

International Centre for Radio Astronomy Research

Australia

Activities and Planning for SKA Regional Centres

Peter Quinn





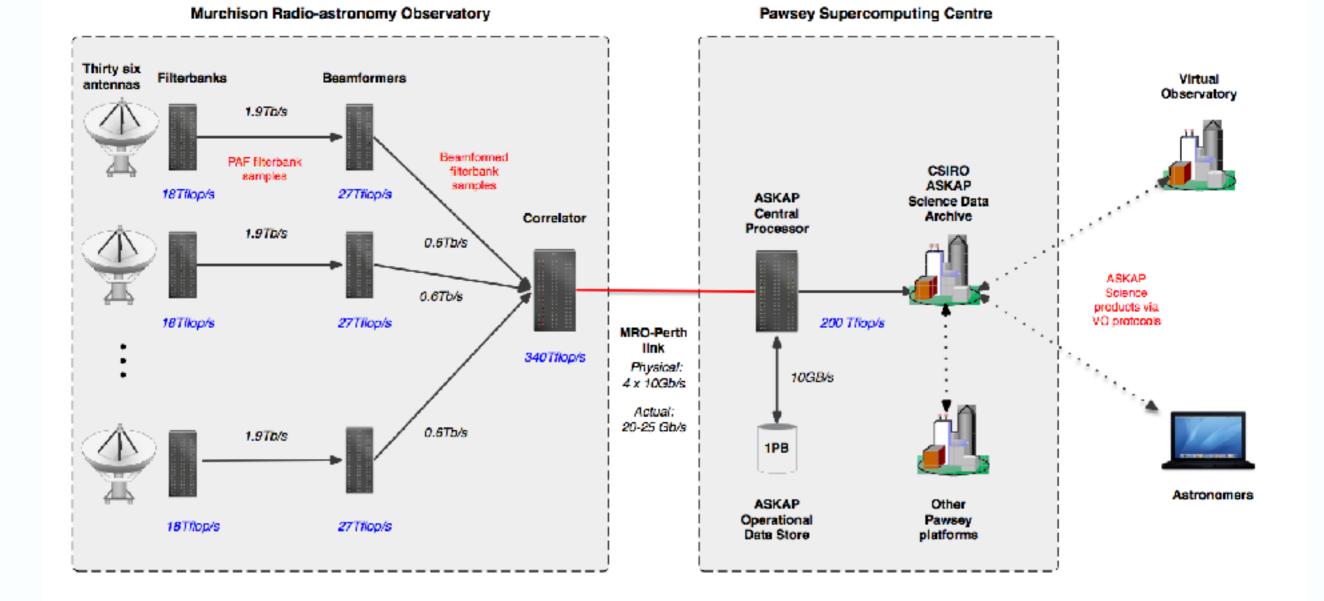
Government of Western Australia Department of the Premier and Cabinet Office of Science



Australian activities

- AENEAS members
 - · CSIRO
 - AARNET
- Australian SKA Regional Centre planning
- The ERIDANUS project & joint Australia-China activities
- Results from SDP and SRC related research and development at ICRAR

ASKAP data



CSIRO ASKAP Science Data Archive

CASDA provides long-term archiving of and access to the large scientific datasets taken by ASKAP.

Functionality includes:

- Long term storage of ASKAP science data products
- Searches and data access via web (CSIRO Data Access Portal) and Virtual Observatory services
- Validation of ASKAP observations
- Upload of value-added science catalogues and image cubes
- Digital Object Identification (DOI) for all datasets
- Archive administration

Approach:

