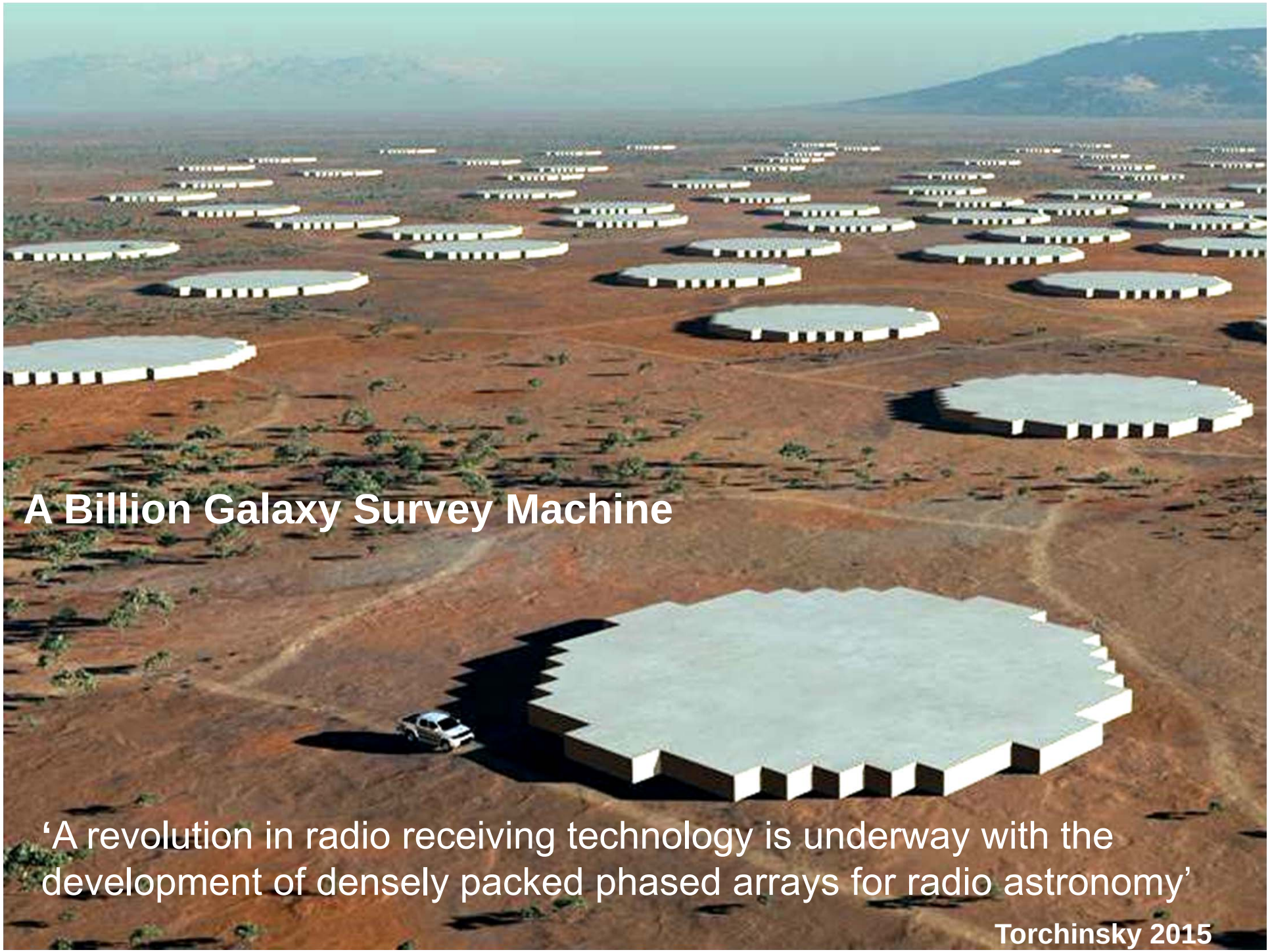
The AAMID consortium:

Mid Frequency Aperture Array

Jan Geralt Bij de Vaate


A Billion Galaxy Survey Machine
‘A revolution in radio receiving technology is underway with the development of densely packed phased arrays for radio astronomy’
Torchinsky 2015

