

Appendix IV AARNet

Statement of Capabilities/Constraints for the Research Community

This document has been prepared to give NCRIS Facilitators, in particular the Facilitator for Platforms for Collaboration, a simple understanding of AARNet's current and prospective capabilities to provide network services to the Australian research community. It also attempts to explain some of the relevant constraints under which AARNet operates.

AARNet is a not-for-profit company owned by its members, comprising 38 of Australia's 39 universities and the CSIRO. These members elect a Board of Directors which determines AARNet's strategy, policies and finances.

The systems and services provided by AARNet include the following:

Basic network:

- National backbone
- International circuits and connections
- Commodity Internet and Research & Education traffic

Network operations (NOC)

Network consulting services (eg design of extensions, customer connections)

Additional network services:

- Basic network services (eg IPv4, IPv6, QoS, Multicast)
- Overlay networks (eg configurable light-wave circuits)
- Content mirror
- Peering with other networks & providers

Value-added services:

- VoIP
- Video over IP
- ENUM
- Middleware
- eduroam
- Network-connected filestore

The following analysis provides detail of the elements of these services likely to be of greatest interest to the research sector, especially as represented by the NCRIS process (see http://www.dest.gov.au/sectors/research_sector/policies_issues_reviews/key_issues/ncris/).

1. Executive Summary

The principal service of AARNet likely to be of interest to the researcher is its basic high-capacity network, providing connectivity between points of interest, whether nationally or internationally. In addition to this network connectivity and capacity, AARNet provides a range of related network services, as well as value-added services and applications, that are likely to be of interest to the research community.

AARNet's network and charging structure has been designed specifically to eliminate all direct traffic volume charges for transfers between members of the international research and education community. This means that, provided the end points of any transfer are within that community, there will be no charge from AARNet for that transfer, regardless of its size or length of time to deliver it.

There are, however, certain caveats to this freedom from charges, which are detailed in the rest of this document:

- a) the hosting institutions for each end of a communications session must be connected to the global research & education network; this may require the establishment of physical connections and completion of access agreements;
- b) users must verify that the end-points of a transfer are indeed within the designated research & education community (see 2(g) below);
- c) users also need to verify that, where their traffic flows over sections of the network that are not under AARNet's control, the conditions applying are consistent with those which AARNet applies;
- d) end users should also verify in particular that they do not incur any charges for their traffic from their host institution (AARNet very strongly encourages its members not to impose any such charges), nor from any intervening non-AARNet network segment operator;
- e) certain services require specific network characteristics to be enabled across the full extent of the network, to achieve full end-to-end capability; these functions may require these other agencies to enable them over their sections of the network (see 2(h) below).

2. Basic Network

The network operated by AARNet comprises a number of different components, as follows:

- a) **Backbone:** A substantial backbone based on fibres acquired on a 15-year IRU from NextGen (which is also contracted to maintain the infrastructure to support that network). These run from Brisbane via 2 geographically distinct paths to Melbourne via Sydney and Canberra. They extend from Melbourne via Adelaide to Perth along a single geographic path with diversity achieved by taking lower capacity services from Optus..
- b) **Optical Circuits or Overlay Networks:** Between Brisbane and Adelaide, the fibres are lit using AARNet's own DWDM equipment, enabling many centres along those paths to be connected at high speed, and for optically separate "overlay" networks to be configured for customers with special needs (eg the several campuses of a regional university, the various telescopes in inland NSW, the partners in APAC). Currently, the Adelaide-Perth circuit is a 10Gbps managed circuit provided by NextGen; however, it is hoped to upgrade this also in the near future to DWDM equipment (the so-called Adelaide-Perth 2nd Fibre Project).

Current connections are typically 1Gbps. 10Gbps is possible with existing equipment, but requiring the purchase of special interface cards. By upgrading the DWDM equipment it would be possible with the current fibres to provide circuits up to an aggregate of 320Gbps (though this option is currently expensive).

The reach of this network can be seen in Diagram A, attached.

The use of the AARNet Network is governed by the AARNet Access Agreement or Regional Connect Agreement as the case may be which reflects among other things the terms of the various supply agreements, in particular NextGen. Simply put, the AARNet Network can be used for any research or educational purpose but, for instance, may not be used by third parties for commercial purposes. Use of any AARNet network or value-added service is covered by AARNet's Acceptable Use Policy (see http://www.aarnet.edu.au/publications/access_policy_2005.html). Most services, including the optical circuits, are available only to AARNet members and associate and affiliate members (see <http://www.aarnet.edu.au/services/nonmembers.html> for a description of what organisations are eligible to become members).