• Agile Scrum software development

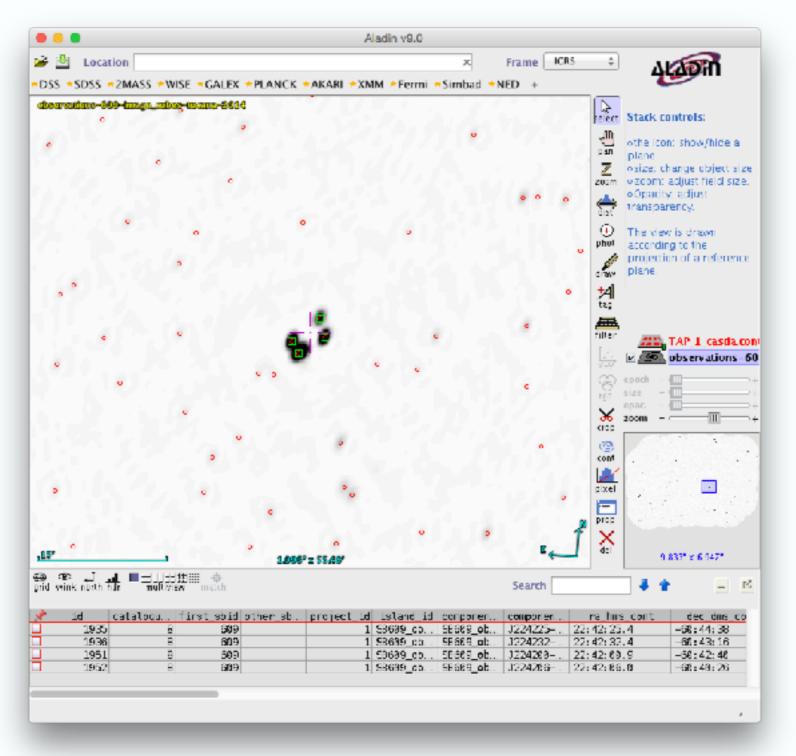


Data Access Portal interface

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Virtual Observatory interface



