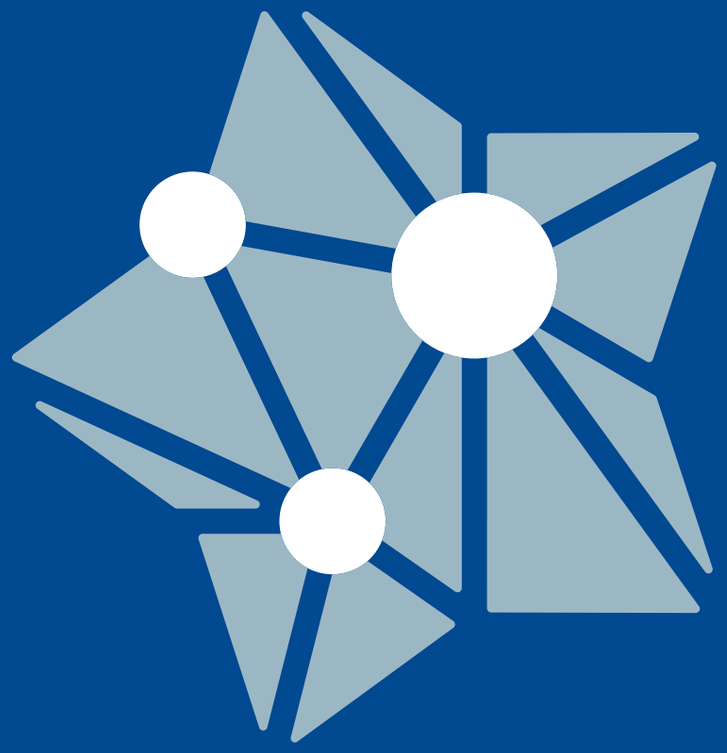


JIVE

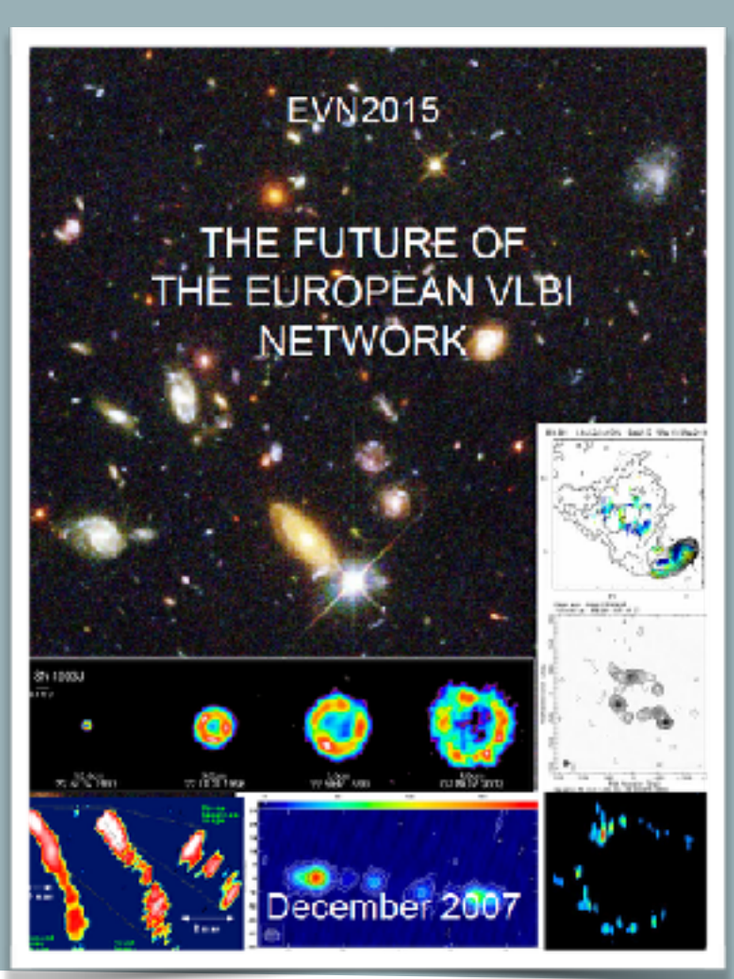
Lessons from EVN2015

Huib Jan van Langevelde

Main lesson:

©THIS IS AN IMPORTANT THING TO HAVE!

