Future ATNF Operations

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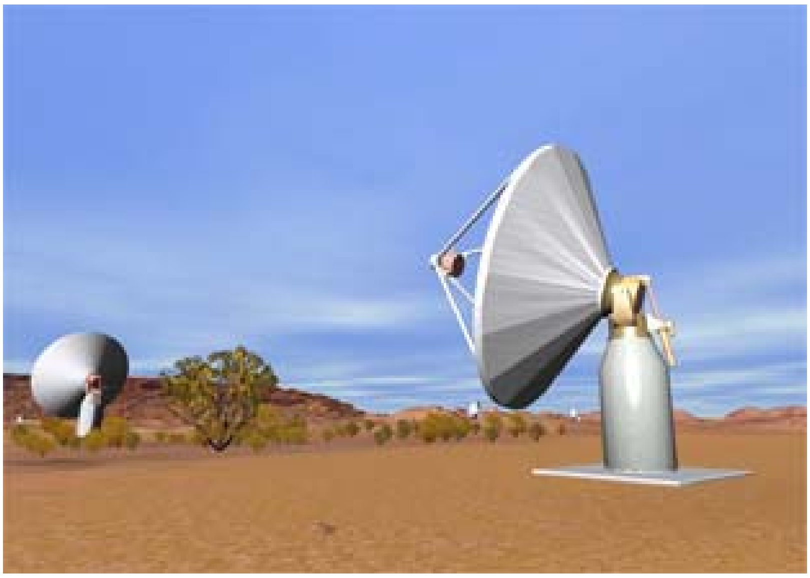
Jessica Chapman, CSIRO-ATNF Operations Research Program Leader
Lewis Ball, CSIRO-ATNF Deputy Director
David McConnell, CSIRO-ATNF Operations Theme Leader



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1. INTRODUCTION

One of the most important issues for the Australia Telescope National Facility today is to plan the changes to operations necessary to implement the strategies for radio astronomy outlined in the 2006 Australian Astronomy Decadal Plan. By 2012 the Australia Telescope National Facility will be operating four world-class observatories: the Australia Telescope Compact Array, the Parkes and Mopra radio telescopes, and the Australian SKA Pathfinder telescope (ASKAP) – currently under development. These facilities will also be operated together for very high angular resolution observations as the Long Baseline Array, and all are supplemented for a small fraction of time by scientific access to the 70m antenna at Tidbinbilla.

Planning for future ATNF operations began in early 2007. In December 2007, a document *Future ATNF Operations (Version 1)* [1] was prepared for discussion with the ATNF Steering Committee and this document was made available to the user community in February 2008.

This current document is Version 2 of *Future ATNF Operations*, incorporating substantial revisions and extensions since Version 1 with the intention of better reflecting the ATNF's thinking and the alignment of that thinking with the needs and priorities of the astronomy community.

Since Version 1, much progress has been made in ATNF Operations. Some of the highlights are:

Community consultation: An extensive process of seeking input and consulting with the user community on the operations plans and the ATNF science priorities has taken place over the last six months [2], [3]. This has been extremely valuable and has had a big impact on the development of the ATNF's plans for the future;

Operations restructure: The ATNF Operations theme has now been restructured into two streams, for science and engineering operations.

Science Priorities: An essential part of the planning process has been to clearly identify the ATNF Science Priorities for the period 2010 – 2015. A document outlining these priorities is now available [4].

ASKAP user policy: Good progress has been made towards establishing the user policies for ASKAP. An international taskforce set up specifically to provide advice on ASKAP user policy issues provided its recommendations to the ATNF Director on 21 October 2008, significantly ahead of schedule. A draft ASKAP User Policy has since been released for comment [5]. On the basis of the draft ASKAP User Policy, a call for Expressions of Interest in the major Survey Science Projects that are anticipated to make up ~75% of ASKAP science time has been released [6].

ASKAP 12-m testbed antenna: A new 12-m testbed antenna for ASKAP has been successfully commissioned at the Parkes Observatory, with extensive input from operations staff, resulting in very promising first light tests with the new phased array feed receiver for ASKAP.

A new 12-mm receiver at Parkes: A new and far more sensitive 12-mm receiver has now been commissioned at Parkes with excellent first science results obtained in September 2008.

These have all added up to a busy and productive period, especially as all of this work has been in addition to the core daily tasks of operating ATNF's facilities and providing observing and other support to our many visitors and observers. It is a credit to all of our operations staff that this has been possible.

The following sections describe the recent and planned operations changes in more detail, with the intention of providing the user community up to date information and an explanation of the broad context to the ATNF plans for its future operations.

Input from the community on any aspect of the operations plans, and on the science priorities, is always welcome. This should be sent either through available web forums, or by email to Jessica.Chapman@csiro.au, Lewis.Ball@csiro.au or David.McConnell@csiro.au.

We envisage releasing the next update, *Future ATNF Operations* Version 3, by April 2009. Version 3 will include more information and details on the development plans for Operations projects and the planned changes to modes of operation and instrumentation.

2. ASKAP UPDATE

2.1 Overview

The Australian Square Kilometre Array Pathfinder (ASKAP) project will deliver an array of antennas at Australia's superbly radio-quiet SKA candidate site for high dynamic range and wide field-of-view astronomical imaging using phased-array feeds. ASKAP is an international collaboration between Australia, Canada, the Netherlands and South Africa, with CSIRO having overall responsibility for the project and managing ~ AUD 111M in Commonwealth funds.

ASKAP has three main goals:

- To demonstrate and prototype the technologies for the mid-frequency SKA, including field-of-view enhancement by focal-plane phased arrays on new-technology 12-metre class parabolic reflectors;
- To carry out world-class science directly relevant to SKA Key Science Projects (KSPs);
- To establish a uniquely radio-quiet site for radio astronomy at Australia's SKA candidate site in Western Australia.

ASKAP will comprise thirty-six 12-metre diameter antennas, giving up to 630 baselines and a physical collecting area of around 4,000 m^2. Thirty of the antennas will be located within a region of two-kilometres in diameter, with six outlier antennas that extend the array baselines to 6 km (Fig 1). The array will be located in the Mid-West region of Western Australia, on the site of the Murchison Radio-astronomy Observatory (MRO). This is one of the most radio-quiet locations on the Earth, and one of the two sites selected by the international community as a potential location for the SKA.

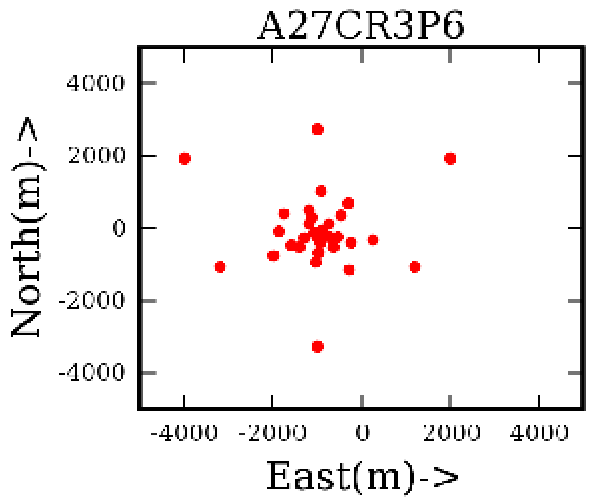

Figure 1. The selected configuration for ASKAP.

ASKAP is designed to be used primarily as a fast survey instrument. It will operate at frequencies between 0.7 and 1.8 GHz with an instantaneous bandwidth of 300 MHz, dual polarisations and up to 16,000 spectral channels. Each antenna will have a phased array feed consisting of about 100 elements as the focal plane detectors. For each antenna the beams from the feeds will be digitally processed in a beamformer to generate around 30 independent beams, giving a total field of view, at 1.4 GHz, of 30 square degrees.

The MRO will house a control building for the antenna control computers and the ASKAP correlator. After beam forming, the signals from the antennas will be correlated and the output correlated data transferred via a high-bandwidth optical fibre link to a Data Processing Centre at the MRO Support Facility (MSF) in Geraldton. A small operations group, comprising primarily engineering operations staff with responsibility for preventative maintenance, will be established at the MSF in Geraldton.

