Submission No. 11
(SKA Pathfinder Radio Telescope
M.R. 01/09/08

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Mr James Catchpole
Committee Secretary
Parliamentary Standing Committee on Public Works
PO Box 6021
Parliament House
Canberra ACT 2600

Dear Mr Catchpole,

AUSTRALIAN SKA PATHFINDER (ASKAP) RADIO TELESCOPE

Thank you for your letter of 13 August 2008 inviting comment on the merit and worth of the ASKAP radio telescope.

I have been associated with Australian radio astronomy since 2003. My initial interest was from the perspective of long term business development for my employer, Cisco Systems. Cisco is a mult-national communications company and a high proportion of the world's internet traffic runs on Cisco equipment.

In 2004 I was invited to join the Australia Telescope Steering Committee (ATSC) as a member and I became the Chair of that body in 2007. The ATSC is Australia's senior governance board for radio astronomy in Australia. It provides advice primarily to Australia's senior radio astronomer who is the Director of the Australia Telescope National Facility (ATNF) at Marsfield in Sydney. The ATNF is a component of CSIRO.

Next generation radio telescopes, of which ASKAP is one of the first, will be built largely from commercially manufactured components and will achieve their performance through software and supercomputing more than in hardware. In this regard, these new telescopes are quite unlike their predecessors such as "The Dish" at Parkes and the Australia Telescope Compact Array (ATCA) at Narrabri.

Networked telescopes, such as ASKAP, will generate huge amounts of data which needs to be gathered, transported, processed, stored and made ready for analysis by astronomers. We should anticipate that the Information, Computing and Telecommunications (ICT) infrastructure required to support ASKAP, in its own right and as a precursor to the mature Square Kilometre Array (SKA), will spawn new technologies and innovation in numerous areas of academic research and industry sectors including:

- ICT

- Sustainable energy
- Systems engineering and control
- Integrated maintenance and logistics
- Modeling and simulation

The potential exists for ASKAP, and later on the SKA, to become a keystone element of Australia's national innovation system.

Radio Physics: A National Strength
Australia's consistent support for and investment in radio astronomy over the past 60 years has brought direct and indirect benefits which are substantial.

- Australia's current suite of radio telescopes, notably at Parkes and Narrabri, are among the most productive telescopes in the world, using conventional academic benchmarks – citation rates, first authorship, etc.

- Radio physics emerged from the development of RADAR in World War 2 and is an area of national research strength which has attracted support from successive governents. Some of the fundamental science, notably deep understanding of the ionosphere, gave the Australian Defence Force the confidence to invest in the Jindalee Over-the-horizon Radar Network (JORN) which provides broad area surveillance of Australia's northern approaches.

- The internet wireless protocol, now taken for granted by millions of people around the world, was developed by CSIRO as an offshoot of radio astrophysics at Marsfield in Sydney.

- Australia has a small but world class capability to design, build and install precision scientific instruments. For example, the receivers on the radio telescope at Aricibo in Puerto Rico were built by ATNF at Marsfield.

ASKAP and the SKA
ASKAP is an important stepping stone to the Square Kilometre Array (SKA) telescope. It will not be unreasonable to characterise the SKA, once completed, as the "mother of all networks", given the amounts of data involved, the distances to be covered and the complexity of the telescope system itself which needs to be tasked, operated and monitored. Once built and operational, the SKA will be the world's largest scientific instrument. The SKA project represents to Australia in the 21st Century what the Snowy Mountains Scheme represented in the 20th Century. ASKAP is a critical step in Australia's bid to host the SKA and in the technology solution which the SKA will eventually adopt.

Further comments are provided under questions drawn from your letter.

Is the work needed?
Australia's current generation radio telescopes are approaching their research limits as a function of their design and construction. Although they continue to produce excellent results their fundamental designs constrain them from taking best advantage of the ICT revolution.

There are compelling reasons to invest in ASKAP now.

- ASKAP is a new generation radio telescope which may be expected to allow Australia to maintain its place at the forefront of global astronomy for the next 20-30 years. Astronomy, and radio astronomy especially, is a national research strength. This is a function of:
    - Australia's location in the southern hemisphere offers a unique vantage point from which to observe distant sources in the universe of high interest;
    - many parts of the Australian continent are radio quiet and likely to remain so into the foreseeable future; and
    - the considerable and considered investment which successive Australian governments have made in radio astronomy over the past six decades.

- Within the next decade, Australia's current suite of radio telescopes almost certainly will require substantial overhaul of their electronics, drives, and primary structures. Such activities are costly and time consuming. The costs and benefits of refurbishing these instruments will need to be carefully evaluated against the costs and benefits of moving to a new generation of telescopes. The new telescopes will operate in a much better radio environment[1] will cost less to operate and maintain than do their predecessors and will produce a lot more data which should help astronomers to unravel some of the remaining 'Big' questions of science.

