

Technologies for Radio Astronomy

CSIRO Astronomy and Space Science

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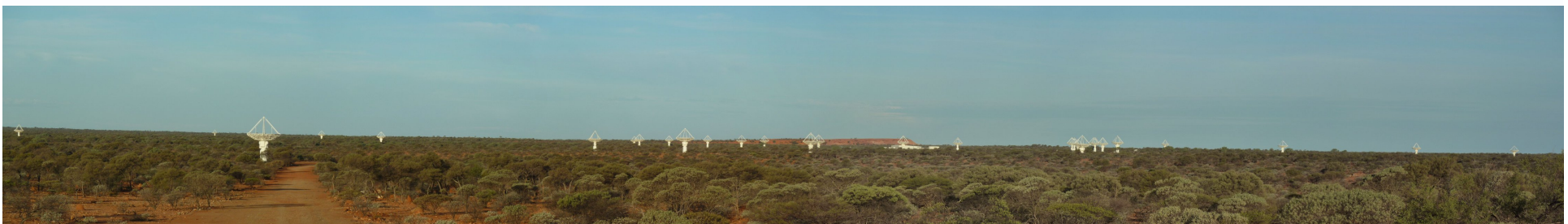
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Directions for ATNF Engineering

(From last ATUC meeting)

- ASKAP & SKA: Core business of the Engineering group.
 - Most of the group's people and effort at present.
- Development projects for all ATNF facilities. Will depend on budgets.
- Strategic developments – develop capabilities.
- External contracts help to maintain capabilities.



Available resources & allocations

- From CSIRO restructure, 8 CCI (now DP) staff to CASS
- Lost: 5 positions via attrition (terms; casual; retirements)
 - + 4 due to Redundancies.
- → ~ 42 FTE total remain in Technologies
- ASKAP : ~ 22 FTE
- SKA: ~ 11 FTE
- ~5 FTE to Store (1.5); Manage (~1.5); student 1; RFI postdoc 1
- → ~ 4-5 FTE (fragmented) for ALL other projects!!
- Many workshop & tech/engineers used on PAF “production line”
- → NOT sustainable??
- (Tim Bateman LWP return 1/12/14. Included above.)

Staffing – Conferences - 1

- Extensive participation in SKA Engineering Workshop, Fremantle, Sept 2014
- +
- Mark Bowen chaired the APERTIF System Critical Design Review at ASTRON (Dwingeloo, The Netherlands) 07-09 October 2014.
- Mark Bowen presented a paper at the 1st Australian Microwave Symposium, Melbourne, June 26-27 2014. [M. Bowen, R. Gough and M. McKinnon,] “Receiver Systems for Square Kilometre Array Survey”
- John Tuthill worked with Steven Tingay in securing a special session on SKA in next year’s ICASSP conference.
 - o Session title “Signal Processing Challenges for the Square Kilometer Array”
 - o ICASSP is the premier international conference for the signal processing community.
 - o John Bunton to present invited paper on “SKA CORRELATORS AND BEAMFORMERS”
- Andrew Brown presented paper at ICEAA conference in Aruba 3-9 August 2014
 - o “Design and Implementation of the 2nd Generation ASKAP Digital Receiver System”
 - o ICEAA – International Conference on Electromagnetics in Advanced Applications
- Stephan Neuhold presented a paper at the URSI-GASS in Beijing, China, 16-23 August 2014
 - o “Design and Implementation of the 2nd Generation ASKAP Digital Signal Processing Platform”

Staffing – Conferences -2

- Ron Beresford and Matt Shields attended Environmental testing workshop in Adelaide in October 2014
 - o “Environmental and EMC Testing Workshop for Defence and other Industries”
- John Tuthill and Greg Hellbourg represented CASS at the IEEE student “Technologies of the Future” event at UNSW, 5 November 2014.
- Greg Hellbourg is currently visiting a number of Radio Astronomy research groups throughout mainland USA. The main focus is RFI mitigation and beamforming algorithms for PAF-based astronomy. Itinerary includes:
 - o Presenting talks at NRAO, Charlottesville, VA and meeting Harvey Liszt, Rich Bradley, Bill Cotton and Fred Schwab
 - o Presenting a talk at Greenbank and meeting collaborators Brian Jeffs and Karl Warnick.
 - o Presenting a talk at Naval Research Laboratories, Washington and meeting researchers
 - o Presenting a paper at IEEE GlobalSIP conference in Atlanta, Georgia