- c) **Extensions to Darwin & Tasmania:** the connections to Darwin and Tasmania are different historically due to distance and lower traffic volumes. These currently are managed services supplied by Telstra, and provide considerably slower speeds. In the next 2 years, it is planned to upgrade the

circuit to Tasmania by leased dark fibre (as for the basic backbone network). In the longer term it is hoped to be able to find a way to do the same for Darwin.

- d) **Compatible Extensions:** the above basic network has been extended by the acquisition, in conjunction with certain groups of customers and other network service providers, and often with special SII grant funding, to reach various sites not covered by the basic NextGen fibre network. These include a 2.5Gbps extension from Brisbane north to Townsville, and thence (by slower circuits) to Cairns. Also in various parts of regional NSW; and also from Perth to Mandurah.

In each case, the nature of the circuits, the supplier, the duration of the arrangement, and the terms under which it can be used, differ; this is as dictated by geography, the available providers and suitable technology. The goal in all cases has been to achieve at least 1Gbps capability, but this has not always been achieved.

Generally, the network extensions are negotiated and managed by AARNet (usually through the local network service provider), and under terms that are consistent with AARNet's contracting principles for an Australia-wide network (AREN) such that it can supply an end-to-end service under the relevant Agreement

- e) **Other Extensions:** In a few other cases, extensions to the network, some with substantial capacity, have been undertaken by regionally-based groups (eg VERN in Victoria and SabreNet in Adelaide), often with financial assistance from DEST's SII or other government sources. These network extensions are typically managed independently of AARNet, and the terms and conditions governing use may differ from AARNet's, in some cases being more restrictive. The effect of this may be to limit the full end-to-end delivery of certain AARNet services, or for certain customers
- f) **International Connections:** as depicted in Diagram B (attached), AARNet has extensive international connections and capabilities. Most of these are for general or commodity Internet traffic (ie any kind of traffic), while others are limited to carrying R&E traffic as determined by the supplier (for instance where capacity has been made available under generous terms, such as by SXTRANSPORT across the Pacific). AARNet routes the traffic according to the destination of the traffic and in accordance with the policies set up by the contract.
- g) **On-Net and Off-Net:** AARNet connects in various ways to the commodity Internet (eg by peering at some Australian Internet Exchanges, and by buying capacity at other Internet Exchanges, locally and internationally). Traffic over these connections is termed "off-net", and is subject to traffic charges, which are passed on to customers on a volume-linked price basis. This off-net traffic currently comprises about 85% of AARNet's total traffic.

AARNet also connects directly with (ie peers with, free of traffic charge) key international R&E networks in the USA and Europe (eg Abilene, the Internet2 network, and GEANT2 the pan-European R&E network), which in turn connect with most R&E networks around the world. Traffic over these networks (as well as over AARNet itself between members) incurs no volume-based charge. These arrangements have been put in place specifically to support high-volume research endeavours, where a volume-based price would be a significant deterrent; these links are currently only lightly used. It is possible (and highly advisable) to determine in advance if a particular proposed traffic flow will be on-net or off-net (see <http://www.aarnet.edu.au/cgi-bin/traffic.cgi>), providing researchers with the confidence that their data will be covered by their on-net subscription charges.

All members (as well as associates) of AARNet are entitled to this subscription-based on-net arrangement having no traffic volume charges. If a member wishes to enter a research partnership with a non-member, under which significant data transfers may take place, then it may be advisable to arrange for that second party to become an associate of AARNet. This is normally possible for research purposes, but a physical connection and membership fees would be involved. Such arrangements are treated on a case by case basis.

- h) **End-to-end Network Characteristics:** certain services, such as Access Grid and Compute Grid, require specific network characteristics (eg Multicast) to be enabled; although these functions are available across the AARNet network, they may not be enabled over sections which are not under AARNet's control, such as within member institutions; institutional firewalls may also represent

impediments to unfettered access; users should verify that these anomalies are not present – AARNet can advise and assist in ensuring there are no such impediments.

Although all of the above comprises the so-called AREN (Australian Research & Education Network), it is clear that it is not homogeneous in a variety of ways. AARNet as the designated operator of the AREN must do so in accordance with the various different arrangements and conditions applying in each case.

3. Network Operations

AARNet operates a Network Operation Centre (NOC – see <http://noc.aarnet.net.au/>), which monitors network performance and collects data on a wide variety of network activity. The management and collection of this data is again limited to those links that AARNet directly owns and manages. This means that some end-to-end connections may not be as “visible” to the NOC as for the bulk of the network. Much of this data collection and error detection is automated, employing software called Nagios (see <http://www.aarnet.edu.au/network/>). A 24x7 service is provided, with staff available for call-out after hours – these calls can originate from automated systems sending SMS to on-call staff, or via the outsourced after-hours call centre (so customers can place calls at any time) – see <http://www.aarnet.edu.au/contacts/nochelp.html>.