ASKAP observations, data acquisition and processing will be controlled through a small number of 'software instruments'. Each software instrument can be considered as an 'entire process' from the control and monitoring of the telescope through to the data products and archives. ASKAP data will be processed in near-real time to provide calibrated data and data products. These will be archived and the data made accessible to astronomers through access to the archives.

CSIRO will initially provide two software instruments for science operations:

- A continuum software instrument to produce calibrated images with a dynamic range of at least 10^3 over the full field of view for a large fraction of the sky (possibly excluding regions of the Galactic plane), over a bandwidth of 300 MHz with a modest number of frequency channels (minimum 256); and
- A spectral line software instrument to produce a catalogue of HI line-emitting galaxies over the field of view for a large fraction of the sky (possibly excluding regions of the Galactic plane), over a bandwidth of 300 MHz with high spectral resolution (16,000 channels).

ASKAP antennas timeline

During the first half of 2008, a 12-m antenna was installed at Parkes as a test bed facility for ASKAP. The first observations with this antenna were taken successfully in July 2008 and the antenna is now being used with a focal-plane array for ASKAP test observations.

Commissioning of a six-element Boolardy Engineering Test Array (BETA) is planned to begin in 2010 followed by a staged rollout of further antennas until ASKAP becomes fully operational in late 2012 with the initial software instruments. Commissioning of other software instruments will occur gradually as they come online after first light in 2012. BETA will primarily be an engineering test bed, but there are also plans to use it for science verification by ATNF staff. Data from these tests will be released into the ASKAP archive (if appropriate) once adequate quality control is performed. There will not be a call for proposals for BETA although ATNF will seek user consultation regarding targets for early science verification.

2.2 ASKAP user policy

Many policy and planning decisions regarding ASKAP's future operations are yet to be made.

In June 2008 an *ASKAP User Policy Taskforce* was established to provide advice to the ATNF Director on issues relating to user policy such as the allocation of time and access to ASKAP data.

The members of the taskforce were:

Ilana Feain (Chair), Jessica Chapman, Ron Ekers, Ray Norris, Simon Johnston (ATNF);

John Dickey (UTas);

Ken Freeman (ANU),

Elaine Sadler (USyd);

Ingrid Stairs (UBC, Canada); &

Lister Staveley-Smith (UWA).

The Taskforce provided its recommendations on 21 October 2008.

2.2.1 Operational principles

The draft set of operational principles for ASKAP is as follows:

- ASKAP telescope time will be assigned to astronomical research projects subject only to scientific merit and to technical and operational feasibility;
- No a-priori guaranteed science time will be allocated to particular countries, institutions, nor to any individuals currently on existing (2008) working groups;
- ASKAP will not be a user-operated telescope; generally users will interact with the data archives;
- The ASKAP science archive will be available to astronomers from all over the world;
- Simultaneous observing programs will be encouraged where possible;
- In general there will be three classes of observing time allocated on ASKAP; Survey Science Projects, Guest Science Projects and Target of Opportunity over-ride projects.

2.2.2 ASKAP Survey Science Projects

ASKAP Survey Science Projects will be large (>1500 hrs) and coherent science projects that make use of ASKAP’s wide field-of-view and fast survey speed to enable major science outcomes early in its lifetime. They will be large and coherent science projects that address widely recognized astrophysical issue and enable scientific results that are of general and lasting importance to the broad astronomical community.

Survey Science Teams will play a lead role in survey design, software instrument design, early science commissioning, data processing and quality control and will facilitate the delivery of Survey Science Project data and data products to the ASKAP science archive.

Processes for establishing the Survey Science Project teams commenced in November 2008 with fully open access for membership to these teams. To facilitate interactions with ASKAP designers, each Survey Science Team will include at least one ATNF staff member. As a first stage in the proposal application process, Expressions of Interest to submit a proposal for a Survey Science Project have been invited from the international astronomy community. Full information on submitting expressions of interest and on subsequent steps in the process are available from the ATNF web site [6].

It is anticipated that:

- For the first five years of routine science operations with ASKAP, at least 75% of observing time will be used for Survey Science Projects.
- Data and data products from the Survey Science Projects will be made available to the ASKAP archives in a timely way to enable effective opportunities for follow-up observations and for archival research with ASKAP and other facilities.
- All data such as calibrated visibilities, images and spectral cubes (where feasible) will be made publicly available to the archive on a time scale determined by operational issues (e.g. quality control) and not proprietorial interests.
- Additional data products (such as catalogues and spectra) that are provided primarily by ATNF will made publicly available to the archive on a time scale determined by operational issues (e.g. quality control) and not proprietorial interests.
- Ranking of Survey Science Projects will take into account the intention of the Survey Science Teams to provide value-added products to the ASKAP archive.

2.2.3 Guest Science Projects

Guest Science Projects will be smaller observational programs that require less observing time to complete but also use ASKAP's wide field-of-view and fast survey speed to enable scientifically valuable experiments.

Guest Science Projects will be selected by a competitive peer-review process through a Time Allocation Committee and proposals will be submitted using the OPAL proposal application systems. It is expected that for the first five years of routine science operations with ASKAP, approximately 25% of time will be made available for Guest Science Projects.

By default, the data and data products obtained from Guest Science Projects will be made publicly available to the archive without a proprietary period. However, if reasonable grounds are established in a proposal, the TAC will have the discretion to allow a proprietary period of up to 12 months.

3. ATNF SCIENCE IN 2010 – 2015

During 2008 discussions and science meetings have been held at several locations in Australia to assist in the identification of the science priorities for the years 2010 – 2015. The high-priority science goals for this period are outlined in the document *ATNF Science Priorities* Version 2 [4]. Table 1, compiled from the *ATNF Science Priorities* [4], provides a summary of the highest-priority science goals for ASKAP, the Compact Array, Mopra and Parkes. In this table the science priorities of each facility are ranked. However, the facilities have not been ranked against each other.

As emphasized by the user community, it is extremely important that decisions for the future are made within the framework of the science priorities and productivity of the ATNF's facilities. We need to identify the strengths and synergies of the ATNF facilities, and to recognise the science areas where the ATNF cannot be competitive.

The process of identifying science priorities for the individual ATNF facilities has strongly highlighted their synergies with each other and with other radio astronomy facilities around the world. Broadly speaking the ATNF facilities have different strengths that can be categorised in terms of surface brightness sensitivity and frequency coverage. Figure 2 shows the frequency coverage for ASKAP, the Compact Array, Mopra and Parkes, as expected in 2012.

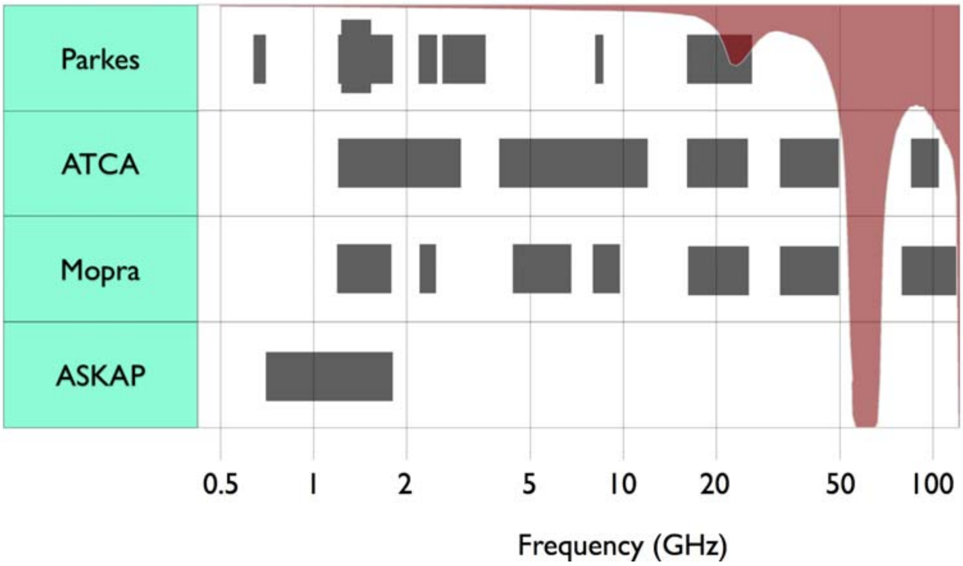

Figure 2 Spectral coverage of ATNF telescopes in 2012. **The shading indicates the atmospheric opacity; features due to H_2O (22GHz) and O_2 (60 GHz, 120 GHz) are visible.**