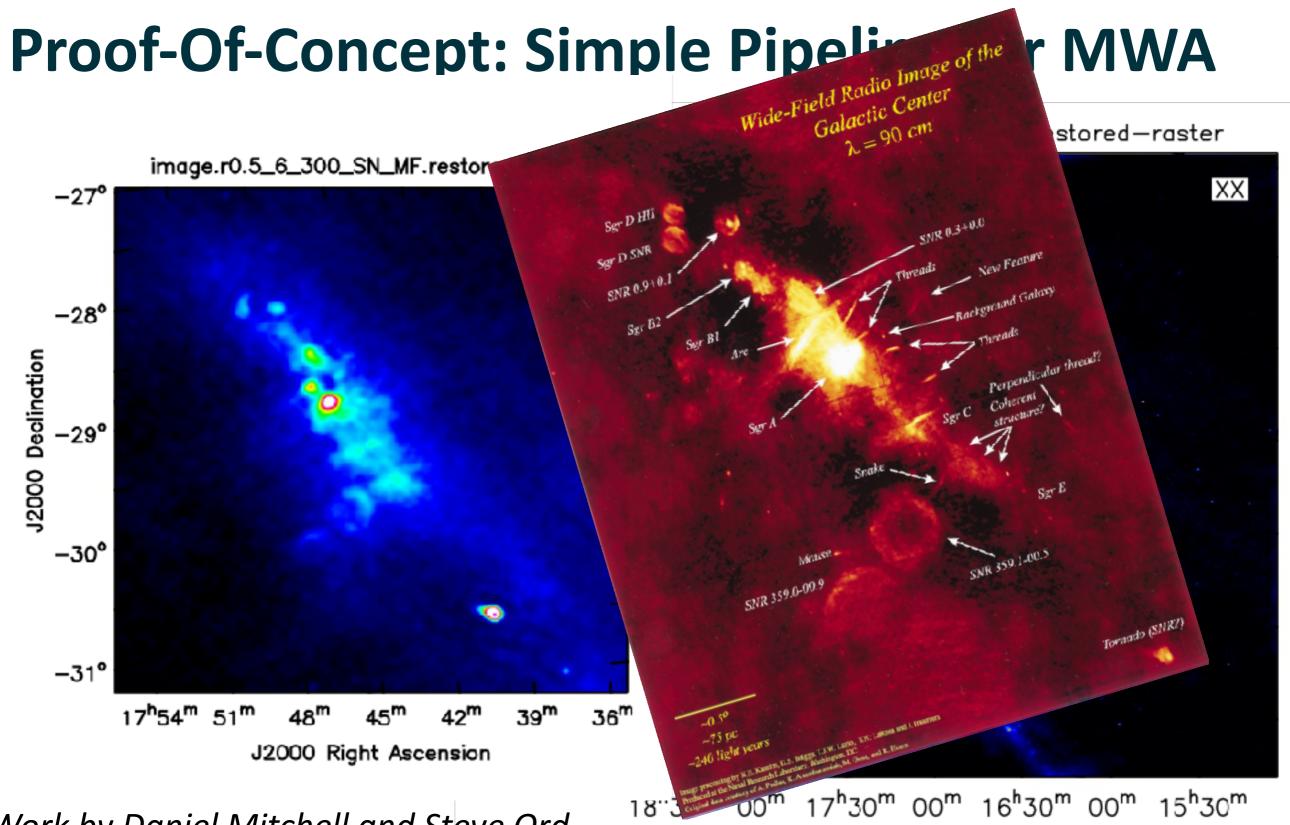


Results: ASKAPsoft: First 36 beam image



- Continuum image with 9 antennas at 939.5 MHz
- Processing resembles an early-science experiment
- Each beam calibrated separately
- Individual deconvolution of different beams
- Only ASKAPsoft used





Work by Daniel Mitchell and Steve Ord

AENEAS – WP4

- Build on CSIRO's work since the mid-2000s with long-haul, high-bandwidth VLBI data transfers and e-VLBI:
 - Australian Long-Baseline Array,
 - EXPReS and NEXPReS EU funded projects (both concluded).
- Work closely with the Australian NREN, AARNet (Australian Academic and Research Network) to build capacity and conduct performance testing.
- CSIRO and AARNet have built and operated the long-haul network to connect the MRO to the world:
 - ~850km (about 390km fibre built as part of establishing the MRO),
 - running multiple 100Gbit/s wavelengths (MRO-Perth),
 - Provides and ideal real-world testbed for long-haul, long distance data transfers.
- Planning to undertake performance testing from April/May 2017 (depending on availability of hardware), initially within Australia and then Internationally.



Australian planning for SRCs

- Australian and New Zealand SKA Coordination Committee (ANZSCC)
 SKA Regional Centre Working Group (ASRCWG):
- * Formed first two meetings 9 August and 12 December 2016
- Members: Chair: Peter Quinn (ICRAR), ASKAO: David Luchetti, CSIRO: Douglas Bock/David McConnell, SKA Operations: Sarah Pearce, ICRAR: Andreas Wicenec, CAASTRO: Naomi McClure-Griffiths, AAL: Yeshe Fenner, AARNET: Peter Elford, Pawsey Centre: Neil Stringfellow, ANZSCC SAC: Carole Jackson, ACAMAR: Lister Staveley-Smith, ASKAIC: Geof Heydon, New Zealand: Willem van Straten, Melanie Hohnston-Hollitt
- ★ Terms of Reference:

ICRAR

Australian planning for SRCs

1. To define the Australian SKA Regional Centre scope, opportunities, requirements and potential funding opportunities, in line with SKAO Operational planning and the SKAO Board's response to the recommendations of the SKA Data Flow Advisory Committee

CRA

- 2. To explore opportunities to expand the Australian SKA Regional Centre activities to include collaboration with similar activities in China, New Zealand and the broader Asia-Pacific Region with a particular focus on business case development and precursor enabled technological and scientific programs
- 3. To initiate a detailed study (ERIDANUS) of the data and processing requirements and costs within an Australian SKA Regional Centre in support of Australian Survey Science with the SKA precursors and SKA-1

China-Australia strengths

***** SCIENCE :

ICRAR

- * ACAMAR (Australian-ChinA ConsortiuM for Astrophysical Research) alliance optical/IR, radio, theoretical and Antarctic astronomy
- ★ Future: FAST/ASKAP/MWA surveys, VLBI, Kunlun

*** TECHNOLOGY**:

- ★ CSIRO Multi-beam technologies for FAST
- ★ Low frequency technology 21CMA, MWA+
- ★ Antennae design

*** DATA:**

- ★ Joint effort on SKA SDP systems
- ★ SDP prototypes FAST, MWA and ASKAP
- ★ NGAS data flow systems for FAST
- ★ Pipelines on FAST
- ★ Developing regional VO capabilities
- Capabilities and opportunities to develop regional solutions for SKAclass data flows and processing



Data Canals and Rivers

ERIDANUS

Exascale Research Infrastructure for Data in Asian-Pacific astroNomy Using the SKA