CABB

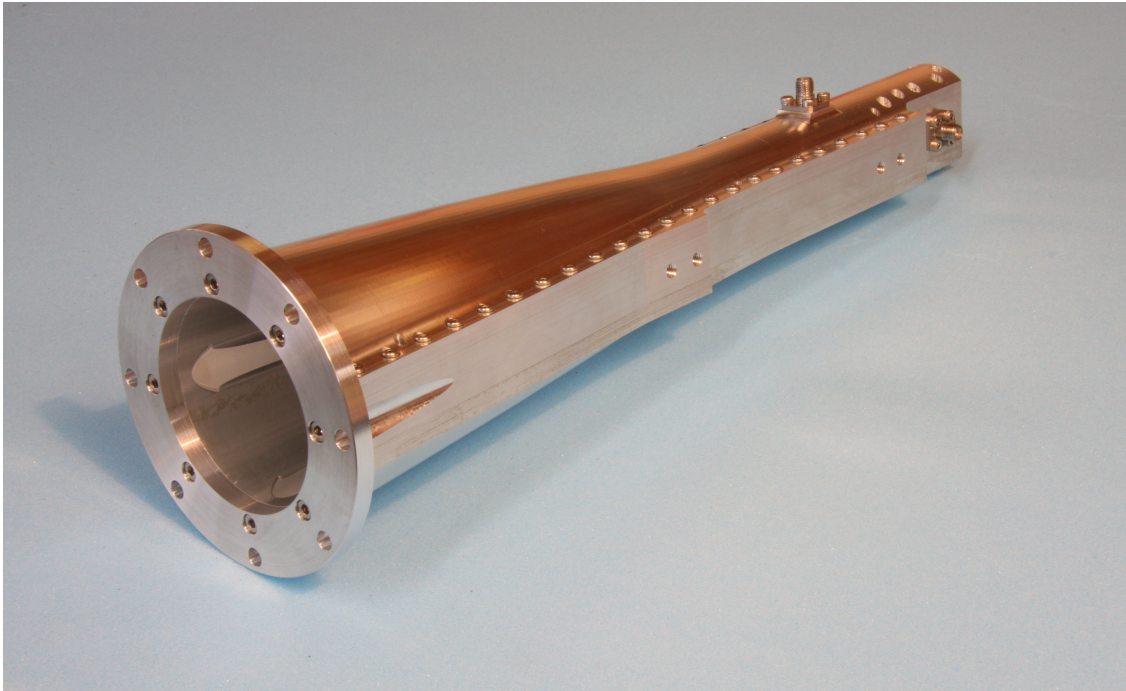
- Last ATUC: **Sept 2014+ finish for 16 MHz mode**
- **BUT**
- Only one person available & affected by restructure!
- Progress has been slower than planned all along. Slowed further!
- Now ALL tasks covered by post-retirement fellows!!
- **Personal commitment** by staff member to continue work on the 16 MHz mode.
- Possible delivery for 16 MHz end 2015?!
- No horizon for 4 MHz mode.
- **NO CSIRO commitment possible. Facilitate as far as possible.**
- **Some hope that 16 MHz may be completed.**

ATCA cm Upgrades Finalised.

- L/S (1-3 GHz) ATCA upgrade operational for a few years.
- C/X (4-12 GHz) ATCA upgrade completed and fully operational.
 - Funded by AAL
- Final documentation and Reports to AAL
 - Very successful project and highly appreciated.
 - Congratulations to the team
- Closure documents to ATNF “Project Review Board”
 - PRB expressed public thanks to the team
 - Excellent state-of-the-art systems.

Ortho Mode Transducer (OMT) 4-12 GHz

- Novel design Ortho Mode Transducer (OMT) for 4-12 GHz



- OMT highly sought after
- Delivered to MPI, Bonn
- Additional enquiries.

- Presentation by Miroslav Pantaleev (Chalmers) at the 3rd International VLBI Technology Workshop (Groningen/Dwingeloo, the Netherlands), Nov 2014.
“Current development towards wide bandwidth front-ends for VLBI”
– Contribution focused on use of the ATCA 4-12GHz OMT!!