ASKAP will operate in the 1 GHz band with moderate to long baselines (2 – 6 km). It will provide an outstanding facility for fast, wide-area surveys. The Compact Array operates over a much wider range of frequencies and is expected to focus increasingly on higher frequencies (2 – 50 GHz) and compact configurations with high surface brightness sensitivity. Mopra will continue to be a world-class niche instrument for high-frequency, broad-band spectral line studies, and will play an essential role in identifying sources for ALMA studies. Parkes will continue to excel as the best facility in the world for pulsar studies, and as a powerful facility across a broad range of frequencies for Galactic and extra-galactic studies. The LBA will provide the highest angular resolution at frequencies of 1 – 22 GHz and is particularly powerful for studies of motion.

The science priorities document [4] incorporates feedback from the user community received through a web forum and other discussions. Further discussion and input from the user community is welcome.

Table 1 Summary of the ATNF science priorities for 2010 – 2015

Notes are given in italics. An asterisk in column 3 indicates desirable or highly desirable.

High-priority science goals	Rank	Requirements (see Table 4, page 19)
ASKAP		
Understanding the evolution in the nearby Universe through HI emission line surveys. *Detection of around one million galaxies.*	1	1, 2, 3,4 ,5
Determining the evolution of galaxies at high-redshift through high red-shift continuum studies. *Detection of synchrotron emission from around 60 million galaxies.*	2	6,7
Characterising the transient and variable radio sky. *Detection and monitoring of transient sources such as gamma-ray bursts, radio supernovae and intra-day variables.*	3	8,9,10
Uncovering the nature of magnetic fields in the universe. *Detection of polarized emission from about 500,000 galaxies, and studies of Galactic polarization.*	4	11,12
Australia Telescope Compact Array		
Star formation	1	1,2,3,4*
Magnetic fields throughout the Universe	2	2, 4, 5, 6,
Understanding the variable sky	3	6, 7, 8, 9
Gas in and around the Milky Way and nearby galaxies	4	2, 4*, 10, 11, 12*
Evolution of galaxies at high redshift	5	2, 3*, 4*, 6, 13, 14
Exploring the unexpected	6	6, 7, 15, 16
Mopra radio telescope		
Star formation	1	1, 2, 3, 4, 5
Dense gas in and around the Milky Way and nearby galaxies	2	1
Exploring the unexpected	3	1, 6, 7
	4	
Parkes radio telescope		
Large-scale pulsar surveys *Ranked equally with pulsar timing.*	1	1, 2, 3, 4*
Pulsar timing *Ranked equally with pulsar searches* *Includes regular timing of samples and detailed studies of individual sources.*	1	5, 6, 7, 8*
Sensitive surveys for diffuse emission in the Galaxy and in other galaxies	3	9, 10
Star formation studies *Primarily for the 12-mm band which includes both H_2O masers and NH_3*	4	1, 11, 12
Miscellaneous smaller studies and the unexpected *Includes studies of individual sources and educational projects such as PULSE@Parkes.*	5	13, 14, 15

4. FUTURE ATNF OPERATIONS MODEL

4.1 Overview

Once ASKAP science operations begin in 2012, the ATNF Operations group will be responsible for the operations of the five facilities, ASKAP, The Australia Telescope Compact Array, Parkes, Mopra and the Long Baseline Array.

Planning to consider changes to our Operations that will enable us to operate ASKAP in addition to our current facilities began in early 2007. The requirements are stringent with the major goals of continuing to be a leader in radio astronomy and to carry out world-class research with our current facilities whilst also preparing for the operations of ASKAP. This has to be achieved within tight budgetary constraints.

A model for future ATNF operations was presented in the document, Future ATNF Operations (Version 1) [1]. As stated there, the ATNF has committed to making the following changes:

1. Restructure ATNF Operations into two “streams” for Science Operations and Engineering Operations;

2. Establish a Science Operations Centre (SOC) in Sydney; and

3. Streamline supported observing modes and the telescope scheduling software.

These changes can be thought of as providing the framework for our future operations. Whilst the internal restructuring of ATNF Operations is now well underway, the detailed planning for the construction and operations of the SOC, and for streamlining telescope scheduling and supported observing modes, are far from finalized. The planning and development work needed to enable these will continue until ASKAP operations begin.

In the remainder of this section we discuss each of these major areas of change in some detail with the intent of providing considerably more context to these decisions than was included in [1].

4.2 Restructure ATNF Operations

The ATNF Operations group has now been restructured from a “site-based” management structure to a “functions-based” structure. The new structure formally replaced the current structure on 1 July 2008.

In the new structure David McConnell continues as the Operations Theme Leader. In January 2008, Jessica Chapman took on a leadership role as the Operations Research Program Leader. She has overall responsibility for Operations staff and capabilities, and also contributes to the Operations planning. Within the Operations theme two “streams” have been set up for Engineering Operations and Science Operations, and in January 2008 Brett Dawson and Phil

Edwards were appointed as the Head of Engineering Operations and Head of Science Operations respectively.

The day-to-day work activities for ATNF Operations staff are structured within eight "projects", with four in Engineering Operations and four in Science Operations. These project teams work together to share knowledge and resources with the overall aim of achieving a better integration of our capabilities and systems across the different ATNF facilities. Each project has a project leader and a project team that includes staff from either two or three ATNF sites. The project leaders were announced in March 2008, following an internal process with a call for expressions of interest. The new structure is shown in Figure 3 and a summary of the work activities for these projects is given in Table 2.

Within the new Operations structure, it is essential that the ATNF continues to provide the high level of scientific and technical expertise previously provided by the Officers-in-Charge. To do this, two new positions for Senior Systems Scientists have been established, with one for the Parkes radio telescope (located at Parkes) and one for the Compact Array (located at Narrabri). After an international search for applicants we are delighted that Ettore Carretti (Italy) has accepted this position for Parkes, while Jamie Stevens (Hobart) has accepted the position for the Compact Array. Both are expected to start in early 2009. The operations support provided by these positions will be part of the Telescope Operations and Science Services project.

