

# New Zealand Impacts on CSP and SDP Designs

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# Past, Present, Future Mega-Science Projects

- Manhattan Project
- Hubble Space Telescope
- Human Genome Project
- International Space Station (ISS)
- Large Hadron Collider (LHC)
- Laser Interferometer Gravitational Wave Detector (LIGO)
- Atacama Large Millimeter Array (ALMA)
- James Webb Space Telescope (JWST)
- International Thermonuclear Experimental Reactor (ITER)
- Extremely Large Telescope (ELT) and Thirty Meter Telescope
- Square Kilometre Array (SKA)

# The Square Kilometre Array Project

- World's largest and most powerful radio telescope
- Broadest range of science of any facility, worldwide
- Will help scientists answer fundamental questions about universe over 50 years
- Cost €674M for SKA phase 1, estimated €2B+ for SKA phase 2
- 11 member countries
- Biggest BIG data project in the world

# NZ SKA Alliance Organisations

- NZA has eight member organisations, and more associated organisations
- Over 35 academic and industry partners
- Have worked closely together since 2013
- Received MBIE \$2.5M funding to date since 2013
- Organisations contribute around \$1.7-2.4M/year to give NZ impact internationally
- 2018 RfI construction involvement by NZ over €39million
- NZ Inc approach to help organisations get embedded in design, construction contracts, international partnerships, secure funding, spinoff IP