Launched Nov 2016 eridanus.net.au

Advanced European Network of E-infrastructures for Astronomy with the SKA

eneas

ICRAR

FUNDED: 15 July



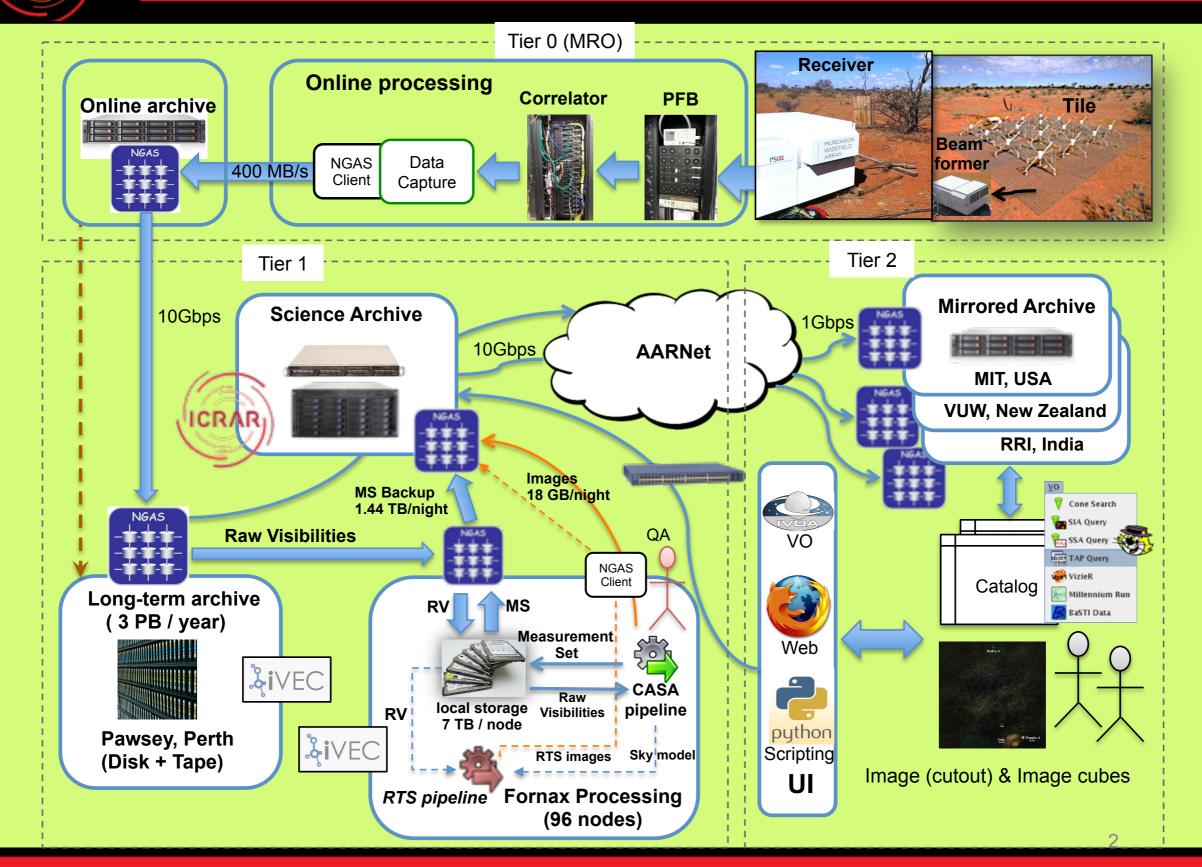
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ERIDANUS - open invitation

- The ERIDANUS Project is a three year, bottom-up, design study commencing in 2017, aimed at deploying prototype data intensive research infrastructure and middleware, between and within Australia and China, capable of addressing SKA-class data and processing challenges. The Project will respond to challenges identified by the SRCCG and will work in a coordinated and collaborative manner with the European Aeneas (Advanced European Network for E-infrastructures for Astronomy with the SKA) project.
 - Founded by ICRAR and SHAO, now includes CSIRO and in discussions with others (e.g. CADC Canada)
- **OPEN INVITATION** to others to discuss joining
- Australia-China workshop on SKA Big Data Challenges Shanghai (April 9-13, 2017)
 - See eridanus.net.au for updates