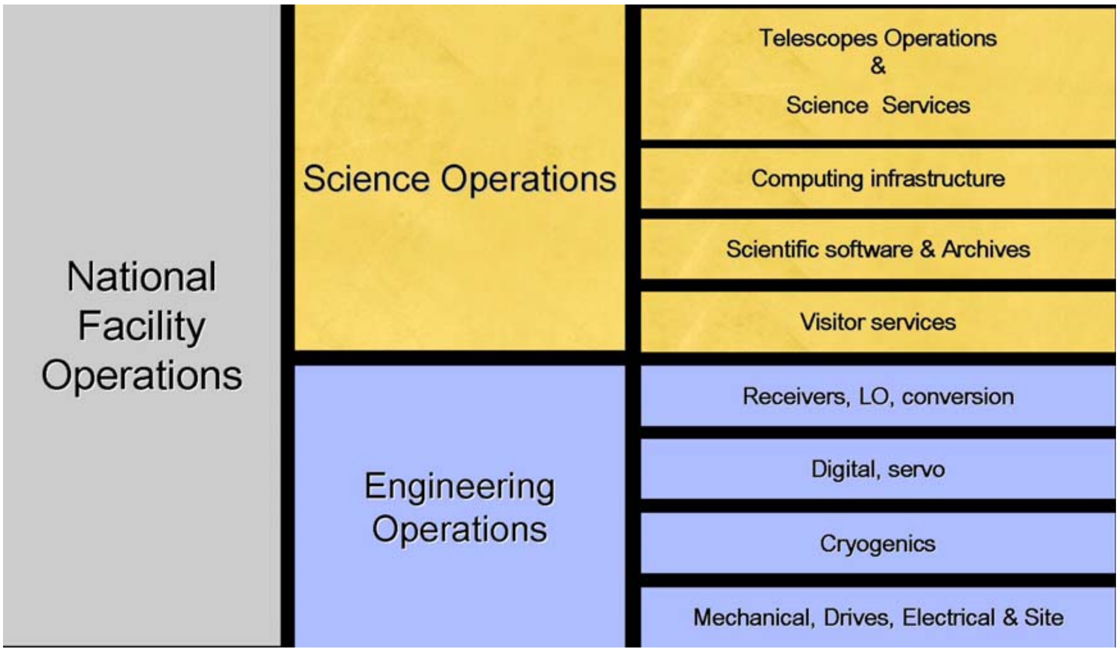

Figure 3. The structure of the ATNF Operations theme, from 1 July 2008

To provide a local point-of-contact and for local matters including site safety, the Parkes and Narrabri sites now have a Site Manager / Technical Coordinator. The Site Manager is the key point of contact for site-related queries, while the technical coordinator coordinates day-to-day maintenance activities and the transition periods between Engineering and Science Operations. Brett Hiscock is the Site Manager and Technical Coordinator for Narrabri. Brett Dawson and Brett Preisig are the Site Manager and Technical Coordinator for the Parkes Observatory respectively.

Table 2 Operations project activities

Operational project	Functions
Telescope Operations and Science Services	Coordination with Engineering Operations; Facility safety Telescope calibration and systems analysis; Time Assignment Committee; Usage statistics; Calibration sources and catalogues; Off-line data verification; User friend support (all stages); User guides and all user support; On-call support; Observing support for Target-of-Opportunity requests and queue scheduling Web: Extensive range of information and services
Computing Infrastructure	Coordination with CSIRO IM&T; Procurements; Operating systems; Site-site communications (conference links etc); Observers environment (terminals etc); User and email accounts and passwords; Data back ups and management (excluding archives); Infrastructure: Networks, servers, data storage; Network services (email systems, authentication, etc) Website structure and security, support for content writers Web: Content to support infrastructure
Scientific Computing and Archives	ASKAP software instruments and data archives (from 2012); The Australia Telescope Online Archive (ATOA); Online Proposal Application system (OPAL); Scheduling software; Telescope control and monitoring software; Data reduction, image analysis & VO software; Web: Technical manuals and other documentation
Visitors Services	Visitor administration, accommodation bookings and invoices; Lodge services; Office allocations; Web: Visitors information, guides, travel, other
Receivers, LO, conversion	Monitor performance, diagnose faults, manage spares, replace faulty modules, arrange for repairs, manual configurations
Digital & servo electronics	Monitor performance, diagnose faults, manage spares, replace faulty modules, arrange for repairs, manual configurations
Cryogenics	Monitor performance, diagnose faults, manage spares, replace faulty modules, arrange for repairs, schedule maintenance program, conduct maintenance work
Mechanical, Drives & electrical	Monitor performance, diagnose faults, manage spares, replace faulty modules, arrange for repairs, schedule maintenance program, conduct maintenance work

4.3 Staff estimates

In July 2008 the ATNF Operations group comprised 67 individual staff. Some staff work for the ATNF on a part-time basis while others also work on other ATNF themes. The total staff resources for operations on 1 July 2008 corresponded to approximately 53 full time equivalent (FTE) staff.

Table 3 provides an estimate of the number of FTEs for Operations needed from now until 2013. These estimates do not include staff resources allocated to larger development projects (Section 6), nor do they include indirect support provided by members of the Astrophysics Group through, for example, advice to users about ATNF capabilities and system characteristics. The increase in numbers from 2011 to 2013 corresponds to the period when ASKAP moves out of a development phase and becomes part of operations. The decrease in staff numbers between 2005 and 2008 is a result of streamlining measures implemented so far.

Table 3 Estimated staff numbers for the ATNF Operations theme

Project	2005	2008 July	2009	2011	2013
Telescope operations & science services	15	12	12	10	15
Computing infrastructure	2.2	2.2	3	3	6
Scientific computing and archives	6	5.3	6	7	9
Visitor services	8	7.0	5	4	5
Receivers, local oscillators and conversion	7	6.6	6	4	8
Digital & servo electronics	10	9.2	9	5	8
Cryogenics	5	4.4	4	3	5
Mechanical, drives & electrical	7	6.5	6	5	8
Total	**60.2**	**53.5**	**50**	**41**	**64**

4.4 The ATNF User-operator model

Unlike many other radio observatories around the world which use paid operators, the ATNF has a “user-operator” model in which most observers visit either the Parkes or Narrabri site and are responsible for taking their own observations. Observers also do their own data reduction with software support and expertise provided by the ATNF. Mopra observations are now taken in a remote observing mode from Narrabri. Mopra observers have found this experience to be beneficial as it provides access to expert staff support, and to better accommodation and site facilities. The Long Baseline Array (LBA) employs a variation on the user-operator model, in which a team of observers supports the LBA sessions.

For the Compact Array some observations are taken in the user-operator mode but with the user controlling the telescope remotely from Marsfield, other Australian locations or overseas. This remote observing has been available for some years but is restricted to experienced observers who have visited Narrabri in the previous 12 months. Typically, 85% of Compact Array observations are taken from Narrabri, 13% are taken from other locations in Australia (including Marsfield), and 2% from overseas.

The ATNF user-operator model has provided significant benefits to the ATNF:

- Visitors receive up-to-date information on the state of the system and benefit from face-face contact with expert staff who help them optimize their observations.
- ATNF staff receive “real-time” feedback on the state of systems from the observers who report almost daily on their progress and any problems.
- Users become familiar and expert with the systems. In some cases this leads to innovative and creative ways of using the facilities. This is especially the case for “power users” who proposed and extend the use of the facilities in innovative ways.
- Overseas visitors strengthen our strong international user base while interactions between ATNF and visiting astronomers lead to many collaborations. Since becoming a National Facility in 1989, the ATNF has especially welcomed international visitors and this has led to the highly successful use of our facilities by international astronomers. About 40% of telescope time is allocated to observing teams with an international PI but this leads to about 70% of the refereed publications. Astronomy leads Australian science as a discipline of international standing and has a particularly high level of international collaboration.
- Students receive essential training in radio astronomy techniques that has become hard to obtain elsewhere.
- Observers have always enjoyed going to the Observatories and found their visits to be inspirational.

4.5 Future observing modes

For future operations, we wish to retain, as far as possible, the advantages of the user-operator model, whilst also making changes to accommodate the operations of ASKAP in a cost-effective and timely way. In particular, we highlight that it is essential that we continue to encourage overseas astronomers to visit the ATNF and other Australian institutions. This is especially the case given our geographical remoteness and the relatively small size of our national astronomy community. Based on publication and citation counts, the best science outcomes are achieved when science teams include both Australian and overseas astronomers and we need to foster and develop these collaborations.

The model for future ATNF operations has four different observing modes and each of these is discussed below.

4.5.1 Observations taken from a Science Operations Centre in Sydney

The construction and implementation of the SOC will herald a major change for the ATNF. It is intended that this will become a high-profile operations centre for the astronomical operations of all ATNF facilities, including ASKAP, with additional facilities for visitors and education programs.

An essential part of the future operations plan is that all observations taken by inexperienced observers that require expert support from ATNF science operations staff will be taken from the SOC. It is expected that the SOC will become the primary location for observations with ATNF telescopes.

A full user-support model for the SOC has not yet been determined and this will be done in consultation with observers and the user community. It is intended that the current Duty Astronomer system, which is widely appreciated by Compact Array observers, will be extended to provide a similar level of support at the SOC for observers using the Compact Array, Mopra and Parkes. On-call night-time support will be available, and ATNF staff will be available to attend to critical failures when necessary.

