SKA leaning towards winners on both sides

Sasha Planting

Talk is that South Africa and Australia will host the giant radio telescope.

In exactly a year from now the international bid committee on the Square Kilometre Array (SKA) project will decide whether it will be South Africa or Australia which will host the giant radio telescope. But as the deadline nears, word on the street is that there will be no outright winner. Instead the bid committee is entertaining the idea of a 'win win' scenario. As implausible as it seems, as the design of the SKA is refined and re-refined it is becoming technically plausible to divide the telescope between the two countries.

Up until now the plan has been to assess both countries in an effort to pick the "best". That is, the best site, science, engineering design, project management, government policy, legislation and so it goes on. But this is a €2bn project, funded and managed by a consortium of 16 countries and requiring €150m to €200m a year for 50 years for maintenance and operations. Picking the "best" is not that simple.

As the time to decide grows nearer it is becoming evident that both countries have strengths and weaknesses. Questions are being raised on whether these could be combined into a best of both worlds solution. SA and Australia have both invested significant resources into the project and have developed remarkable and critical capacity in their particular areas of focus. SA's strength lies in big reflector antennas, but this is just one component of the envisaged SKA project. The other two are big aperture arrays and sparse arrays.

The Karoo Array Telescope (MeerKAT) is SA's precursor instrument for the Square Kilometre Array, but will in its own right be amongst the largest and most powerful radio telescope in the world. Australia is building the Australian SKA Pathfinder (ASKAP) radio telescope, using a different design, and creating another world-leading astronomy research facility in the process.

"These are the last two radio quiet areas in the world," says a source close to the project. If there were telescopes in two different places then observation [of a particular point] could take place 24 hours a day.

This is not yet official policy, says another source, but it is being considered. "The obvious limitation is the cost."

Whether the decision goes in favour of one, the other, or both, local companies working on the project are attracting international attention. They include EMSS, a Stellenbosch company which works with the team on innovative receivers, radio feeds and cryogenics; Tellumat, which is working on the manufacturing of boards and receivers; MMS and BAE Land Systems, which have built the composite dishes; Optic 1, which built the power and optical fibre cables to the site; Broadband Infraco, which is connecting the site to Cape Town and the world, and Stellenbosch-based MESA Solutions, working on electromagnetic compatibility.

Together they are developing and testing the technologies appropriate to the SKA, including the use of composite, one-piece reflectors, single-pixel wide-band receivers, low-cost, high-reliability cryogenic systems, and reconfigurable digital processing systems.

None of the companies involved can (or will) quantify the financial benefit of their involvement in the SKA project. But the benefits are obvious in other ways, they say.

For instance EMSS, which has a global reputation for the computational methods it has developed to solve big electromagnetic problems, has tripled the size of its subsidiary working on the SKA project, EMSS Antennas.

Tellumat, which has an established reputation for its ability to develop and manufacture complex systems, has extended its skills set. "We are involved in research on and the development of cryogenic low noise amplifiers [cooled to -240ºc] which were typically imported from the US," says COO Shawn Hendricks. "This is a new area of expertise for us."

It is also manufacturing the digital signal processing boards (computers with the ability to suck in vast quantities of data, processes it and send it on) which have recently been developed by Meerkat engineers. "This is a complex electronic product – it's the type of technology many people do not associate with South Africa, and it requires world class manufacturing skills," he says.

This system, with the unfortunate acronym ROACH (reconfigurable open architecture computing hardware) will be a primary building block for digital signal processing systems in many next-generation radio telescopes, adds Adrian Tiplady, project scientist, SKA SA. "Beyond the telescope it is a cutting-edge innovation that enables highly specialised and high-performance computing."

Initially he sees its application in telecommunications networks. "Radio astronomy and the telecoms industry have been closely linked for past 60 years." It was a radio astronomer who invented the wireless network. Radio astronomy also takes the credit for the development of low power X-ray imaging, and GPS networks.

But the difficulty with such specialised technology is that other, more commercial applications, are not always apparent, says LJ du Toit, MD of EMSS Antennas. "For instance, we are working on high precision antennas that are cryogenically cooled, that operate in a very deep vacuum, using high end microwave equipment. There are not many companies that require that type of technology."

It is perhaps difficult for individual companies to commercialise bleeding edge technology, but there is little doubt that SKA's science will benefit the commercial world. "This is niched technology," says Tiplady. But commercial problems typically look to science for solutions. The cryogenic cooling systems being developed could have other applications – like MRI machines which require cooling systems to work. (Heat generates noise and instability in a system he explains). SKA research is leading to the development of technology that is making the cooling process easier and enabling systems to work at higher temperatures. "This will have applications in other systems."

Other research underway is basic research, where the benefits are indirect and happen over a long time. For instance the SKA team is developing new algorithms. For instance, their big challenge is the need to process data fast. "We are generating terabytes of information per second; you can't just dump that on a hard drive. The algorithm development we are working on and the technology that is developed from that has to have commercial application – the world's data processing demands are growing."

But arguably the biggest economic benefit is the massive human capital programme that the SKA project is driving. “We are creating a population of professionals armed with analysis and critical thinking skills. Their use in a society goes way beyond complex engineering. The treasury department of any big bank is not populated with economists, but with engineers and the like - people who have problem solving and analytical skills. And these are the people we are developing.”