Outline

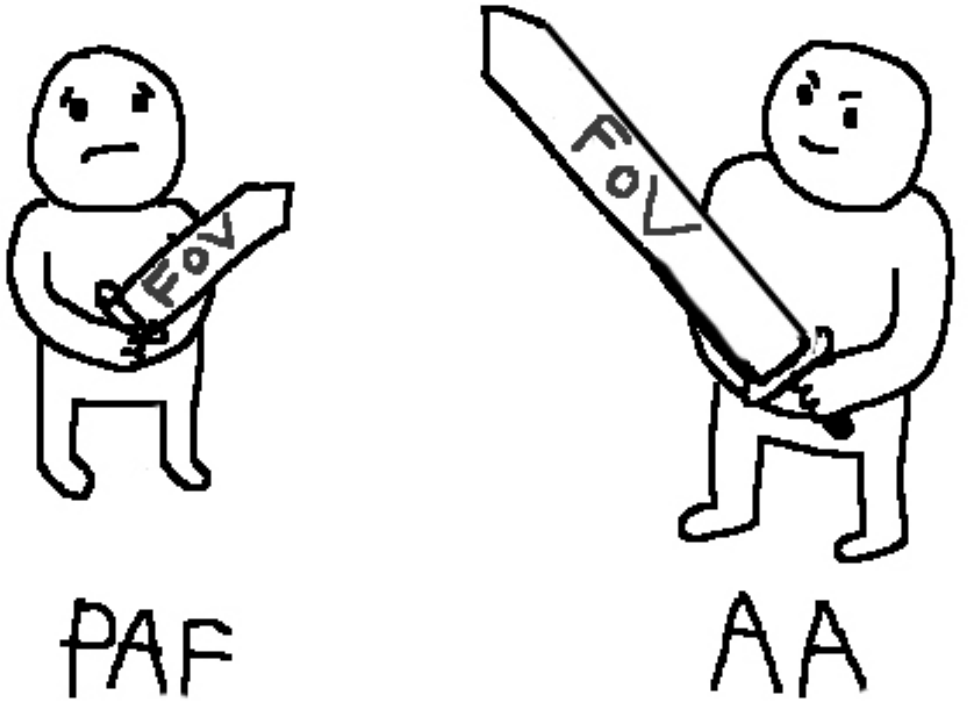
- SKA1 -> SKA2
- Consortium structure
- Opportunities and Challenges
- Schedule

SKA1 -> SKA2

- Re-Baselining result for SKA1
  - Single pixel feed dishes
  - SKA1-LOW
  - PAFs deferred to AIP
  - xxM euro construction budget for AIP
    - WBSPF
    - MFAA
    - PAF

PAF versus AAs

- Fair competition?



PAF versus AAs

- Power?
  - Power budget for Survey was 2MWatt:
    - 140 Watt /m^2 (2015)
  - EMBRACE
    - ~100Watt/m^2 (single pol) (2009)
    - **Both numbers are unacceptable for SKA2!**

PAF versus AAs

- Cost?
  - Budget for Survey was €10.000 /m^2
  - Target AAMID €2000 /m^2
    - **Significant engineering required** (for both)

AAs

- (more) Challenges?
  - Calibration
  - Imaging
  - Wide band performance
- SKA1-LOW will resolve some of this

Advantages of AAs

- Large Field of View: surveys
- Multiple FoVs: Science + Calibration
- High Filling factor possible
- Fast response time

- Station diameter > dish diameter:
  - Much-much lower imaging compute cost

$$P_{imager} = N_{op} \underbrace{\frac{10^5}{3} \frac{T_{obs} N_{stat}^2}{f_{min}} \frac{B_{max}^2}{D_{stat}^2}}_{\text{number of visibilities}} \left(\frac{\lambda_{max}^2 B_{max}^2}{D_{stat}^4} + N_{kernel}^2 \right)$$