COMPUCON



**Massey University**

NYRIAD™

**Open Parallel**  
Innovation Partners

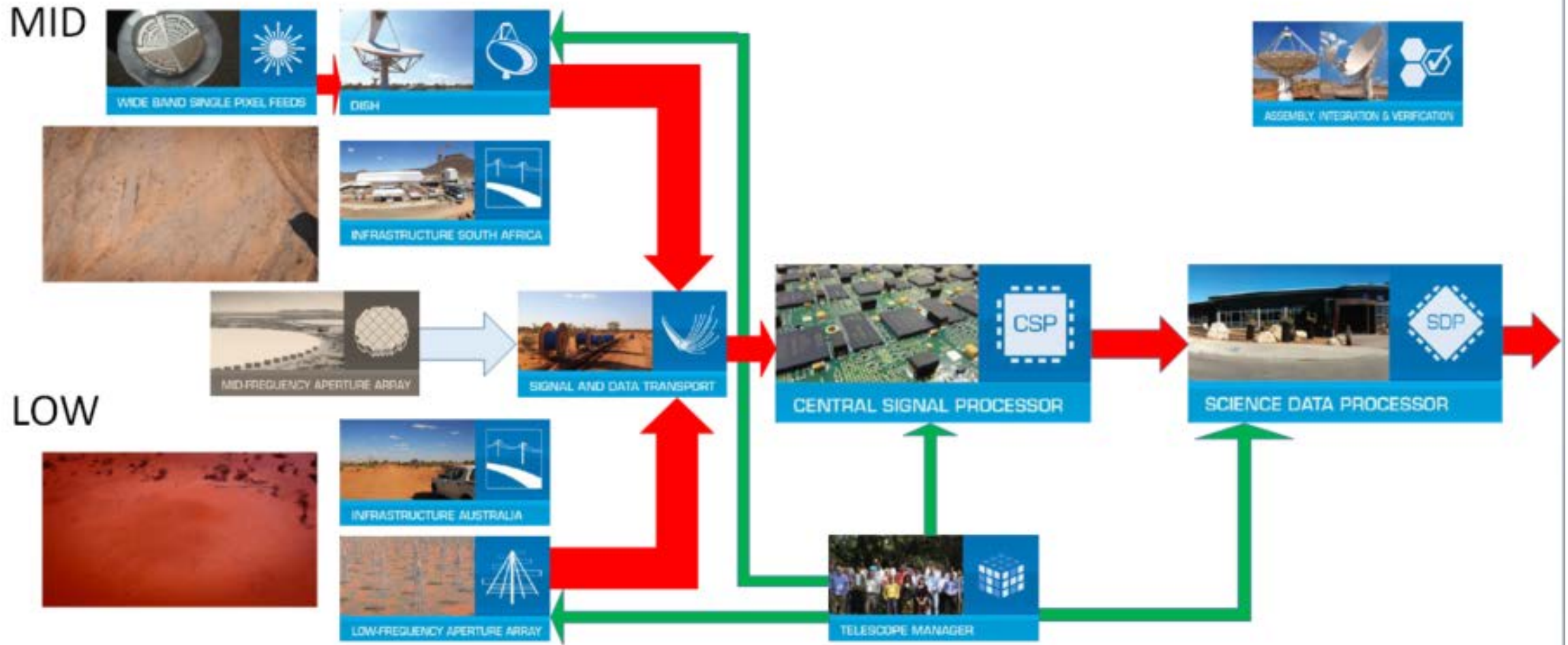
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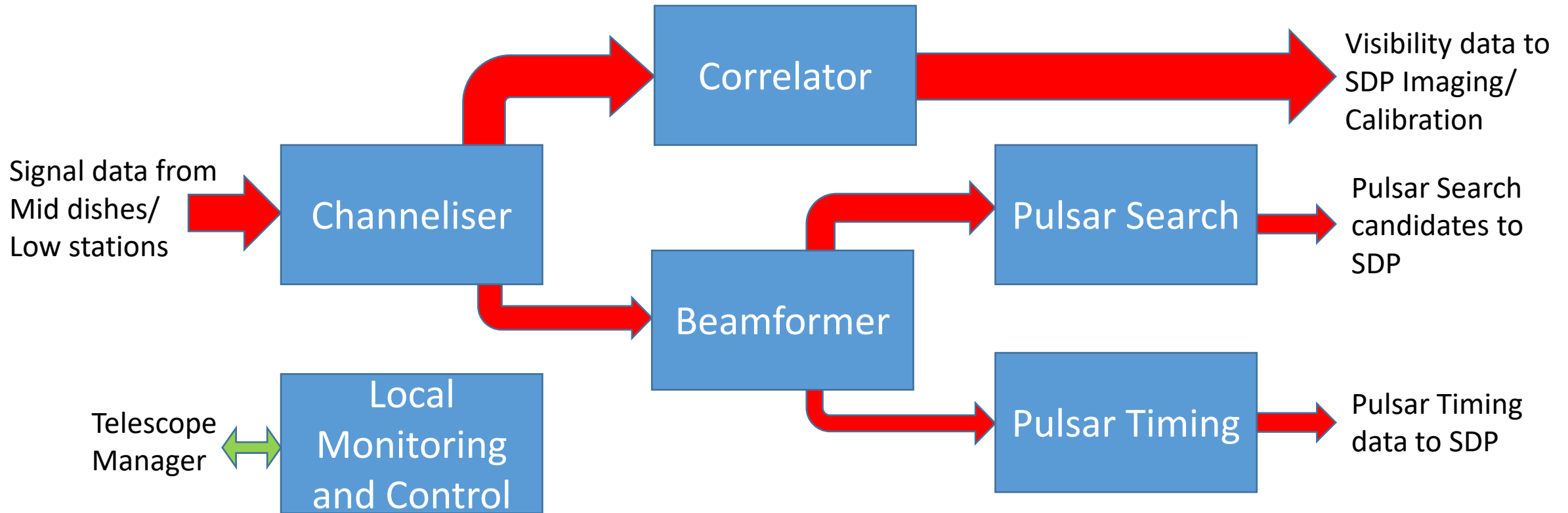
**THE UNIVERSITY  
OF AUCKLAND**



# SKA1 Data Flow and International Consortia Teams



# Central Signal Processor



Real-time processing of data on the fly

All data processed together in correlator, outputs up to 0.7 TB/s

Pulsar Search pipeline must sift through data every few minutes to find new candidate pulsars