An ultra-wideband radio receiver for Parkes

Observed band 700 MHz to 4000 MHz

System temperature $< 20\text{K}$ over most of band

Main science: pulsar timing, polarisation, interstellar scattering, dispersion, spectral lines, Galactic continuum, VLBI

ARC Linkage Infrastructure, Equipment and Facilities grant

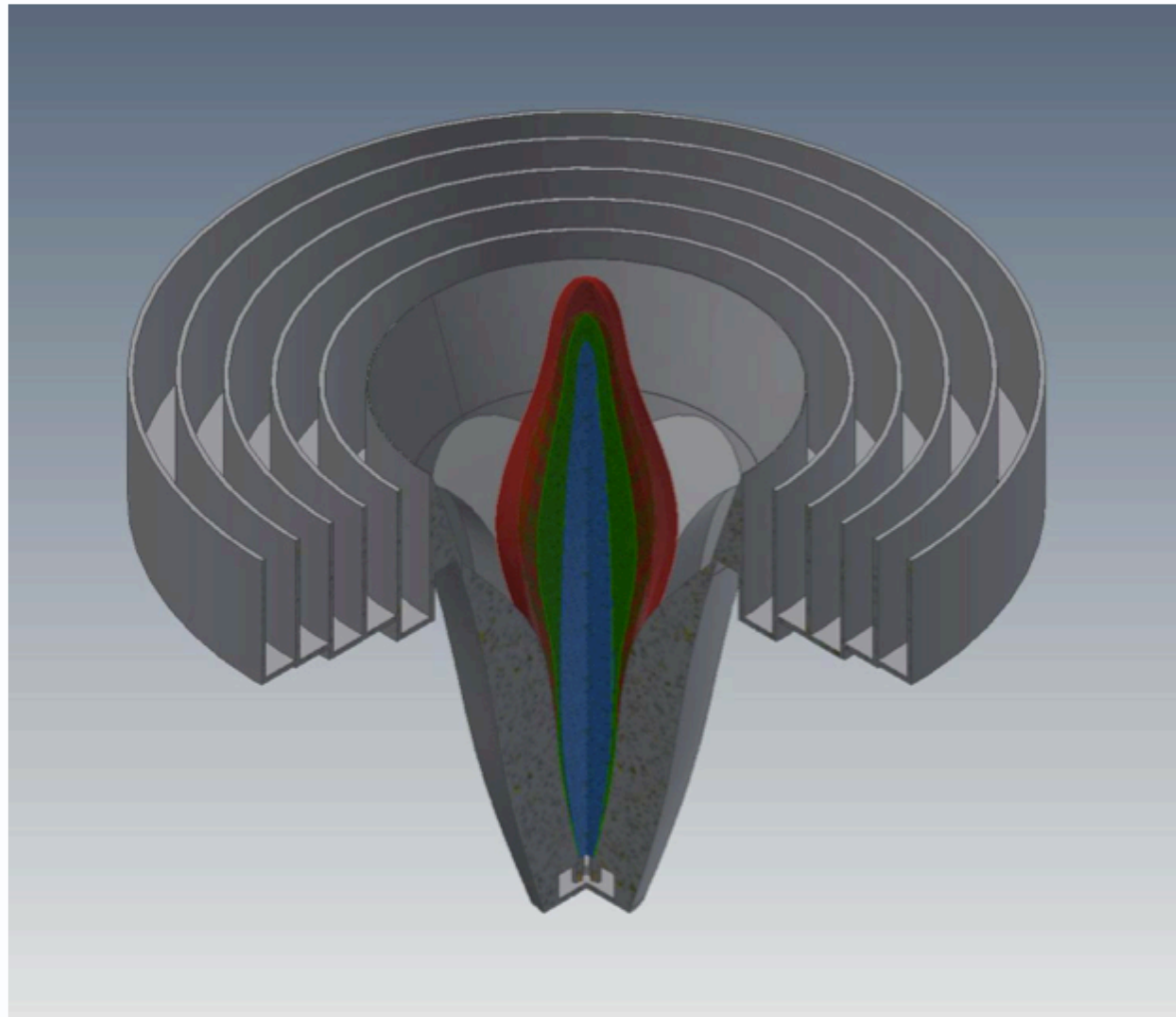
Investigators: Bailes, Gaensler, Wyithe, Bhat, Levin, van Straten, Wen, Melatos, Manchester, Hobbs, Kramer, Han