Wijnholds 2013

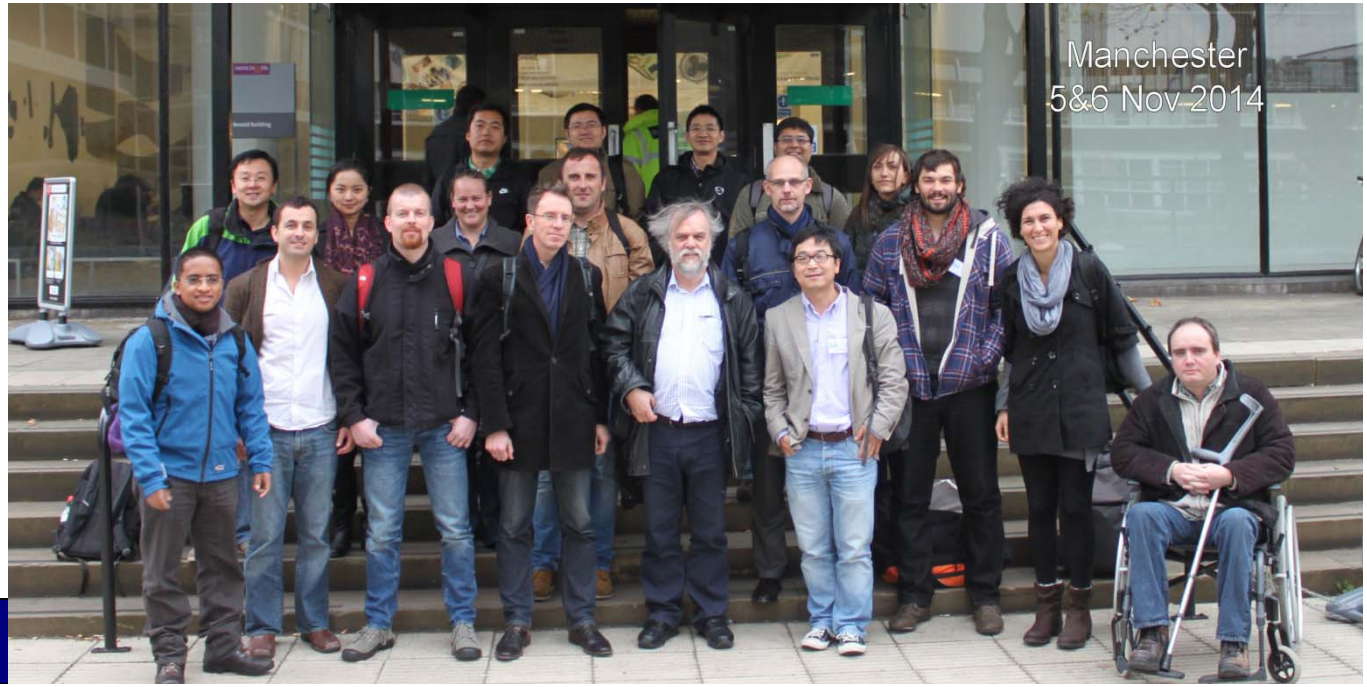
AAMID Consortium

- ASTRON
- KLAASA (China)
- Observatoire d'Paris
- University of Bordeaux
- University of Cambridge
- University of Manchester
- ENGAGE SKA (Portugal)
- Stellenbosch University

- ***Associate members:***
- *SKA South Africa (incl. Rob Millenaar)*
- *Mauritius*
- *Talks started with University College London*