# CSP Correlators and Beamformers

- Mid CBF
  - Led by NRC Canada
  - Contributions from NZA (AUT) and INAF
  - “Frequency slice” two stages of custom FPGA boards, large data movement challenges
  - NZ involvement in FPGA firmware
  - CDR subelement review passed in 2018
- Low CBF
  - Led by CSIRO
  - Contributions from NZA (AUT, Massey) and ASTRON
  - Custom FPGA boards, large data movement challenges
  - NZ involvement in project management, modelling, FPGA firmware
  - CDR subelement review passed in 2018

# CSP Pulsar Search

- Pulsar Search led by Manchester
- Contributions from Oxford, Max Planck, NZA (Auckland), INAF, STFC
- Same design for Mid and Low telescopes
- Commodity GPU and FPGA boards, large compute challenge and a lot of hardware
- NZ involvement in FPGA OpenCL software
- CDR subelement review passed in 2018

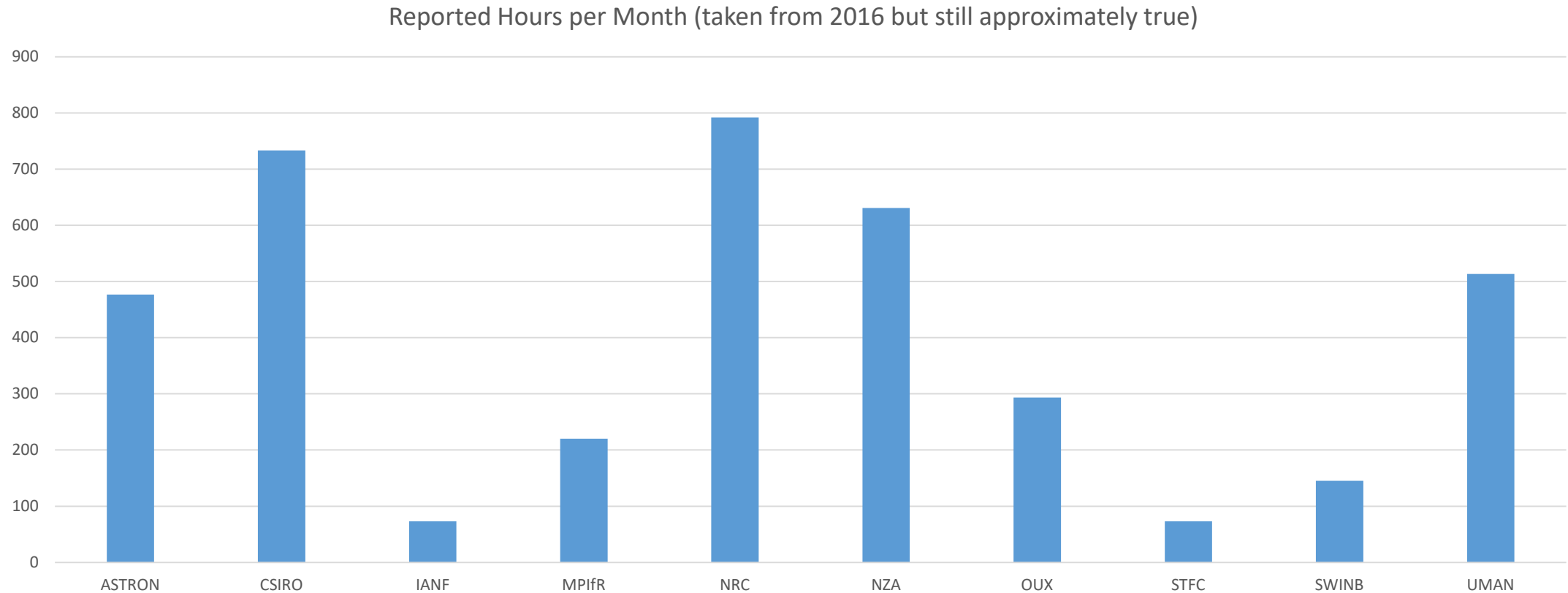


# CSP Pulsar Timing



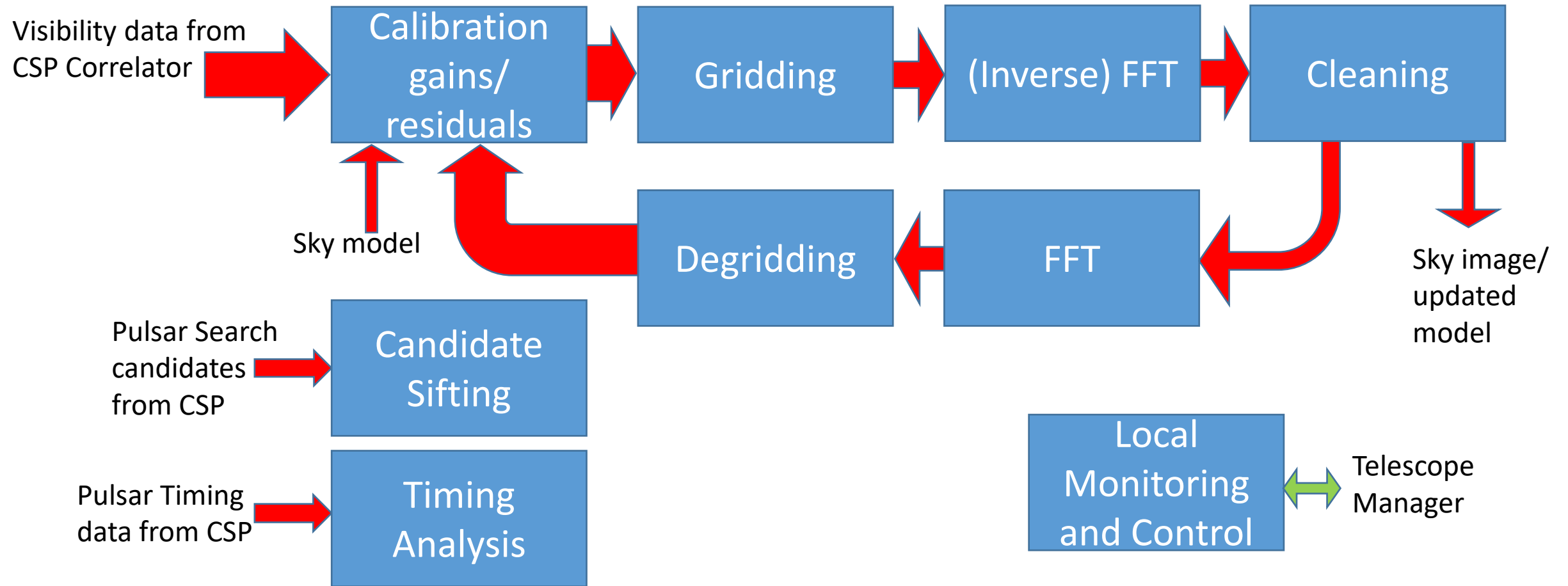
- Pulsar Timing collaboration between Swinburne and NZA (AUT)
- Same design for Mid and Low telescopes
- Commodity GPU, a lot of software but small hardware
- NZ involvement in project management, algorithm and software design
- CDR subelement review passed in 2018

# Central Signal Processor Organisations



NZA is third largest worldwide in CSP

# Science Data Processor



Processes correlator output to form images of the sky will require approx 260 PetaFLOP machine  
Mix of real-time and off-line processing, a lot of iterative processing on data

