

# BIGCAT

## Broadband Integrated-GPU Correlator for ATca

Chris Phillips

6 June 2017

ASTRONOMY AND SPACE SCIENCE

[www.csiro.au](http://www.csiro.au)



# CABB

- CABB has been a great upgrade for the ATCA
  - 4 GHz bandwidth (2x 2 GHz, dual pol)
  - 0.49 kHz spectral resolution over 8 MHz (1 MHz zoom)
    - 0.1 km/s over 1700 km/s at 1.4 GHz
  - 31.25 kHz spectral resolution over 512 MHz (64 MHz zoom)
    - 6.7 km/s at 1.4 GHz
    - 0.09 km/s over 1500 km/s at 100 GHz

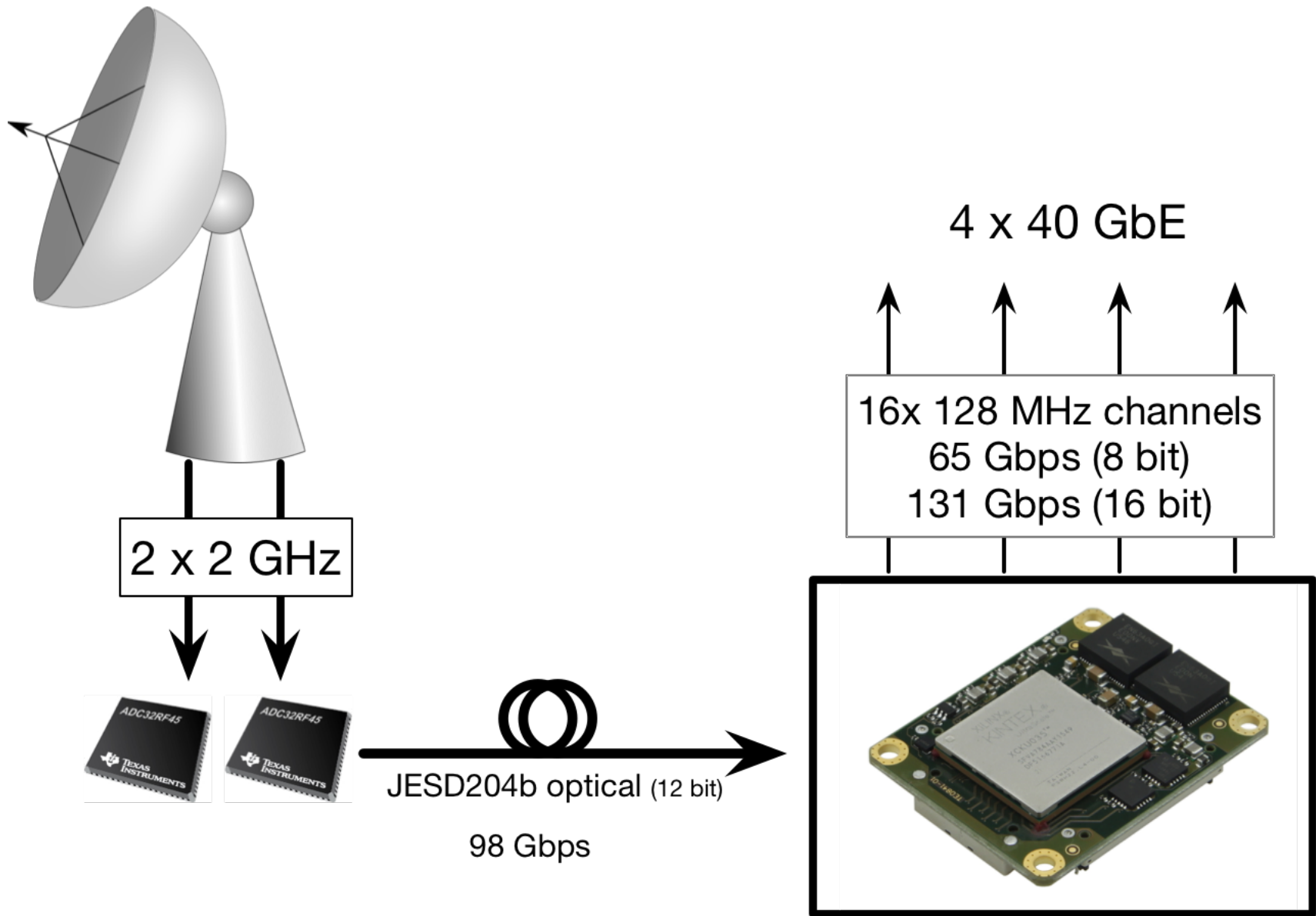
# CABB - But

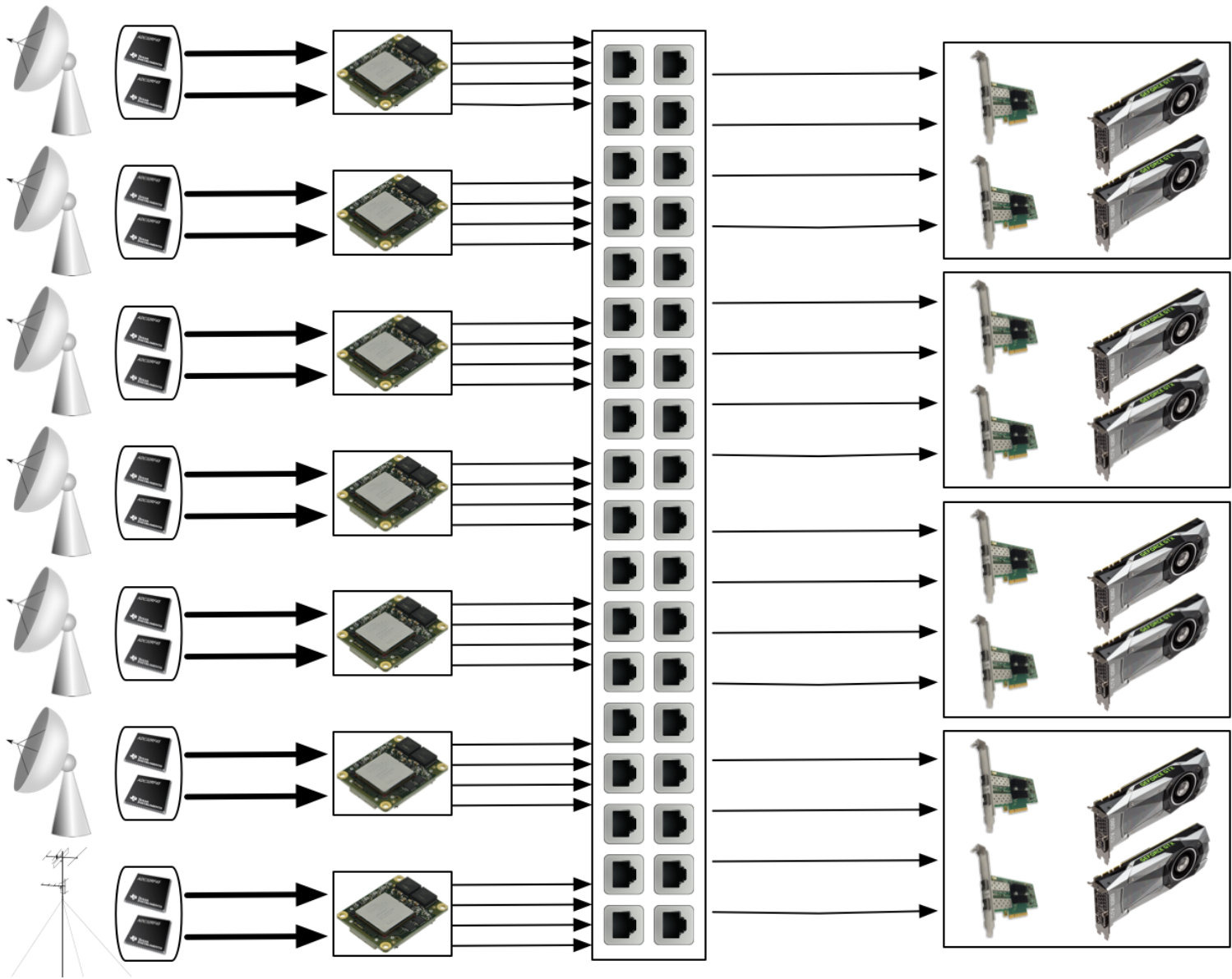
- Reliability
  - Lost observing time
  - Expert staff needed to reconfigure
- Support difficult
  - Dependent on retired fellows
- No “automatic” mode changes
- “16 MHz” zoom band never delivered
- Limited tied array bandwidth (2 x 64 MHz)
- Difficult to add advanced modes
  - Fast dump visibilities, RFI mitigation, pulsar binned modes