AAMID status

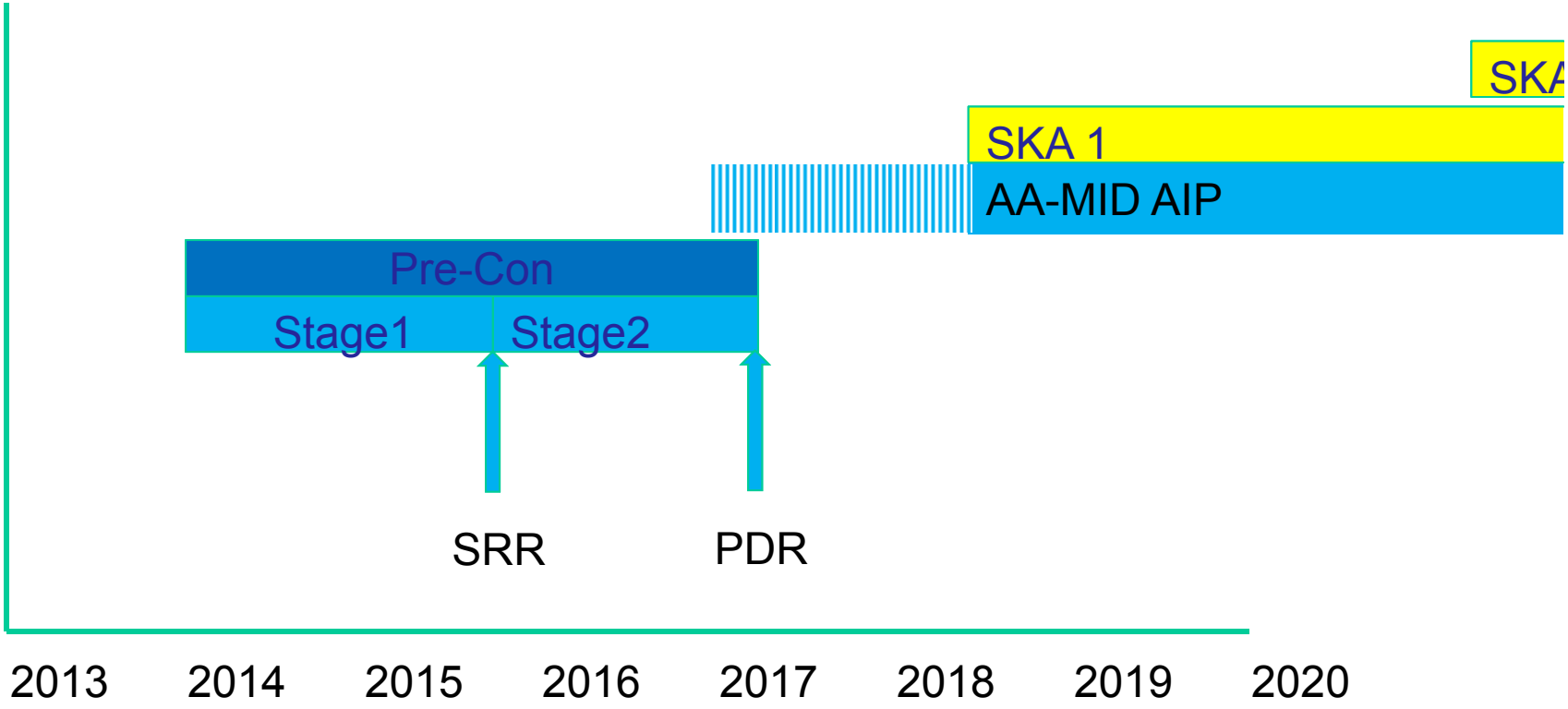
- Good progress on all work packages
- New ORA, new LPDA, new DDA, new Beamformer MMICs, new ADCs, new LNAs, new Low cost manufacturing approaches etc.
- Design meetings Dwingeloo, Manchester, China



Schedule

- SRR, end of stage 1: Nov 2015
  - Front-end decision
- PDR, end of stage 2: Nov 2016

MFAA Schedule

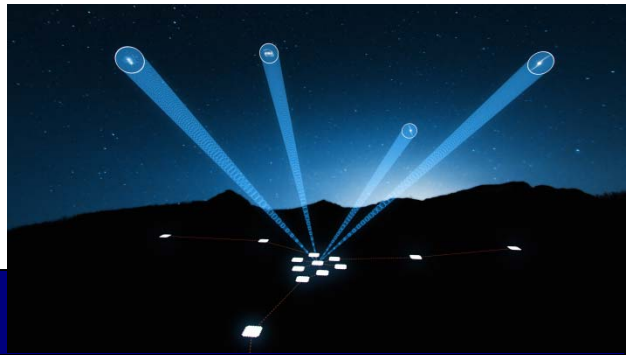


Possible AA prototype

Parameter	Value or range	Units
A_{eff}/T_{sys} at 1GHz	40	m^2/K
Frequency range	400 - 1450	MHz
Bandwidth	>500	MHz
Baseline length	300 - 1000	m
Compactness	50%	A_{eff} inside 100m
Number of stations	10 - 20	
Independent fields-of-view	≥2	
HPBW (FoV) at 1GHz	15 (175)	deg (deg^2)
Polarizations	Full Stokes	

- 2000 m^2
- This system would already give competitive survey performance

Van Bemmel 2013



Way forward

- MFAA should consider the **AA-MID** system

  (AA-MID = complete telescope)

  – Back-end should be considered
  – Implications on correlator, CSP, and imager, SDP
  – L0 for SKA2
  – How? Stronger system team

- Concept Design Review for science capable demonstrator 2016

Conclusion

- Mid Frequency Aperture Arrays would give the greatest benefits for (survey) radio astronomy
- Integration & Front-end design
  -> cost reduction
  -> power consumption reduction
- Competitive performance
- Science capable demonstrator within reach