



BRIEF: NON-ASTRONOMY BENEFITS OF THE SKA

Information Technology

The SKA will require exascale computing to process the 'real time' data torrent from over 3000 antennas. It will be one of the world's most demanding applications for high performance computing. Working closely with other data-intensive domains (climate, health, security), the SKA will help drive the development of broad-based archiving, data manipulation/retrieval and sharing systems, spearheading the e-research revolution over the coming decade.

High performance computing (HPC) has been a significant driver of technologies that are now widely adopted in everyday life: distributed computing, parallel computing, cluster computing, grid computing, large-scale data management, compilers, processor design and system design. Supercomputers are routinely used for numerous scientific and industrial applications ranging from weather prediction through to protein folding and aeroplane design. Most HPC applications are simulations, where complex phenomena are modelled to provide prediction and warning services. HPC is now emerging as an essential tool for tackling some of the world's other pressing challenges, from modelling climate change to designing 'smart cities'.

The world's fastest computer is currently the Jaguar system at Oak Ridge National Laboratory, which has petascale computing power. The SKA provides a pathway to exascale computing, a thousand times greater than petascale, which will provide the power to address immense and complex problems.

The SKA challenge is a primary driver for HPC developments, as it needs to:

- ▶ Ingest huge data flows and analyse patterns in real time;
- ▶ Manage the timing of data flows to the major data processing centre;
- ▶ Manage exascale computing and data storage (smart archiving).

Expected outcomes from the SKA computing challenge are:

- ▶ An ability to solve immense and complex IT problems in a more effective way;
- ▶ Better systems to support remote regions world-wide;
- ▶ Improved techniques in the management of very large scientific instruments and archives;
- ▶ Improved transnational collaboration in an 'open skies' approach.

Artist's impression of dishes that will make up the SKA radio telescope. Credit: Swinburne Astronomy Productions/SKA Program Development Office.



CASE STUDY

CERN and the World Wide Web

Tim Berners-Lee and major collaborations at CERN were the genesis of the world wide web. As an independent contractor at CERN during 1980, Berners-Lee proposed a project on a hypertext concept to share information among researchers. In 1989, on his return to CERN from the United

Kingdom, he recognised the opportunity to join hypertext with the Internet. At that time, CERN was the largest Internet node in Europe. The first web site built was at CERN and was first put 'online' on 6 August 1991. The World Wide Web Consortium was then founded by Berners-Lee at MIT in 1994, with standards based on royalty-free technology that has allowed it to grow freely and globally. The SKA offers an ICT challenge on a similar scale to that of the CERN infrastructure.

CASE STUDY

Single Digital Backend for the SKA?

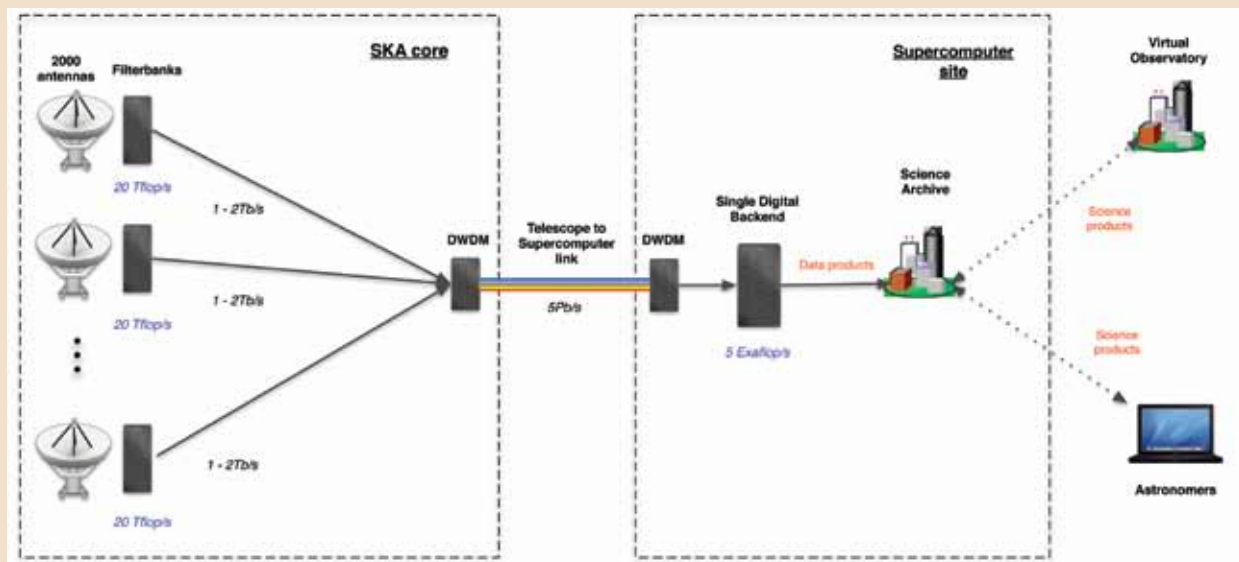
The sheer scale of the SKA demands a flexible, adaptable and low-cost processing system for the massive digital data stream, estimated at 2–5 Petabits/sec, which will be constantly streaming from all the SKA antennas. This corresponds to transmitting about 100,000 full length movies each second! An option being investigated by IBM and CSIRO is to base all of the digital processing on a single supercomputer running a standard operating system called a 'single digital backend' (SDB). This would be a significant evolution from existing radio astronomy systems which have been based on bespoke, inflexible, digital processing systems ahead of the imaging computer. The SDB would reduce complexity and offer real flexibility in its operational capabilities – making the SKA a true 'software/

ICT telescope'. The SDB has the potential to significantly augment the scientific capabilities of the SKA; the SDB would be made available for targeted, unique science observations and for community-based development of observational techniques enabled by the SDB concept.

Tools and techniques developed to realise the SDB will also be applicable across a wide variety of other applications that have very large input data rates and require on-demand access to exascale computing resources such as geophysical processing, on-demand storm modelling and real time medical imaging.

Realising the SDB requires Terabit/sec (100 movies per second) transmission of the digital signal to a supercomputer over long-distance networks: this SKA-related development is discussed in the accompanying Communications brief.

Diagram of SDB implementation for the SKA. Credit: Tim Cornwell, CSIRO.



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Australian Government

New Zealand Government