- Maybe not always visible to contributors
  But used in many places:
  - ready input for ASTRONET exercises
  - Starting point for ERIC science case
  - National funding/roadmap exercises
  - Direction for EC funding applicationtions
  - Even smaller (science) projects



What?

- What is it that we must have?
  - In fact 2 or 3 things (IMHO)

1. A science ambition
   - Developed by the user community
     - Accredited by the EVN board

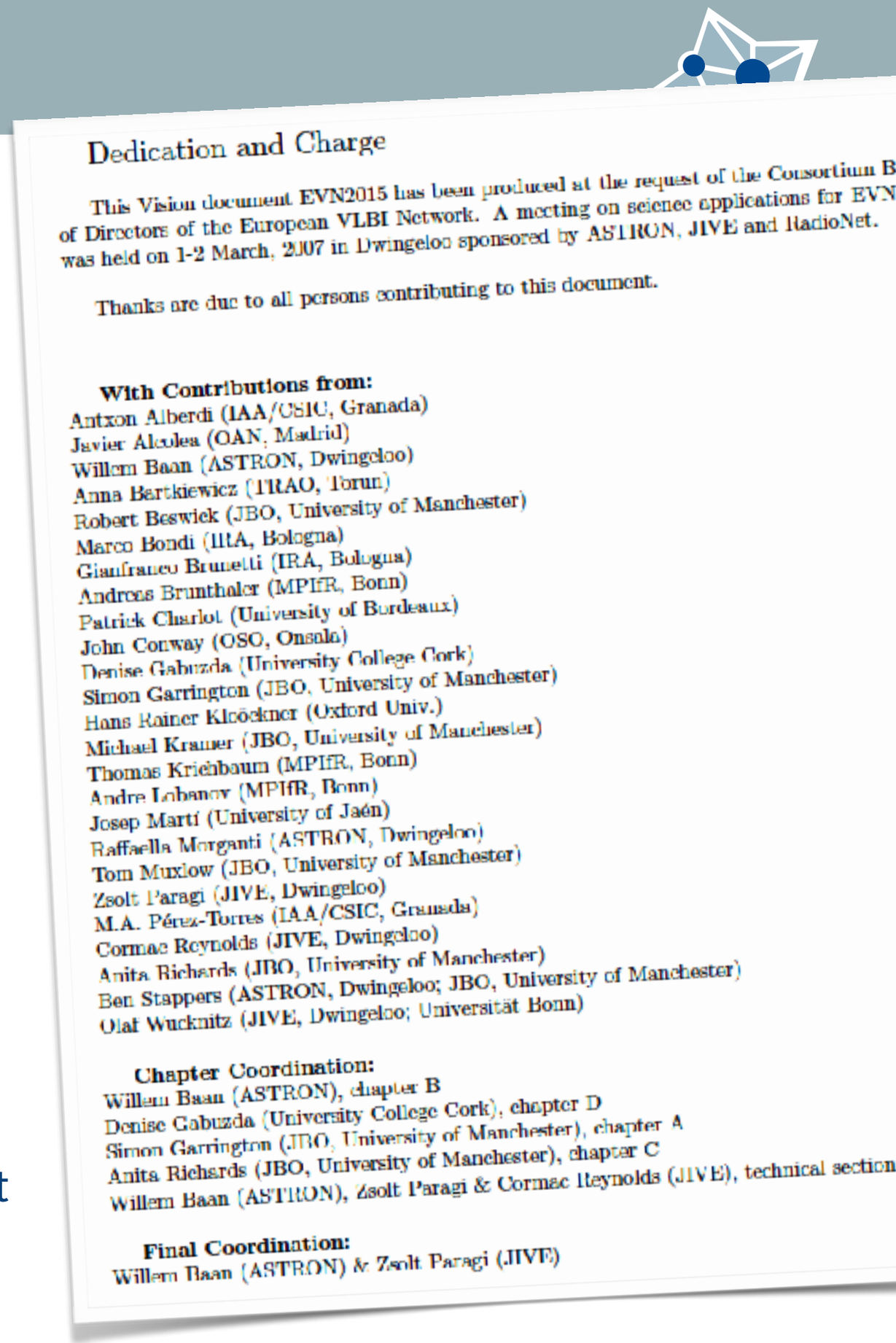
2. An analysis of technical options
   - Ready to be prioritised
     - Science aspects
     - Technical aspects: scalability, open standards, promise
     - International context
   - Requires some budget estimates
   - Resulting in a roadmap?