4. Network Consulting Services

AARNet constantly undertakes consulting assignments for customers and others in the design of network extensions, overlays and other basic network services, drawing on its wealth of experience in dealing with tier 1 fibre suppliers, tier 2 network service providers, network equipment and software suppliers, typically involving leading edge equipment and services. Many network configurations and services (eg configured light-waves) are not yet available from commercial suppliers, and AARNet undertakes its own designs and configurations, drawing on its contacts with similar advanced research network operators (such as Internet2) overseas.

5. Additional Network Services

The network provided by AARNet currently supports a range of advanced services, which are integral to the network infrastructure and which extend over all (or nearly all) of the network. They are typically not charged for in addition to basic network charges.

These services include IPv6, Multicast and QoS, which are required by certain advanced applications such as Access Grid. It should, however, be noted that while these services are activated on the backbone, there may be issues within a connected organisation or campus that prevent full end-to-end compliance.

AARNet technical staff can advise on what the requirements may be for any particular application, and can assist with appropriate configurations and implementation.

AARNet’s network, as indicated above, is capable of supporting dedicated circuits via independent wavelengths (termed “overlay networks”), over most but not all of its length. These are usually established as 1Gbps circuits between specific end points (two or more). Once again, staff are able to advise on, design and set up such circuits to suit specific requirements. In due course, it should be possible to establish user-configurable circuits of this kind (User-Controlled Light Paths, UCLP), which can be established by researchers themselves (or with the assistance of their own technical staff) on an *ad hoc* basis or for short-lived projects. This service incurs additional costs, so cannot be provided (at this stage) free of charge.

An integral part of the network is a Content Mirror, which supports local, on-net access to a wide range of popular software and other files, so providing faster and no cost to these files; see <http://mirror.aarnet.edu.au/>.

In a similar vein, aimed at reducing the cost of traffic, AARNet peers its network with a range of other networks in Australia and overseas. Peering is usually free of charge (excluding cost of equipment), and provides un-tariffed bi-directional traffic flow between the two or more peered networks. Of particular significance are the peers with Internet2, GEANT2 and other R&E networks worldwide. AARNet is also working to gain on-net access to a range of content appropriate to the Australian higher education and research sector, including such content as Australia Screenonline, ResearchChannel, the ABC. Researchers generally do not need to be aware of these peering arrangements (other than to note which are available on an un-tariffed basis).

6. Value-Added Services

AARNet also is providing a widening range of value-added services and applications which are layered over the network which may be relevant to researchers. Typically, these services incur additional charges, though in some cases (eg VoIP) are low. Most of these services are currently being reviewed with a view to expanding them and making them easier to use.

The services currently provided are detailed at <http://www.aarnet.edu.au/services/> and include:

- a. Voice-over-IP (VoIP) – AARNet provides a VoIP service over its network so that, for example, interstate phone calls can be made between participating members at negligible cost (see <http://www.aarnet.edu.au/services/voip/index.html>);
- b. Video and Audio over IP – AARNet provides a general multi-point audio/videoconferencing service, based on its recently-upgraded MCU, which is currently being enhanced and made simpler to use, incorporating a booking system, integration with desktop calendaring systems like Outlook, and other collaboration and presence tools; plans are being made to add a session recording service, and to experiment with immersive multimedia solutions (see <http://cbr-b-voip1.aarnet.net.au/cgi-bin/bookmcu>);
- c. ENUM – AARNet is one of a 2-3 accredited Registrars in Australia for the ENUM communication medium numbering system, set to rival IP addresses – see <http://www.aarnet.edu.au/services/enum/index.html>;
- d. eduroam – AARNet provides the Australian and APAN regional nodes for this global wireless roaming system, and provides support and promotion; it is based on authentication at a researcher's home institution by means of a Radius system and the 802.1X protocol; once set up at the home institution, and a certificate has been loaded onto the user's laptop, it automatically connects to the Internet at any other institution worldwide which has also been set up (see <http://www.eduroam.edu.au/>).
- e. Network-connected filestore (RETAIN) – as well as hosting the above Content Mirror service, AARNet's 15TByte file store can also be used by researchers for holding file on a temporary or permanent basis (see <http://mirror.aarnet.edu.au/>); AARNet also has taken responsibility for the former GrangeNet filestore.
- f. Middleware services – AARNet provides several middleware services, including hosting the WAYF service for the MAMS Test Shibboleth Federation, maintaining a library of information about middleware initiatives locally and internationally, and co-chairing the APAN middleware stream (see <http://www.aarnet.edu.au/engineering/middleware/index.html>); these services are currently being reviewed and expanded.