Institutions: CSIRO, Curtin, MPIfR, Melbourne, Monash, NAO/CAS, Swinburne, Sydney, Western Australia

\$370k in 2015

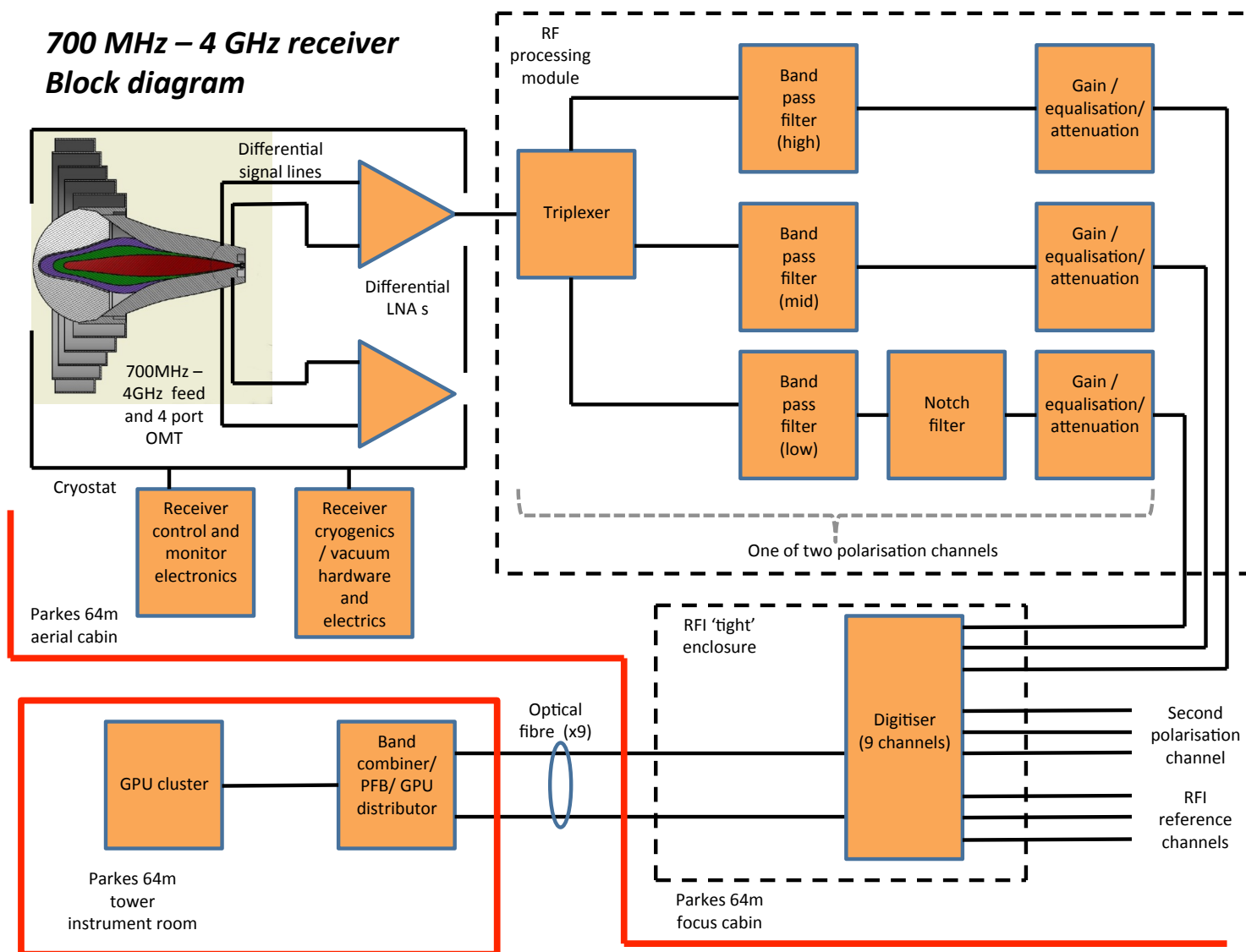
Parkes UWB Feed Design

- Quad-ridge horn with dielectric insert and outer ring slots
- Horn and dielectric cryogenically cooled (outer rings at ambient)
- Low cross-polarization (< -15 db)
- Beamwidth and focal position nearly frequency-independent