MWA data flow

ICRAR



Trials Execute a radio astronomy survey science process in the Cloud with AWS

CHILES, the COSMOS HI Large Extragalactic Survey

1002 hours JVLA B array

Jacqueline van Gorkom, Ximena Fernandez, Kelley Hess, D.J. Pisano, Kathryn Kreckel, Emmanuel Momjian, Attila Popping, Tom Oosterloo, Laura Chomiuk, Marc Verheijen, Patricia Henning, David Schiminovich, Matthew Bershady, Eric Wilcots, Nick Scoville

ICRAR

Computing efforts

Conventional Cluster (pleiades) 5 nodes each node has 2x Intel Xeon X5650 2.66GHz CPUs (6 cores / 12 HTs)

Super computer (MAGNUS) Cray XC40 - 24 cores per node 2.6GHz Intel Xeon E5-2690V3 64GB per Node 35,712 cores available 3PB of storage #58 in the world Enough computing power, however it would take weeks



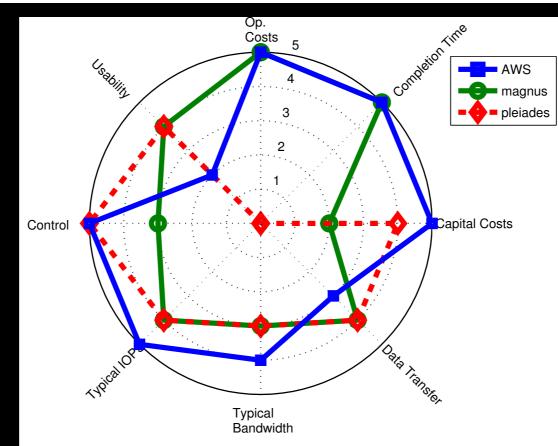
AWS Whatever we wanted r3.xlarge 16 cores 122GB Ram



Environment comparison

ICRAR

AWS		Magnus	Pleiades		
96hr	5	110hr	5	1,060 hr (est.)	0
\$0	5	\$340,000	2	\$50,000	4
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1Gb (high variance)	3	10Gb	4	$10\mathrm{Gb}$	4
$\sim 300 \mathrm{MB/s}$	4	$\sim 100 \mathrm{MB/s}$	3	$\sim 100 \mathrm{MB/s}$	3
$\sim 1,000$	5	~ 100	4	~ 100	4
Root Access	5	Limited Access	3	Root Access	5
Python/Boto	2	Python	4	Python	4
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International Centre for Radio Astronomy Research DALiuGE – Data-Activated Liu (流) Graph Engine for Harnessing the Astronomical Data Deluge



Chen Wu (ICRAR, UWA)







Government of Western Australia Department of the Premier and Cabinet Office of Science



Why DALiuGE (II)

Algorithms best algorithm to get the desired answer Pipeline Logic reduction components and sequence **Component Parameters** default parameter values of components Data Parallelisation hints about the potential of parallelism Parallel Execution what is executed where Parallel Coding writing parallel code Code Optimisation optimise parallel code I/O Optimisation optimise I/O on hardware OS and hardware co-design optimise hardware for code to be run