3. A plan
   1. To which the EVN directors commit
   2. Or proposals for external funding

EVN2015

- Run by Willem Baan, finished by Zsolt Paragi
  - And/or Anita Richards?
  - Anyway, it was not me
- Was a long process
  - Meeting in Dwingeloo March 2007
  - Finished by e-mail?

- Constructive criticism:
  - Could have looked more ‘glossy’
  - Science part could have been more concise?
  - Technical part was a vision, not a plan endorsed by EVN
    - mea culpa
  - Should have been translated in a project
    - But did result in some externally funded projects



Dedication and Charge

This Vision document EVN2015 has been produced at the request of the Consortium B
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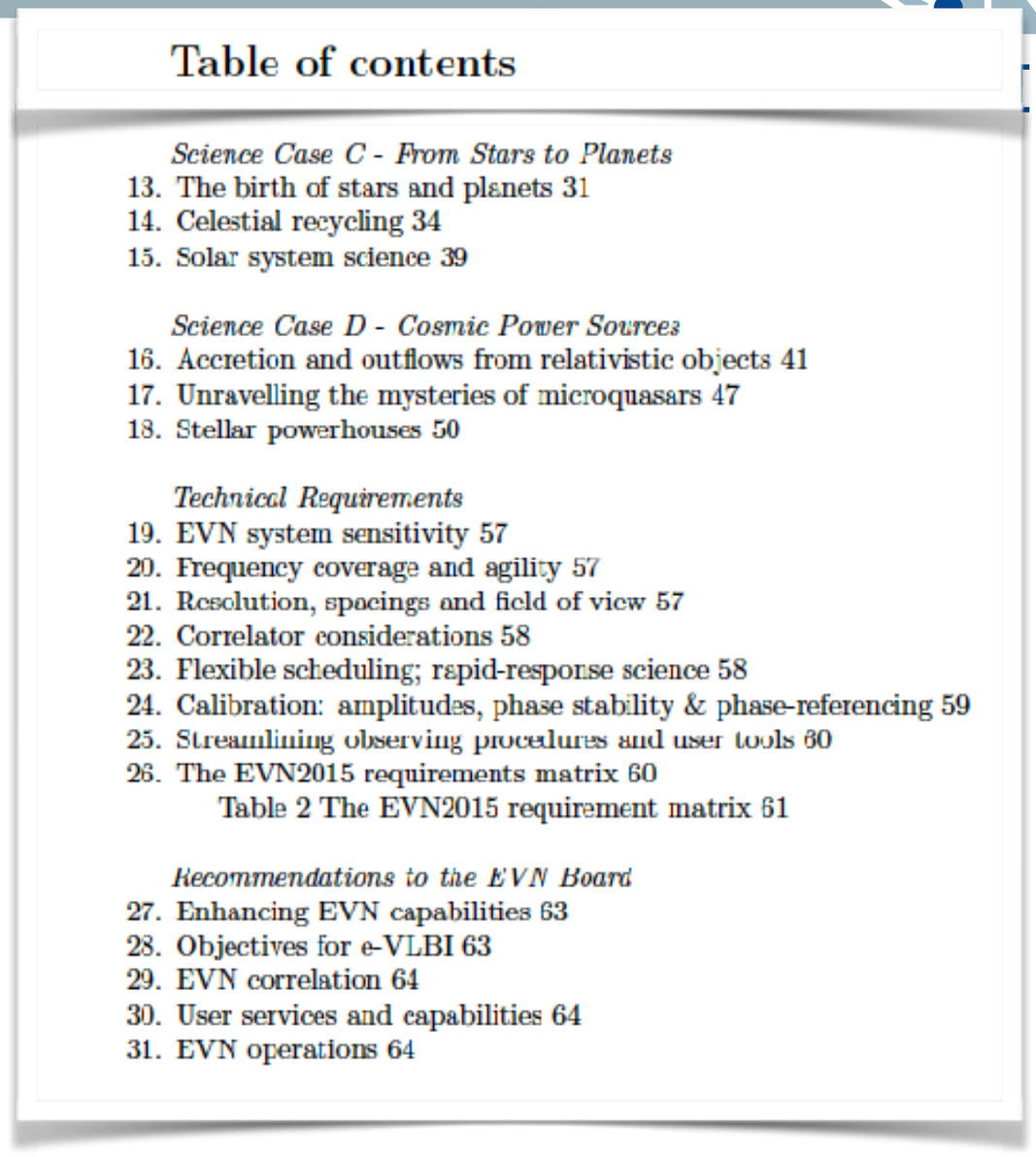
Report contents I