As at November 2008, CSIRO intends to consolidate its Sydney sites by locating the majority of its activities at its North Ryde location on Delhi Road. The current expectation is that staff currently at Marsfield will move to North Ryde by 2012. This move will require significant construction works including a sizable new building at North Ryde. An existing CSIRO building at North Ryde has been identified as a possible location for the Science Operations Centre and associated facilities for education and public interaction and this may be available for operations from an earlier date.
Detailed planning of the SOC will take place during 2009 and further information will be provided to the user community as the plans develop. Based on initial concept plans and input from the user community, the SOC will provide:

- A dedicated Control Room with a quiet and focussed working environment and observing facilities for astronomers to observe with the Compact Array, Mopra, Parkes and the LBA. The control room will also be used by ATNF staff operators to set up and monitor ASKAP operations.

- Visual and auditory monitoring tools to facilitate interactions with staff at the Observatories and other locations;
- Dedicated facilities to support educational and public outreach programs;
- Informal meeting areas where observers from the different facilities, ATNF staff and other visitors can rest and hold discussions;
- Office space for visiting astronomers to work while not observing;
- On-site accommodation for observers and visitors with the provision of meals.

4.5.2 Observations taken from the Narrabri and Parkes Observatories

Some observations will continue to be taken from the Observatories. A general rule will be that the observing teams will need to be experienced so that they can manage their observations with little support beyond the initial setting up to observe. Astronomers working on projects that have complex technical requirements, or use new observing modes or techniques, will be likely to visit the sites to interact with the engineering staff, at least for the start of their observing programs.

Postgraduate students and postdoctoral fellows will be encouraged to visit the Observatories, for training and observing opportunities, so that they can become more expert with the facilities (section 4.5.5).

4.5.3 Observations taken from other remote locations, including overseas

Observations by experienced users not requiring full support will be possible from remote locations other than the SOC, as is currently offered for the Compact Array. This capability will continue to be offered for Compact Array observers, and will grow as the options of taking remote observations with Mopra, and ultimately with Parkes, are added. Some restrictions on remote observing will continue to be used to ensure that observers who undertake observations from remote locations (other than the SOC) are experienced and maintain regular contact with ATNF staff.

The upgrades planned for the Parkes radio telescope necessary to enable observations from the SOC and from other remote locations will provide scientific and educations options that are not currently possible. As examples, the option of remote observing from any location would allow overseas observers to undertake and monitor pulsar timing observations which often require regular repetition (weekly or monthly) while the *Pulse@Parkes* project could be extended from an Australian-only program to become a fully international education program.

4.5.4 Observations taken by operators

We anticipate that ATNF staff operators will setup and monitor ASKAP observations from the SOC in Sydney, and will provide coordination with engineering and other staff located in Western Australia. The ASKAP operators may possibly also assist with some observations with other ATNF telescopes, for example with large-scale surveys that have routine requirements and can be semi-automated.

4.5.5 Finding the balance

Careful planning is needed before the balance between the different observing modes is established. This will take into account the scientific priorities, and the timescales and costs for development programs needed to support the changes. The balance between observing modes will, almost certainly, change with time.

We note that operation from the SOC, or from a remote non-ATNF location, will not necessarily imply operation without a staff or user presence at the telescope. Nor will the operations necessarily be exactly the same for each facility. For example, while Mopra is already operated from Narrabri without any human presence required at Mopra itself, operation of the Compact Array from Marsfield (say) currently requires a responsible person present and contactable at the Compact Array.

For the Compact Array and Mopra radio telescope, the ATNF already has most of the network technologies needed to support the first three observing modes. For Parkes a limited mode of remote observing is now used on a semi-regular basis for the *PULSE@Parkes* educational program. In this mode, school students control the telescope from Marsfield or another Australian location, but an astronomer is present at the telescope to take over if needed. Significant upgrades are planned for the Parkes telescope so that the telescope can be used in a safe and effective way for remote observing where astronomers can carry out their observations from Marsfield or other locations, with some support from on-site engineers (Section 5).

4.5.6 Postgraduate students

The Australian community places a very high value on the training and inspiring of postgraduate students of astronomy and related disciplines such as engineering. Student training is a key priority for the ATNF, and the ATNF is committed to continuing to support the development of future generations of scientists. Visits from post-graduate students to the Observatories for observations and other training opportunities will be supported. There will also be value in students interacting with astronomers and other experts at the SOC and student visits to the SOC will have a significant role in their training.

As at present, the ATNF will continue to encourage graduate students to provide support for observers and will provide travel and accommodation funding to enable this. The intention of expanding Duty Astronomer support to include Mopra and Parkes as well as the Compact Array is likely to provide even greater opportunities for student development through this activity.

4.6 Measures to streamline operations

4.6.1 Observatory accommodation

The change to observing from the SOC will result in reduced demand for on-site accommodation at Parkes and Narrabri. The number of astronomers visiting the observatories will decrease but this is likely to be partially offset by an increase in the number of visits by Engineering Operations staff based at other ATNF sites. A gradual reduction in the resources devoted to visitor accommodation at the observatories is likely to occur over the three years as the SOC comes online. Once the SOC is fully functional, it is possible that the lodges will be operated only intermittently and /or that contract support may be used.

Some changes to the organisation of Visitor Services activities are already being implemented although these do not impact on visitors. Following the change in Operations structure there is now a single Visitors Services Group that manages the visitor requirements for all locations. This group is working together to integrate and improve the efficiency of visitor services and to share the work load between the staff involved. These changes include, for example, setting up a single database system for all accommodation bookings and invoices that can be seen from any ATNF location.

4.6.2 Support for Tidbinbilla observations

Access to antennas at the Canberra Deep Space Communications Complex (CDSCC) at Tidbinbilla is provided under the Host Country agreement with NASA and made available to the astronomical community though the ATNF. The 70-m antenna provides the most sensitive system in the southern hemisphere for this band, with a system temperature of 60 Jy. Tidbinbilla has been used with considerable success for sensitive single-dish observations using the 70-m antenna in the 12-mm band. The new 12-mm receiver at Parkes has a sensitivity three times that of its predecessor but Tidbinbilla remains the most sensitive southern hemisphere antenna for this band. Tidbinbilla single-dish observations are taken in a service observing mode with typically 200 hours of observing time available in a year.

The level of support to be provided by the ATNF for single dish spectroscopy at Tidbinbilla has been uncertain until recently. An arrangement is now being set up in which service observations will be taken by the CDSCC Radio Astronomy Engineer while the ATNF will provide in-kind support and will nominate a member of ATNF staff to liaise with the Radio Astronomy Engineer in his role of astronomy support. The in-kind support will include announcements of opportunity and time allocation processes, the maintenance of Tidbinbilla-related web information and engineering support for specialised ATNF equipment. The ATNF Tidbinbilla liaison person will be the primary point of contact for astronomers wishing to use the 70-m antenna.

4.6.3 Other measures

In *Future ATNF Operations (v1)* [1] a range of measures was proposed to streamline operations and reduce the work load on ATNF operations staff. These include reducing the number of receiver changes at Parkes, and restrictions to the lengths of the millimetre observing seasons at Mopra and the Compact Array. The goal is to find ways of improving the cost efficiency of our operations whilst minimising the impact on the science outcomes by ensuring that the highest priority science continues to be supported.

Progress towards this has been made through the consideration of likely science priorities for 2010 – 2015 [4]. Table 4 provides a summary of the technical and some scheduling requirements identified during this process. Note that these requirements are NOT ranked. A mapping between the highest priority science for each of the ATNF telescopes and these technical requirements is provided in the final column of Table 1. The requirements listed in Table 4 will be considered, as part of the planning process to determine future measures that the ATNF will implement in order to streamline operations and minimise costs. This will be discussed further in Version 3 of this document.

Table 4 Requirements for ATNF Science Priorities in 2010 – 2015

Note: A reference number is provided but this does NOT indicate a ranking order.

