anzska
Square Kilometre Array ▸ Australia ▸ New Zealand

askaic
Australasian SKA Industry Consortium

BRIEF: NON-ASTRONOMY BENEFITS OF THE SKA

Communications

Requiring point-to-point connectivity in excess of the world's current global internet traffic, the SKA will be at the cutting-edge of innovation in broadband networks. The exacting requirements for radio astronomy to detect the feeble signals from the distant cosmos will continue to drive the invention of novel technologies for signal detection receiver technologies and data transmission capacity.

It is estimated that humanity has spoken five million million million words in its entire history. This is also the total amount of information that will be collected by the SKA in its first week of operation. As such, the communications infrastructure for the SKA will be the largest terrestrial system link in the world and will transmit data to the world's most powerful computing facilities.

Preserving the physical and signal integrity of optical fibre across hundreds, perhaps thousands, of kilometres of remote environment; addressing redundancy issues; aligning the signals into a fully automated process; and maintaining or enhancing the transmission capability of such a link offers challenges for the global telecommunications industry. Cost effective, high capacity compression technologies and photonics techniques will be required for the SKA and adaptable for all global applications.

Regional communities and industries will benefit from a broadband fibre network. Significant non-science benefits will be realised with the establishment of broadband capacity to regional communities, delivering economic and social returns to the region, as well as providing the tools for large-scale environmental modelling of natural resources and events. Efficacy of almost all industry will be enhanced by pervasive broadband capacity leveraging off the SKA.

Note: For comparison, the data rate for ASKAP to the central processor is about one movie's worth of data every two seconds: this is a factor of 200,000 less than that for the SKA core (that is, 'only' 40 Gigabits/sec).

"...the communications infrastructure for the SKA will be the largest terrestrial system link in the world and will transmit data to the world's most powerful computing facilities."

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

CASE STUDY

Radio Astronomy and Wi-Fi

CSIRO's Dr John O'Sullivan and his pivotal work in the development of Wi-Fi technology is a powerful and compelling demonstration of the huge benefits that can flow from ground-breaking research in this field.

The invention came out of CSIRO's pioneering work in radio astronomy. Dr O'Sullivan and his team determined that they could send information over many different frequencies, linking the signal up again at the receiver. That work involved complex mathematics known as 'fast Fourier transforms' as well as detailed knowledge about radio waves and their behaviour in different environments. Indoor environments are particularly difficult for the rapid exchange of large amounts of data using radio waves. CSIRO solved these problems in a unique way at a time when many of the major communications companies around the world were trying, but with less success, to solve the same problem.

Wi-Fi technology is now in use in over 800 million wireless devices around the world such as computers, printers, game consoles, TV sets and phones. Forecasters predict that there are likely to be more than a billion devices sold worldwide over the next several years using the technology invented by CSIRO scientists.

The winner of Australia's 2009 Prime Minister's Prize for Science, CSIRO's Dr John O'Sullivan. Dr O'Sullivan won the prize for his achievements in astronomy and wireless technologies. Credit: Bearcage Productions.

CASE STUDY

Fast, Long Data Transmission

The SKA will require data transmission rates of 1 Terabit/sec to get the digital signal from every antenna to the SKA supercomputer to exploit the full capacity of the receivers over the longest baselines. For the inner SKA core, this gives a total transmission rate of about 2–5 Petabits/sec. However, the most remote SKA antennas will be distributed thousands of kilometres from the core and the key will be to transmit their signal over these long distances at reasonable cost. While the data transmission rates required for the SKA are technically feasible, they are prohibitively expensive using today's terminal transmit/receive devices.

Solving this challenge will lead to innovation in wavelength multiplexing laser technology (DWDM transponders), which is the primary cost driver in this domain. The SKA will benefit by moving to industry standard 10 Gigabit Ethernet systems within the SKA's own digital systems and 100 Gigabits for long-haul transmission. The challenge for the SKA, which is about two steps ahead of the leading-edge consumer products, is to develop a separate transmission/receiver capability able to provide very long transmission links (that is, avoiding multiple regeneration of the signal every 50 km or so) at 100 Gigabits, optimised for unidirectional massive data flow. This equipment would lead to a 10-fold increase in capacity on the existing fibre infrastructure (for example, provided by Australia's national broadband network and its global equivalents).

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Australian Government

New Zealand Government

CSIRO

The Government of Western Australia