- Note, doc started with Technical potential: very ambitious
  - Direct sampling 4 GHz
  - Many bits, WVR, GPS calibration & mitigation
  - e-VLBI connectivity, quality control
  - Many telescopes (up to 32)
- History of Universe
  - Starburst vs AGN
  - Gravitational Lenses
- Galaxies to Stars
  - The AGN host galaxy relation
  - The content of starbursts
  - SN an GRB
  - ISM, absorption and megamasers
  - Astrometry

Table of contents

Report contents II

- Stars to planets
  - (High mass) star formation
  - Evolved stars
    - replenishing the ISM
  - Solar system
- Power sources
  - AGN physics
  - Micro quasars
  - Radio supernovae
  - Pulsars & transients
    - Magnetars and RRATs



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Technical Requirements

- More telescopes and sensitivity first!
  - Calls for 4GBps, even with many bits
  - eMERLIN baselines
- Frequency coverage and agility
  - Push for high frequency (astrometry, synergy with VSOP2, ALMA)
  - Polarisation purity
- Imaging fidelity
  - More antennas in the right places
  - Also for transients
- Impacting the correlator
  - Continuum bandwidth, short integrations
  - Requirements became huge for 32 antennas and multi-bit representation
- Flexible scheduling
  - astrometry, transients (but no mention of space VLBI)
- Calibration & User Tools

Table 2: The EVN2015 requirements matrix

Subject (SciCase & section)	Key frequency bands	Freq. agility	Wide FOV	Polari-zation	Calibration issues	e-MER LIN	Flex., e-EVN	Other requirements
History of star-formation (A - 5)	GHz cont.							
AGN-Starburst connection (A - 6)	GHz cont.		✓					
Gravitational lenses (A - 7)	GHz cont., $\ll 1$ GHz		✓		low freq cal., RFI	✓	✓	modifiable libraries for data processing
Low-luminosity AGN (B - 8)	GHz cont.	✓		✓	circular polarization		✓	
Radio hot spot evolution (B - 8.3)	GHz cont.	✓	✓	✓		✓		
Extreme star formation (B - 9)	GHz cont., HI line	✓	✓	✓		✓		
ISM components in AGN (B 10)	cont.; H_I, OH $\ll 1$ GHz		✓		low-freq cal tools			
Megamasers (B - 10.2)	OH, H_2CO H_2O			✓		✓		
The birth of stars and planets (C - 13)	cont.; CH_3OH OH, H_2CO, H_2O	✓	✓	✓		✓	✓	12 – 15 GHz; 30 GHz for ALMA!
Search for nearby planets (C - 13.1)	GHz cont.				ion./trop. corrections		✓	microarcsec astrometry
Molecules and dust from cool stars (C - 14.1)	OH, SiO, H_2O 22 – 43 GHz!	✓			high-freq phase-ref			microarcsec astrometry
Maser physics (C - 14.2)	H_2O, H_2CO, OH, H_2COH^+			✓		✓		
Low-mass binary evolution (C - 14.3.1)	GHz cont.	✓		✓		✓	✓	
WR stars and their progenitors (C - 14.3.2)	GHz cont.	✓				✓	✓	coordinated VLBI, optical/IR obs.
Solar System science (C - 15)	GHz cont. S/X				ion./trop. corrections		✓	high-precision astrometry
Physics of relativistic jets (D - 16)	GHz cont. up to 43 GHz	✓		✓	circular polarization		✓	frequent monitoring obs.
Jets and the nuclear regions of AGN (D - 16.1)	GHz cont. up to 43 GHz	✓		✓			✓	coordinated radio, optical, X-ray obs.
Atomic and molecular material in AGN (D - 16.1.3)	H_I, CO OH, HCO^+			✓			✓	
AGN on sub-parsec scales (D - 16.2)	43, 86 GHz and higher	✓		✓	mm p-ref trop. corr.		✓	adaptive antennas, new receivers
Microquasars (D - 17)	GHz cont.	✓		✓	circular polarization	✓	✓	continuous 24-h global monitoring
Local Group XRBs, ULXs (D - 17.4)	GHz cont.		✓			✓	✓	
Radio supernovae (D - 18.1)	GHz cont.	✓		✓		✓	✓	long-term monitoring
Pulsars, neutron star transients (D - 18.2)	GHz cont.	✓		✓	multiple pulsar binning rates		✓	astrometry; tied array EVN