Reference number	**Technical requirements**
ASKAP	
1	Maximum sensitivity on baselines less than 2 km.
2	Low point-spread function side lobes to avoid the need for deconvolution
3	Data processing of 16,000 frequency channels across the entire field of view.
4	Automatic detection and classification of HI galaxies in a pipeline process.
5	The ability to perform long (day, weeks) integrations and continue to reduce noise levels.
6	Baselines up to 6 km.
7	The ability to produce dynamic range limited images. A dynamic range of at least 10^5 over many parts of the sky.
8	Detection algorithms for transient detections.
9	Ability to observe the entire sky daily.
10	Ability for rapid response follow ups on other facilities.
11	High surface brightness sensitivity.
12	Polarisation calibration accurate to 1:1000 over the entire field of view.
Australia Telescope Compact Array	
1	Access to good winter weather at 7 and 12 mm
2	ATCA compact configurations.

3	Extension of north-south baselines to about 400 m
4	Placement of antenna 6 on the 3-km track.
5	Good polarization purity across the full primary beam in all bands.
6	Broad instantaneous bandwidth (for both millimetre and centimetre bands).
7	Frequency agility and dual simultaneous frequencies.
8	Continued availability of 6-km baselines.
9	Rapid response and clear guidelines for Target-of-Opportunity and NAPA projects.
10	Baseline overlap with Parkes for total power
11	7 mm, 12 mm and 20 cm bands
12	20-GHz focal plane array
13	Fast scanning speeds for continuum surveys
14	High angular resolution
15	Access too ATNF staff and others with in-depth system knowledge for innovative engineering solutions to new scientific problems.
16	Ability to build custom built hardware for unusual projects.
Mopra radio telescope	
1	Access to good winter weather for 3, 7 and 12 mm, and some access for 12-mm observations in good weather during summer months.
2	Large blocks of time allocated for surveys.
3	Semi-automation of surveys
4	Focal plane array or multi-beam system at 3 mm.
5	Focal plane array or multi-beam system at 12 mm
6	Access to ATNF staff and others with in-depth system knowledge for innovative engineering solutions to new scientific problems.
7	Ability to build custom built hardware for unusual projects.
Parkes radio telescope	
1	Allocation of large amounts of time (about 30%) with Parkes telescope with the 20-cm multibeam (13-beams) receiver installed. Large blocks of time preferred.
2	13-beam digital filter bank with Parkes Digital Filter Bank (PDFB) 3 system (currently being developed) and the ATNF Parkes Swinburne Recorder (APSR).
3	Current observing bands for frequencies up to 3 GHz.
4	Remote observing capability available for overseas users, with ability to select receiver and monitor observations
5	Allocation of large amounts of time with Parkes telescope (about 40%), with regular observations scheduled for the H-OH (one-beam) 20 cm receiver and the 10/50 cm receivers (~every two weeks).
6	PDFB2 and PDFB 3 for 10 and 20-cm observations PDFB3 + APSR for 50-cm observations
7	Radio frequency interference mitigation at 50 cm.
8	More extensive remote observing capability available from overseas with ability to swap between 20-cm and 10/50-cm receivers and for backend systems to be monitored and reconfigured as needed.
9	Access to broad frequency coverage, and all current observing bands between 70 cm and 1.3 cm.
10	Broadband receivers with good polarization capability.

11	Broadband spectrometers and excellent frequency resolution
12	20-GHz multi beam or focal plane array on Parkes radio telescope
13	Allocation of time for small projects
14	Ability to schedule any available receiver at short notice if there is a very high science priority for quick result
15	Full remote capability available from any location in Australia and overseas.

4.7 Instrumentation suite for 2012

The expected state of instrumentation in 2012 is summarised in Tables 5 and 6. Table 7 lists the instruments we expect to decommission over the next five years.

Table 5 ATNF receiver systems in 2012

Telescope	**Receiver**	**Band (GHz)**	**T_{rec} (K)**	**notes**
Parkes *	10/50cm	0.64-0.70	40	
	20cm MB	1.2-1.5	23.5	13 beams
	H-OH	1.2-1.8	28	
	13cm	2.2-2.5	20	
	10/50cm	2.6-3.6	30	
	6cm (methanol)	5.9-6.3	50	Single beam
	3cm	8.1-8.6	25	
	13mm	16-26	25	
ATCA	L/S	1.2-3.0	30	6 antennas
	C/X	4.4-6.9, 8.0-9.2	30	6 antennas
	12mm	16-26	25	6 antennas
	7mm	32-50	75	6 antennas
	3mm	84-106	280	5 antennas
Mopra	L/S	1.2-1.8, 2.2-2.5	30	VLBI only
	C/X	4.4-6.9, 8.0-9.2	30	VLBI only
	12mm	16-26	25	
	7mm	32-50	75	
	3mm	79-119	280	
ASKAP	100 elements	0.7-1.8	35	36 antennas

In the light of receiver developments for the Compact Array, the Parkes single-beam receiver fleet is being reviewed to seek a rationalisation that will simplify maintenance and management, and also enhance performance. In addition, significant operational savings could be made at Parkes by adding a 2.3-GHz capability to the existing 8-GHz receiver. This would reduce the number of receiver changes need to support important astrometry projects, and would allow the decommissioning of the “multiband” receiver.

Table 6 ATNF backend signal processing units in 2012

Telescope	Backend	Polarisations x Bandwidth	Channels, time bins	Notes
Parkes	PDFB2/3	2 × 1GHz	2048, 2048 bins	1, 2
	APSR	2 × 1GHz		3
	13-beam digital filterbank			4
ATCA	CABB	4 × 2GHz	8192	1
Mopra	MOPS	2 × 8GHz	8192	1
ASKAP		2 × 256MHz	65536	1,5

Table 6 notes:

1. *Digital signal processing backends are highly configurable and trade-offs can be made between bandwidth, number of quantising levels, number of channels and time bins and so on. Parameters given merely indicate the general level of performance achieved.*
2. *PDFB3 has an input dedicated to a reference signal and firmware to use this for RFI mitigation — excision of interfering signals from the sky signal.*
3. *ATNF Pulsar Swinburne Recorder: provided by Swinburne University, this is a computer cluster used for base-band signal processing for pulsar observing and for real-time VLBI correlation.*
4. *The Swinburne University is developing a digital correlator to work with the 13-beam 20-cm receiver.*
5. *ASKAP digital systems are not yet completely specified, but will process dual polarization signals from 30 beams across 300 MHz of bandwidth. There is a requirement for 5 kHz frequency resolution and high time resolution for pulsars and transients.*

Table 7 Provisional list of equipment to be decommissioned

What	Where	Replacement (and other notes)	When
Original 1.3 cm receiver	Parkes	Replaced by new broad-band 13-mm receiver	2008
AT Correlator	Parkes, ATCA, Mopra	PDFB3, CABB, MOPS	2007, 2009, 2008
WideBand Correlator	Parkes	PDFB3, PDFB4	2008
AT multiband receiver	Parkes		2009

Analogue Filter Bank	Parkes	BPSR (26-IF digital filter bank)	2009
Methanol Multibeam	Parkes	May be transferred to an overseas organisation	2009
DAS units	Parkes, ATCA, Mopra	PDFB/CABB	2010
HI multibeam	Parkes (if ASKAP PAF viable)	PAF	2012

5. WORKPLACE CULTURE AND IMPACT ON STAFF

5.1 Communications within the ATNF

The changes taking place in ATNF operations will require significant changes to the work culture within the ATNF. Since July 2008 Science Operations staff have worked in groups that are distributed between the sites, instead of in site-centric groups. In some cases, staff work in two or more different groups and this is coordinated using CSIRO matrix management practises. It is especially important to build trust between members of new teams. This is essential for working effectively and for consensual decision making in groups. This team building requires some extra travel for face-to-face meetings as well as using appropriate technology to facilitate cross-site meetings. At present the project leaders travel fairly frequently between sites for individual or small group discussions. As the groups become more established the time needed for travelling is expected to decrease, with a corresponding increase in the use of technologies to facilitate inter-site meetings.