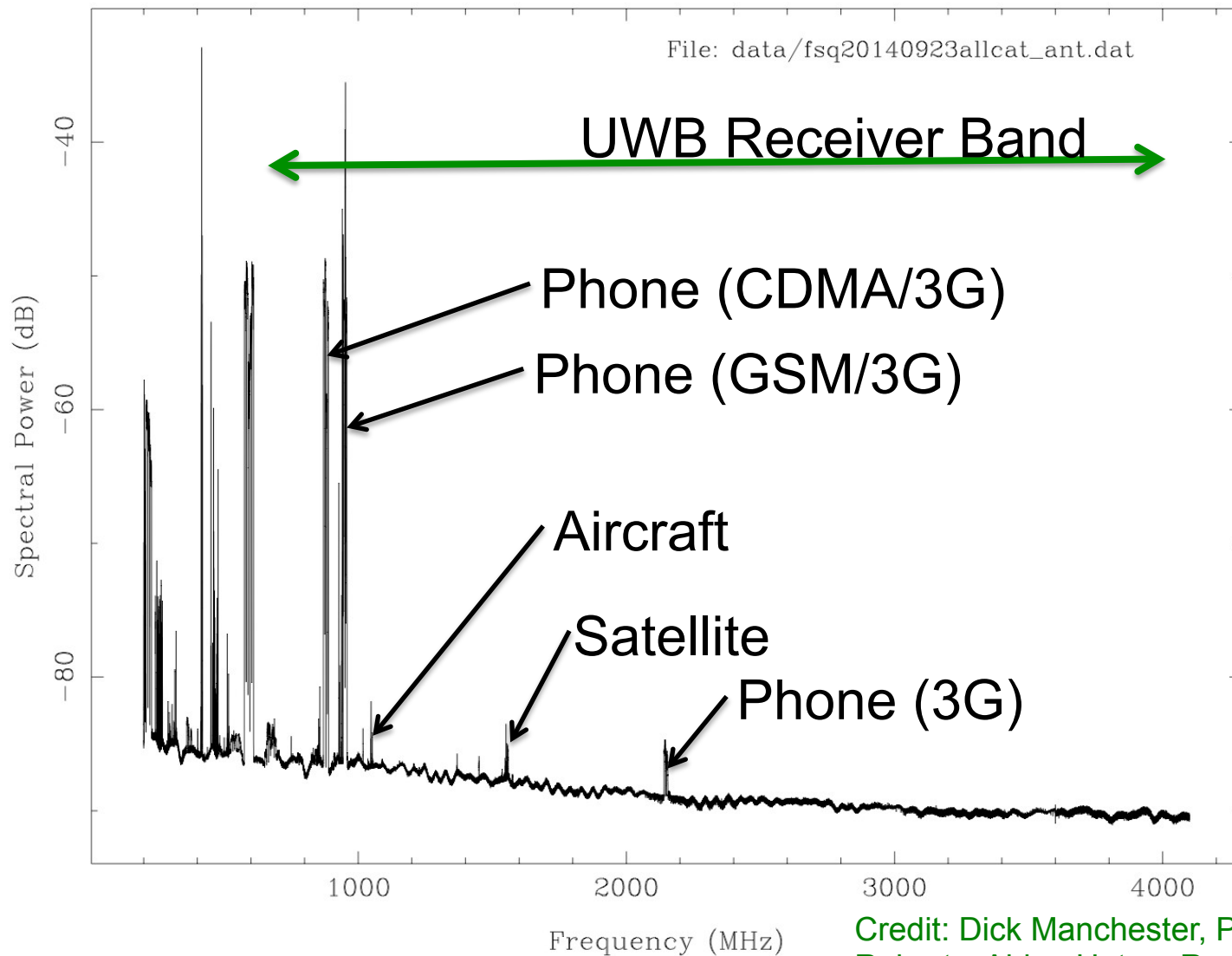
(Credit: Alex Dunning)