Recommendations

1. Immediate action on DBBC and IF bandwidth
2. Extend capabilities below **L** and above **K**
3. Match LOFAR low frequency, low brightness sensitivity
4. Broadband receivers at e.g. **C**
5. Additional telescopes
6. e-VLBI will change VLBI modes and enable transients
7. Integrate MERLIN
8. 256Gbps correlator
9. Calibration tools, VO, Grid computing
10. Teaching the community at large
11. Oversubscription is healthy, PC is important, allow ToO
12. More frequent sessions and coordination other instruments
13. Seek synergy with SKA, antennas in the right places
14. Have local RFI mitigation projects
15. Advertise e-VLBI with global partners

What changed?

- Besides GRB & FRB we now have GW events for sure!
  - Transient science required much more functionally to be developed than anticipated
    - Which JIVE fortunately was able to accommodate, on the SFXC
- ALMA shows off: e.g. proto-planetary discs
  - And even can do VLBI (we hear)
- SKA design is becoming mature
  - Is the funding and governance in Europe mature?
  - Managed to get VLBI functionality in the design
    - But be careful with operational & commissioning priorities!
    - Must be addressed on Global scale [IMHO]
    - Can VLBI benefit from design studies?
- VSOP2 did not happen, RadioAstron did…
  - and impacted on resource priorities
- No progress with many bit representation
  - Not much cross-fertilisation LOFAR science & software
    - Ionosphere
- CASA achieved user acceptance (in some places)

Expectations current exercise

- EVN is a bottom-up collaboration
  - With a consensus decision culture/reality
  - Not all partners can move with the same speed
- But its strength also originates from that
  - User locked into observatory's priorities in various degrees
  - Many users also have technical/operational duties

- EVN needs YOU (us) to set the direction
  - Gauge the ambition of the user community
  - Will be tensioned by other ambitions of the community
    - Everybody is keen to operate VLBI in the context of e.g. SKA
    - But also many other facilities: ALMA, LIGO, Gaia, JUICE, JWST, ngVLA

- May seem the EVN is limited by operational aspects
  - Recording media logistics
  - Fixed operational sessions
- But must aim for things beyond that…
  - Should be realistically ambitious about technical aspects

Final remark…

- How I see the JJ vs EVN processes
- JUMPIG JIVE must deliver the document(s)
  - Has the resources to facilitate the process
  - Must inform EC that work has been done
- EVN CBD should own the content
  - Should endorse committee members
  - Should endorse the science vision
  - Should endorse technical roadmap
  - Must make sure a plan is put into place
    - Which is understandably not a simple process in a distributed facility
    - Ambitions, budgets, perspective different among members
- Clear, realistic plan much needed!
  - Based on ambitious science vision!