# BIGCAT:

## Broadband Integrated-GPU Correlator for ATca

- Submitted SEIF application to upgrade ATCA backend with GPU based system
  - CASS, Swinburne, Curtin & UWS collaboration
- Based on Parkes UWB hardware and design
  - 2 GHz bandwidth sampler, FPGA coarse filter, GPU based processing
  - 128 MHz initial filtering
- 8 GHz total bandwidth
- Flexible processing, lots of possible options...
- 12 bit initial sampling, 8 bit after coarse filterband (16 bit for 1-3 GHz band).





— 8 GHz —

4.0 GHz  
4.3 GHz?

12.0 GHz  
12.3 GHz?

— 2 GHz —

— 2 GHz —

— 2 GHz —

— 2 GHz —

# Data Rates

- Assuming 8 bit data
  - Each antenna produces 65 Gbps
    - Total 1572 Gbps (LOFAR 240 Gbps)
  - 4 nodes per 2 GHz, 2 GPU per node
    - 16 compute nodes
    - 32 GPU Total (GTX 1080 Ti)
  - Each GPU 2x 128 MHz (dual pol) x 6 antenna
    - 49 Gbps/GPU

Excluding RFI reference



# Design Priorities

- Reliability
- Simplify control (hands off reconfiguration)
- “Unlimited” spectral resolution (0.1 kHz over 8 GHz?)
- RFI mitigation (Blanking, adaptive filtering)
- Double bandwidth (8 GHz)
- Advanced modes
  - 8 GHz tied array – Recombine to single channel?
  - Multiple tied array beams
  - Short integration visibilities (piggyback FRB searches?)
  - Sub array (CA06 single dish – 12/7mm?)

# Fast Dump Visibilities

- Assuming full stokes and autocorrelations
  - 2 GHz bandwidth
  - 0.2 MHz channels
  - 1msec integration times
- 55 Gbps sustained data rate
  - Could be ingested onto another GPU for realtime transient detection
  - Dump voltages on detection
- Expect 1 FRB every 25 days of L-band observing
  - 8+ GHz transient searches

# Request for community

- What design specifications do people want?
  - Need to know “extreme” requirements
    - Spectral Resolution
    - Velocity coverage
    - # spectral points
- Are fast dump visibilities scientifically interesting
- Coherent de-dispersion?
- ....?

# Prize

- Can you come up with a better name than BIGCAT?
- Can you “improve” the BIGCAT acronym?  
(Broadband Integrated-GPU Correlator for Atca)
- Can you design a logo?

Prize on offer (TBD)!

# Thank you

Chris Phillips  
LBA Lead Scientist

t +61 2 9123 4567  
e [Chris.Phillips@csiro.au](mailto:Chris.Phillips@csiro.au)  
w [www.atnf.csiro.au](http://www.atnf.csiro.au)

CSIRO ASTRONOMY AND SPACE SCIENCE  
[www.csiro.au](http://www.csiro.au)