# SDP Imaging Pipeline

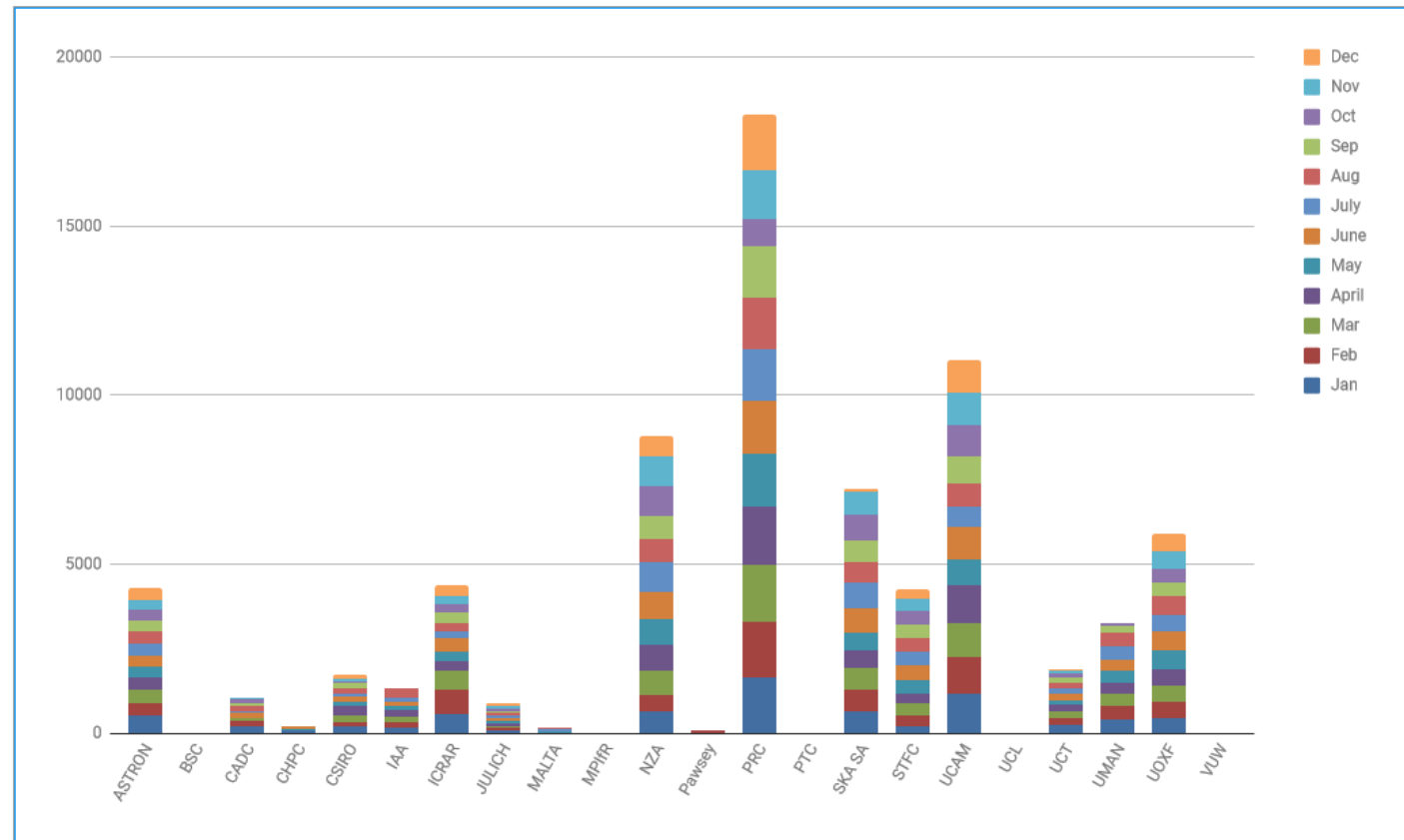
- Contributors include Manchester, NZA (AUT), Cambridge, ASTRON, CSIRO, SKA South Africa
- Same design for Mid and Low telescopes
- Extremely large compute and data movement challenges
- Together with calibration forms bulk of SDP processing
- NZ involvement in algorithm optimisations on accelerators, modelling, precision analysis

# SDP Compute Platform

- Contributors include Cambridge, Oxford, ASTRON, NZA (AUT, Catalyst, Compucon, Open Parallel), CSIRO, ICRAR, China
- Same design for Mid and Low telescopes
- Extremely large amount of hardware, system orchestration, data movement, compute, data buffering
- NZ involvement in node design, prototyping/benchmarking, middleware, services, OS, security

# Science Data Processor Organisations

Reported hours per month totalled for 2017



NZA is third largest worldwide in SDP



Questions?

# The Square Kilometre Array

Thank You

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