700 MHz – 4 GHz receiver Block diagram



(Credit: Alex Dunning)

Parkes RFI Spectrum (Sept. 2014)



Credit: Dick Manchester, Paul Roberts, Aidan Hotan, Ron Beresford, Brett Preisig

Cost of UWB system (ARC proposal)

- Total direct costs: ~\$1M
 - Proposal for 50% from Partners & 50% ARC funds
- → Shortfall: ~\$100k
- Labour effort (from ATNF) at ~\$1.5M
 - ~ 6 FTE years effort. Timescale? (~2 years?)
- Many key people allocated to ASKAP/SKA
 - Need to manage resources!!
- Some preliminary design work
- Leverage from current ASKAP/SKA developments?
- → May be possible within 1-2 years with some extra resources?
 - May have to go slower if resources not available?

FAST – 19 beam 1.3 GHz receiver

- Feasibility study complete with report delivered to NAOC and accepted.
- Feasibility test system (quad-ridge) constructed.
- Alternative prototype also designed & constructed
- Discussions/negotiations started with Chinese for full system design & construction!!
- Delivery deadline: September 2016!!
- **Fully externally funded.**
- Detailed costing to be done.
- Strategic relationship with China!
 - **MUST nurture & develop!?**
- Resource requirements & conflicts?
 - **Recruit/Collaborate/secondments?**



ADE PAF and system for MPIfR

- Contract for standard ASKAP PAF for Effelsberg telescope.
- Poor RFI environment at Effelsberg – need mods to PAF filtering

SPECIAL SYSTEM

- Single dish PAF system
- PAF filter mods
- Mods to beamformer outputs
- Ethernet output
- Will require some effort.
- External funds for mods.
- Strategic use of PAF....
- **Commissioning/Early science:**
Bonn OR Parkes?
- Request from MPIfR for Bonn
PAF at Parkes



Bonn PAF at Parkes?

- **Advantages:**

- Attraction of early PAF science at Parkes (~ 1 year)
- Showcasing single-dish PAF – more customers (e.g. Jodrell)
- Easier to commission/debug PAF
- Resources at Parkes from Bonn & others
- Demonstrate need for PAF @ Parkes – future funding?
- More collaborations & outside resources

- **Costs:**

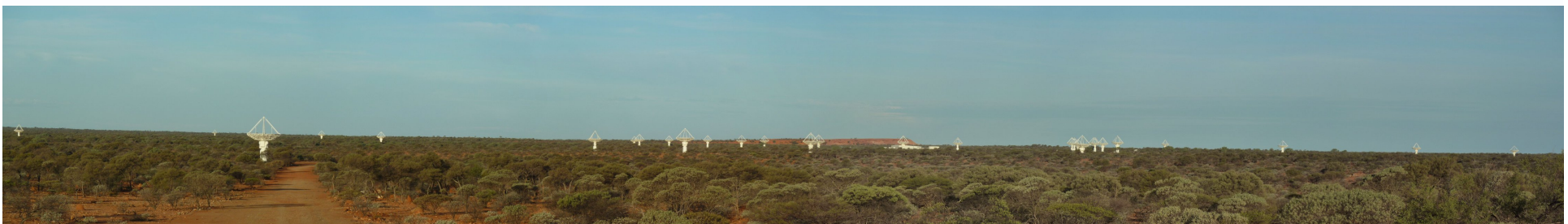
- Effort to install at Parkes – 2-3 months FTE?
- Disruption of Operations at Parkes
- Need to maintain Parkes Pulsar effort → Rx changes? (costs?)
- Commissioning effort (BUT experience very valuable)

- **Recommendation:**

- Can be done at small cost and effort scheduled over next 2 years.
- Benefits outweigh costs??

Summary

- ASKAP & SKA: Core business of the Engineering group.
 - Most of the group's people and effort at present.
- Development projects for all ATNF facilities. Depends on budgets.
 - UWB Receiver at Parkes
 - Single-dish PAF at Bonn/Parkes
 - FAST 9-beam system
- **Strategic developments – develop capabilities.**
- **External contracts** help to maintain capabilities.



Thank you

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