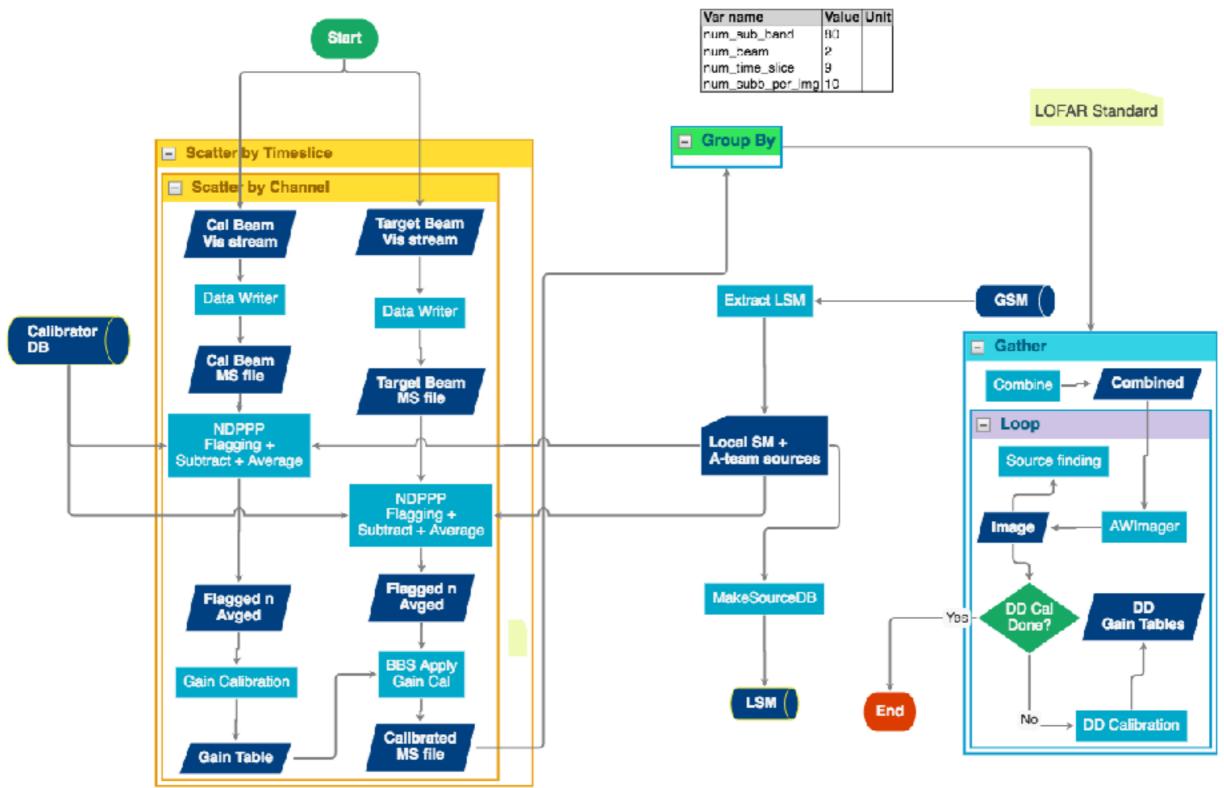
Astronomer Operator HPC Software Engineer OS level S/W Engineer Computer H/W