The ATNF uses various media for communicating within geographically-distributed groups. These include electronic mail, audio and video conferencing and internet-based tools such as the *trac wiki* (see trac.edgewall.org), which is an integrated internet-based project management system. An ongoing challenge is to make our communications as effective and people-friendly as possible.

5.2 Impact on staff

The implications of the new operating model for staff are significant. The challenges of working within the new structures, whilst also maintaining effective day-day operations and planning for the future, are high.

In Sydney the SOC will lead to a very different working environment with observations taking place around the clock and some staff and visitors working outside of standard hours. The increase in the number of visitors to the SOC and the interactions between visitors and between staff and visitors should lead to an increasingly dynamic and interesting work environment. At the same time, staff astronomers may be interrupted frequently with requests for advice causing disruption to their work and some measures may be needed to control this.

If the level of observing at the sites drops too far then there may be some loss of motivation for site staff. ATNF Observatory staff perceive the presence of visiting astronomers, and face-to-face feedback from them, as a highly important validation that they are participating in a world-class operation. This applies especially to the scientific staff and to the engineers responsible for maintaining the facilities. The presence of observers for some observations, together with visits from staff and astronomers, for other purposes, such as workshops and educational programs, will be essential to maintain high levels of staff motivation.

From 2008 to 2010, the development projects will create jobs in some areas. From 2011 – 2012 as ASKAP becomes operational there will be an increase in the staff required for the operation of the whole set of ATNF telescopes.

Pressures for staff to relocate are likely to be greatest in the Science Operations area, with some shift of staff towards Marsfield from Parkes and Narrabri being required. However, the number of staff likely to move to Sydney is expected to be small, since most of the staff in Science Operations are already based in Sydney. Most Operations staff who are located at the Observatories will continue to work at the Observatories, and in almost all cases, staff moves will be voluntary.

For the current facilities, Engineering Operations staff will remain distributed across three sites (Marsfield, Parkes and Narrabri), and it is unlikely that many relocations will be necessary. A reduction in duplication of skills and effort will be possible as a result of the move to functional rather than regional groups and in those instances ATNF will seek to take maximum advantage of natural attrition to reduce staffing, though a small number of redundancies may occur. For ASKAP, we expect a new centre to be established in Geraldton and this will include 12-15 Operations staff, primarily in the engineering area.

6. DEVELOPMENT PROJECTS

In the first version of this document Future ATNF Operations version 1 [1] the need for technical developments was identified and four separate projects were proposed to organise this work. Briefly, the four projects were:

- automation—increase the level of computer control and monitoring of equipment and introduce more scriptable observing software;
- telescope safety—analyse telescope issues, upgrade the Primary Monitor and introduce new procedures to allow an increased amount of remote and, where practical, unattended telescope operation;

- schedule telescope collectively—devise the means to schedule time usage on all ATNF telescopes to be maximally convenient to the new single Engineering and Science Operations teams;
- build the Science Operations Centre.

Since FAO Version 1 was written the development work has been re-assessed and caste into a larger set of projects. These are described briefly in the sections below. More detailed information on the development projects will be provided in Version 3 of this document.

6.1 Parkes drive control

The Parkes telescope drive system was designed and installed in 1985. Although most computers command most operations, there remain some processes that require manual activation. This project will make all routine operations computer controllable.

Technically, the focus of this project is to augment the function of the Parkes Manual Control Panel (MCP) and provide computer access to all its operations, particularly the stowing and unstowing procedures.

A full project plan has been approved by ATNF management and work has commenced. The initial plan schedules the project completion for July 2010 at a total cost of approximately $160k.

6.2 Parkes equipment control and monitor

Currently most observations at Parkes require equipment to be configured by hand. Some operations during observation also require manual activities. This project will introduce the means to configure the telescope systems automatically (as is available at the Compact Array) and to give the observing software control of all equipment.

Three main areas encompass most of the project:

1. Focus cabin – access to the equipment in the focus cabin involves time and risk and is not always possible. The project will give remote monitoring and diagnostic access to the major subsystems in the cabin (DC power, receiver translator) and will provide an improved facility for video and audio monitoring. The latter will use the technique already established for video monitoring of the Mopra Observatory.

2. Power systems – a synchroniser unit of the kind recently installed on all motor/generators at Narrabri will give remote control and should greatly reduce the number of power-cuts experienced by telescope instruments. Remote monitoring of the Uninterrupted Power Supply will be enabled.

3. Conversion system and signal distribution – the manual cable patch panel will be replaced by a computer controllable switching matrix.

A full project plan has been approved by ATNF management and work commenced in October 2008. The initial plan schedules the project completion for July 2010 at a total cost of approximately $150k.

6.3 Parkes receiver upgrades

The fleet of receivers on the Parkes telescope will be reviewed in the light of receiver developments across other parts of the ATNF. The availability of very broadband systems opens the possibility of covering the spectrum used at Parkes with a smaller number of packages, which would result in fewer receiver changes and a general reduction in the overheads of receiver management. If significant changes are found to be attractive, the changes themselves are likely to take several years to complete, and the user community will be consulted and informed during the specification and planning of the changes. The review will be conducted over the first half of 2009, and the changes should be finished by the end of 2010 to be consistent with other aspects of implementing the model.

6.4 Upgrades to Observatory Software

At present the level of commonality and integration of telescope operating software across the ATNF is patchy. There is currently a major software development in progress as part of the ASKAP construction. Moreover, the changes in operations will demand both more automatic modes of observation and the management of the software base by a single team. The aims of this project are to:

- Introduce a consistency in methods used across all ATNF telescopes, including ASKAP.
- Increase the support for long, automatically managed observations.

Planning of this project has begun, but will not be to the point of a detailed schedule of work until mid-2009. Elements of the plan will include:

- Adoption and use of an SCA (Service Component Architecture) in the Parkes, Mopra and Compact Array systems, and in a manner consistent with the developing design of ASKAP software.
- Adoption of a standard structure for the scheduling of observations and telescope control comprising an “Executive” process in control of the telescope and taking commands from the observation queue; a loosely linked User Interface gives the operator the access needed to interrupt observations or enter an interactive mode of observation.
- Progressive introduction of the EPICS control package for the hardware control layer, consistent with ASKAP usage.
- Elimination of unsustainable “legacy” components of the current systems, such as pSOS currently used in the Compact Array antenna control computers.

Preliminary analysis of the software suggests that the steps listed above can be taken without large-scale rewriting of most of the software.

6.5 Telescope scheduling

Until now the schedules of telescope time have been largely independent. Each observing semester, three schedules are produced, one each for Parkes, Mopra and the Compact Array. With the exception of common periods set for LBA observations and some informal attempts to avoid scheduling the same observers on two telescopes at once, the three schedules are independent.

In future, out of necessity, many members of the operations staff will have responsibilities at all telescopes. The ease of managing telescopes through their cycles of astronomy, maintenance and engineering and system test time will be increased by paying careful attention to the scheduling of these phases on the different telescopes in a coordinated manner.

This project will have two aspects: improvement of the tools available to the scheduler, and an analysis of the work flow in the new model to seek some new structure for the schedules that will reduce staffing conflicts and simplify the scheduling process without seriously violating the scientific imperatives. An example of a simple structure was suggested such in FAO-I: a three-week observing cycle at each observatory, avoiding as much as possible simultaneous maintenance periods.

It is expected that, with the support of improved scheduling tools, telescope schedules will evolve into their new form over the next three observing terms.

6.6 Construction of a Science Operations Centre

We plan to establish a Science Operations Centre (SOC) at the ATNF headquarters. As discussed in section 4, as part of a wider CSIRO consolidation, the ATNF plans to move to a location in North Ryde, Sydney, and the current plan is to establish the SOC at that new location.

The SOC will become the control centre for the operations of all ATNF facilities, including ASKAP. From 2012, ASKAP observations will be taken from the SOC by ATNF staff operators using a queue scheduling observing mode. Astronomers will not participate in ASKAP observing but will be encouraged to visit the SOC for expert staff advice and to work with ASKAP data products.