- ASKAP is a technology and operational pathfinder telescope for the SKA. The receivers developed for ASKAP, known as focal plane phased arrays, involve considerable technical risk – risk which has already been brought down considerably by the installation of a technology test bed system at Parkes. This system is already producing promising results and gives cause for confidence and optimism in the utility of focal plane phased arrays in next generation radio telescopes.

Will the proposed work adequately satisfy the need?
Australia has already invested in excess of 20m dollars in preparatory activities for the SKA. The proposed additional investment for ASKAP is in the order of 100m dollars to construct and 10-15m annually to operate. ATNF's initial plan for ASKAP involved an array of up to 45 antennas. This number was contingent on funds being available from an international partner which did not progress. A number of 36 antennas is now proposed which still delivers an exceptionally capable telescope.

An advantage of radio telescopes is that more antennas can be built and brought into service as funds become available. As ASKAP proceeds I hope that additional funds will be provided to add antennas to the system in order to demonstrate conclusively the power of the instrument and the potential of the technology when applied to the SKA.

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[1] Radio frequency interference (RFI) is almost negligible at the site proposed for ASKAP in Western Australia. The central west of New South Wales (including Parkes, Narrabri and Coonabarabran) is considerably more noisy from the RFI perspective and expected to worsen over time.

Is the estimated cost of the work justified?
The proposed direct investment of the Commonwealth in ASKAP is in the order of 100m dollars. In addition, the Government of Western Australia has committed further funds to assist with site access and related infrastructure. Since 2006, Australian industry has also made a modest direct investment through an organisation now called the Australian SKA Industry Consortium (ASKAIC). This group has as its primary goal to provide such support as is appropriate to secure the SKA for Australia. A secondary goal is to facilitate interaction between industry and ATNF and to build a culture of cooperation and collaboration. A tertiary goal is to ensure that Australian industry is able to bid for as much work as possible within ASKAP and, later, the SKA project. ASKAIC views ASKAP as an essential step on the path.

Within the context of the resources boom, the WA Government is commended for its strong support of ASKAP and SKA. A 100m dollar project pales to insignificance beside some of the mining and energy projects currently under development. The WA Government could have simply walked away from radio astronomy as being a distraction from the generation of more short term wealth. That it has not done so may be taken as an indicator of the overall importance to Australia of ASKAP. A vibrant, well-resourced science community is a prerequisite for any economy which places a high value on innovation and ASKAP is a key component of capability.

ASKAP is one element within Australia's national capability in radio astronomy. Other programs and projects are working in parallel to develop the science and engineering workforce which will be needed to construct and operate the telescope. The PWC can be confident that ASKAP will be well-used.

ASKAP will deliver modest direct economic benefit to the Mid-West during the construction phase of the project. More importantly, it may be expected to generate a small number of jobs – from the semi-skilled to professional levels which will endure for the life of the telescope. New jobs will be created in areas which include site security, technical and broader site maintenance and telescope and data centre operations. The support facility which is proposed to be located at Geraldton may well be expected to attract a number of highly skilled computer specialists from which further industry development opportunities in the Mid-West may well arise.

My sense is that the investment of $100m by the Commonwealth in ASKAP will be repaid many times over in the life of the telescope through the contribution it will make to the intellectual capital of the nation, the State and the Mid-West region of WA.

What revenue, if any, will the proposed work generate for the Commonwealth?
ASKAP is not planned or likely to produce direct revenue for the Commonwealth. It's purpose is scientific discovery in areas of fundamental physics. However, new discoveries, new and novel use of materials and new approaches to data collection and management may well be expected to foster patents from which the Commonwealth may derive benefit over time. Even within the global astronomy community, new instruments, whether built in hardware or software, may also be expected to generate modest income for the Commonwealth as they are sold to other observatories around the world.

Summary and Conclusion
ASKAP represents a stake by government in the future of Australian science through continued investment in and support for radio astronomy. ASKAP will be the fastest whole-of-sky radio telescope in the world when commissioned in 2012. It is also a technology and operational pathfinder for the SKA which is a nation-building project with potential and possibilities well beyond astronomy.

In my judgement ASKAP represents value for money and an exceptionally wise investment in a piece of science infrastructure of national and international importance. I commend the project to the Public Works Committee.

The Public Hearing
I understand that the PWC will hold public hearings about ASKAP on Friday 19 September 2008. I am due to be in the United States at that time but would be more than willing to give evidence by phone, should the Committee see merit and value in me doing so.

Yours sincerely,

Brett Biddington
Chair
Australia Telescope Steering Committee.