5

Engineer

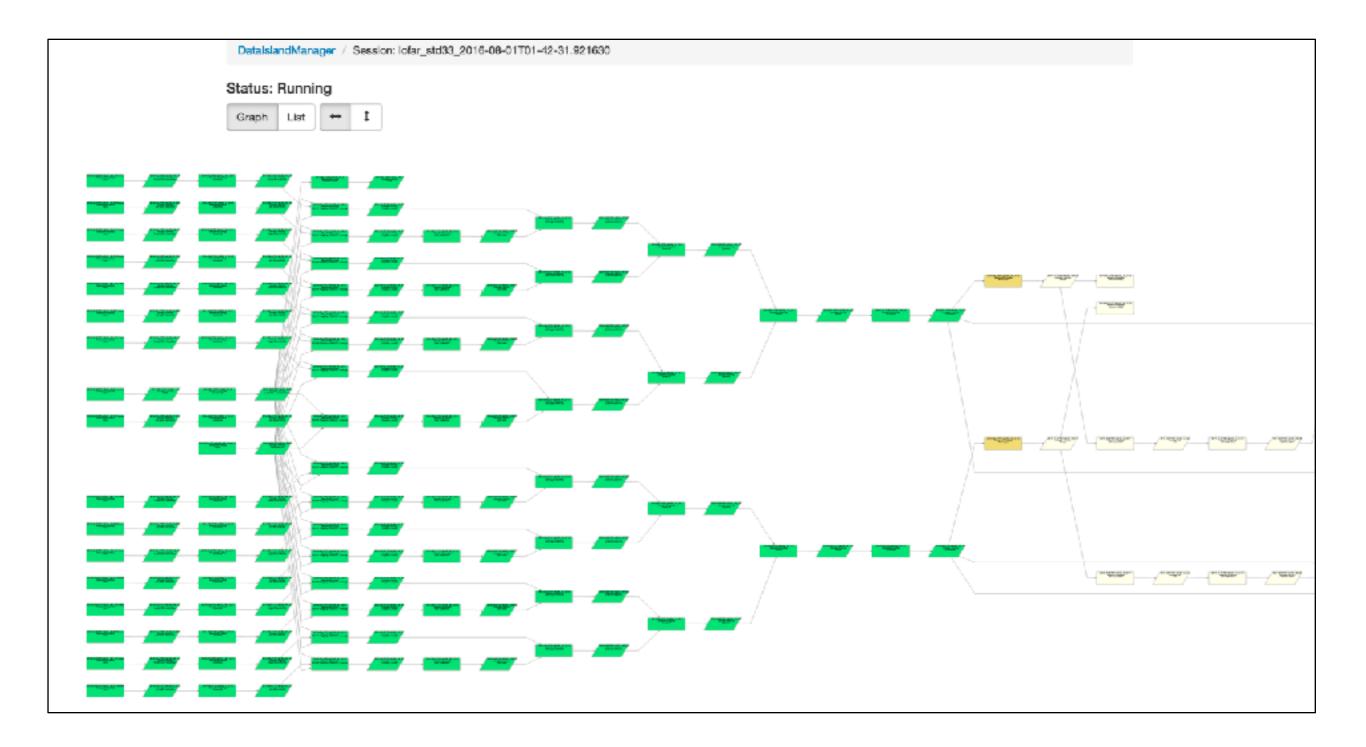


DALiuGE Case study – LOFAR





DALiuGE Case study – LOFAR



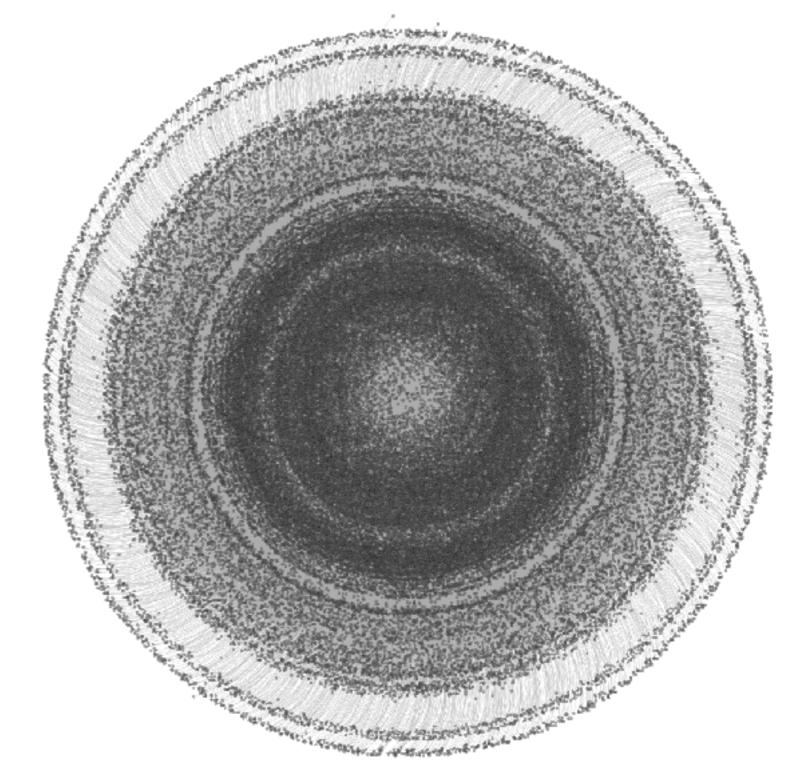


DALiuGE Case study – LOFAR



70K Drops running on 500 compute nodes at the Tianhe-2 Supercomputer for simulated LOFAR imaging "Dry" run

Gray – Drops not yet started Yellow – Drops being executed Green – Drops completed executions Red – Drops failed



Future

ICRAR

- ERIDANUS deployment of processing and storage prototypes and scaling tests to SKA-1 scale using largest facilities available in Australia and China
 - Focused on precursor needs: ASKAP, MWA and FAST
 - Focused on large-scale surveys: CHILES+, GLASS, IMAGINE, as workflow and CLOUD testbeds
 - Focused on ASKAPsoft, DALiuGE and codeveloped technology with industry: Nyriad (NZ) on new processing/storage HW (GPU optimisation)
- Australian SKA Regional Centre requirements definition (with SRCCG and KSPs) and Australian government funding application (2017?)