The SOC working areas will include:

- **Shared control room:** This will provide a quiet and focussed environment with four separated working areas for the Compact Array, Mopra, Parkes and (later) ASKAP. Each area will have space for up to three people to sit near a terminal (possibly with their own laptops), and a high-end workstation running LINUX that is capable of displaying all the telescope control and monitoring information of the Observatory. To facilitate communications to the Observatories video and teleconference links will also be provided in each area in the Sydney control room, and at the Narrabri and Parkes Observatories. The control room will be set up to provide easy access to all observer-related information with manuals, latest information, rosters etc. and will have a shared area where observers can sit and relax or hold discussions

- **Offices for visitors:** The SOC will also provide offices and computing facilities for short-term visiting astronomers who wish to work on their data, use the ATNF archives or work with ATNF staff.
- **Staff support:** A key feature of the SOC will be the provision of expert support by the Duty Astronomers (or equivalent), operations staff, observing friends, and local experts. Access to all such levels of support will be a central feature of the implementation of the SOC.
- **Staff offices:** We anticipate that several staff will move from the Observatories to Sydney to work in the Operations group and to support astronomers and observing.
- **Other facilities:** Access to toilets and a small kitchen will be provided, with suitable amenities for visiting astronomers and staff who will be interacting with the telescopes at all hours of the day. This will include the provision of meals tailored to suit the requirements of astronomers.
- **Observers' quarters:** Suitable serviced accommodation will be provided in an environment that recognises the need for sleep at non-standard times of the day, and any other specific requirements associated with astronomical observing schedules.

6.7 Human-machine interfaces

The ability of the telescope user to productively operate the telescope is dependent on being informed of the state of the telescope and its environment. Providing this information particularly to a remote location is the aim of this project. Contact has been made with scientists in CSIRO Information and Communications Technology Centre (ICTC) who specialise in the Human-machine interface design. The project plan will be developed in concert with the SOC specification and design; it is not expected to be developed in detail before the third quarter of 2009.

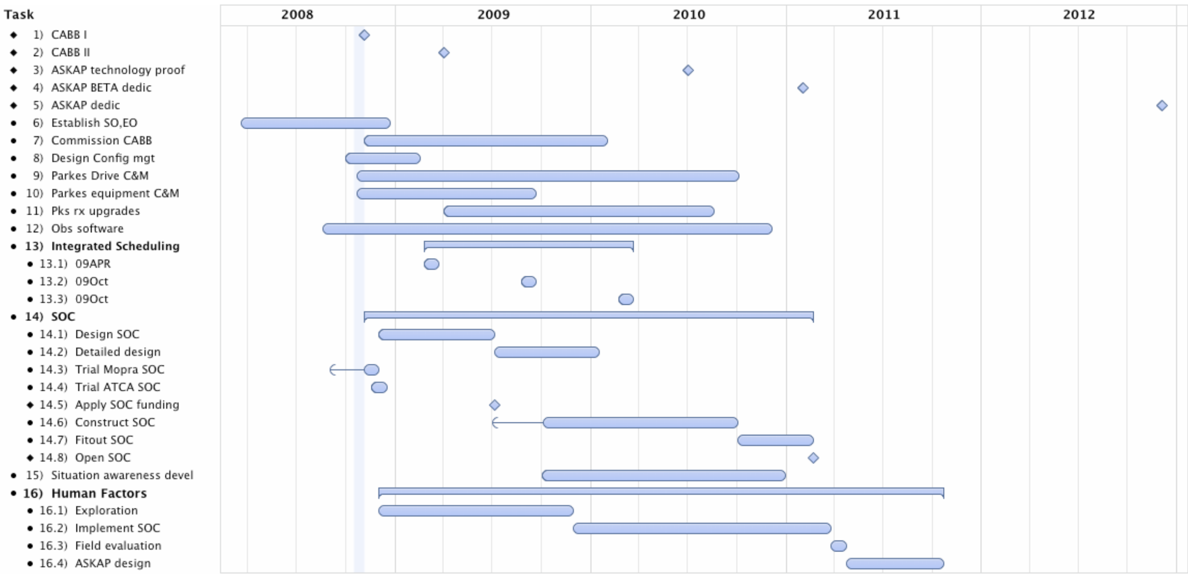

Figure 4 (Version: October 2008). A timeline for development projects. Schedules for other related developments are indicated in the top part of the chart.

APPENDIX A: WEB REFERENCES

Links to the documents are given from the web page www.atnf.csiro.au/observers/planning/

Ref in text	Document Title	Authors
1	ATNF Future Operations (Version 1: Feb 2008)	ATNF Leadership Team
2	ATNF Future Operations: Community feedback (August 2008)	J. Chapman & E. Sadler
3	ATNF Future Operations: ATNF response to community feedback (August 2008)	J. Chapman & L. Ball
4	ATNF Science in 2010 – 2015 (Version 2: November 2008)	L. Ball, N. McClure-Griffiths, R. Braun, P. Edwards, I. Feain, G. Hobbs, S. Johnston
5	Draft ASKAP User Policy	I. Feain & S. Johnston
6	ASKAP Call for Expressions of Interest	
	Discussion Forums	
7	Community feedback and Future Operations Discussion Forum	
8	ATNF Science Priorities and Science Priorities Discussion Forum	

APPENDIX B: RISK ASSESSMENT

Table 8 below gives a preliminary risk assessment for the ATNF future operations implementation. This will be updated as the plans develop.

Table 8 Risk assessment

In this table, likelihoods and consequences prior to mitigation strategies are estimated to be low, medium, or severe. Including mitigations strategies, the 'residual risk' categories are estimate to be low, moderate or high.

Risks	**Like-lihood**	**Conse-quence**	**Mitigation strategies**	**Residual risk**
Work culture				
Loss of interaction between ATNF and the User Community if use of external remote observing becomes high.	Medium	Severe	Impose restrictions on amount of remote observing from outside of the ATNF.	Moderate
Staff have work conflicts through trying to support two different groups and reporting to two or more supervisors.	High	Medium	Build experience with Matrix management. Good management practises.	Moderate
Scientific staff at Observatories feel isolated.	Medium	Medium	Use of technology to facilitate communications. Continued used of some observing at Observatories. Encourage staff travel. Use of Observatories for some other activities such as workshops. Encourage visitors to sites to give talks.	Moderate
Observers lose motivation if they don't visit the telescopes.	Low	Medium	Encourage some visits to the Observatories.	Low
Science and technology				
The Compact Array becomes marginalized due to EVLA and ALMA operations.	Medium	Severe	Provide a thorough analysis of science goals for the Compact Array over the next 5 – 10 years. Set up collaborative programs. Promote the ATNF capabilities to the international community.	Moderate
Requiring observers to be present leads to the community not bothering with major programs on	Low	Severe	Provide outstanding facilities. Provide paid operators to	Low

ATNF facilities that require large amounts of observing time.			provide support for Large Projects. Use of external remote observing.	
Decrease in radio astronomy expertise within the broad user community due to less exposure to the telescopes	Medium	Medium	Student and other training opportunities at Observatories and also at SOC. Some observing at sites.	Low
The unification of systems and interfaces proves intractable.	Medium	Medium	Adopt a systematic approach to development. Use knowledge gained from ASKAP R&D.	Low
Less feedback to Observatory staff leads to increase in faults not being quickly resolved.	Medium	Medium	Require use of fault reporting. Good communications between EO and SO staff and between staff and observers.	Low
Inadequate information flow leads to a loss of "latest news" information to observers.	Medium	Medium	Require current status reporting and hand overs. Use technology-based solutions. Determine the cultural changes needed for these to be used effectively.	Low
Fewer observers at Observatories leads to poorer communication with engineers and ultimately a drop in science quality.	Low	Medium	Good coordination between ATNF science and engineering staff. Skilled Senior System Scientists facilitate information flow between scientists and engineers.	Low
Scheduling changes make it difficult to support some types of observing programs.	Medium	Low	Careful consideration of science priorities.	Low

Contact Us

Phone: 1300 363 400
+61 3 9545 2176

Email: enquiries@csiro.au

Web: www.csiro.au