

**AV-CC****Australian Vice-Chancellors' Committee**

(INCORPORATED IN THE A.C.T.)

AVCC/AARNET/127c/91

27 November 1991

## AVCC Memorandum

To: AARNet Advisory Board Members  
From: T. J. Mullarvey  
Re: AARNet link to USA

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Attached is an AVCC memorandum from Geoff Huston regarding the outcome of additional investigative activity regarding the requirement for upgrading of the AARNet link to the Internet Exchange point on the West Coast of the United States.

I have conferred with professor Don McNicol on this subject, and the recommendation to proceed with the upgrade within the timeframe indicated in the memorandum is endorsed by Professor McNicol.

Could you please review the attached material and lodge any comment you may care to make with the AVCC Secretariat by 2.00 pm Friday 6<sup>th</sup> December, to allow the AVCC to determine whether this recommendation has the support of the AARNet Advisory Board, and if so to be able to proceed with the necessary preparatory activity before the end of this calendar year.

**AV-CC**

## Australian Vice-Chancellors' Committee

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AVCC/AARNET/127/91

5 November 1991

### AVCC Memorandum

To: T. J. Mullarvey  
From: G. Huston  
Re: AARNet link to USA

I would like to advise you of further developments regarding the AARNet link to the USA, following investigations of this matter by AARNet staff. As you are aware, the international link is currently a 256Kbps link, implemented via satellite. This capacity has been in place since April of this year.

There are a number of concerns regarding capacity of this link and current usage levels. Accordingly a detailed analysis of the usage statistics has been undertaken by AARNet staff in order to provide a reasonable basis for consideration of this matter.

The attached graph indicates the sustained 8 hour average utilization of this link for every weekday from August 1990 until the present. The daily period analysed is from 1000 until 1800 Australian Eastern Time. As well as looking at total daytime utilization the graph also includes maximum hourly load and maximum 15 minute load figures for the link for each weekday, in order to map peak usage against average day usage on the link.

As was anticipated, the 15 minute samples correlate relatively closely with available line capacity. The maximum hourly show more a tendency to take some 5-6 months to reach available line capacity, and the 8 hour average load figures indicate a consistent pattern of growth at a similar rate to the maximum hourly figures.

It is noted that current usage levels are now reaching available capacity of the link. The graph indicates that for the most recent 15 days the daytime levels of usage of the link are running at sustained saturation levels, with the consequent problems of dropped packets, retransmissions, highly variable round trip times and overall poor performance due to saturation of the resource.

A linear extrapolation of the usage figures indicates a doubling of traffic levels over the next twelve months, with projected traffic requirements reaching 512Kbps levels in some 12 months within this model. Of course there are a number of caveats that should be expressed regarding the applicability of a linear fit extrapolation to such data, and the predictive figures are indicative of general trends in expressed requirements. The caveats would include provision for a slowdown in growth across the December – February period, as occurred in 90-91, and, of course, growth in traffic is effectively constrained by available capacity. *Yes minutes!*

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While it is a feasible course of action to keep the level of available resource at 256Kbps for the future, this is not a decision which should be taken lightly. The inherent problem here is that the protocol performance degrades rapidly at average line loadings above some 65% of peak capacity, and the effective user delivered bandwidth starts to decrease in response to increased offered load. Thus under the conditions of current usage the 256Kbps link is performing at effective throughput rates of under 150Kbps, effectively increasing the unit cost of the decreasing user available capacity of the link. With continued growth in presented load, the effective throughput will decline further, causing an exponential breakdown of the facility. Of course such problems are not unknown within this type of network architecture and the two major upgrades to US domestic resources (the upgrade of the NSFnet from 56Kbps to 1.5Mbps and from 1.5Mbps to 45Mbps) were largely in response to such catastrophic failure of links under high levels of imposed load. It is a reasonable certainty that we would witness a similar catastrophic failure in AARNet's international connectivity under similar conditions of imposed load and available resources.

Accordingly it is recommended to upgrade the link to a capacity of 512Mbps in February 1992. It is anticipated that current usage levels will be relatively steady over the new year period, and February will see a resumption of a general trend of increased requirements for access to this resource, so that the engineering recommendation for timing of the upgrade is seen as being in phase with demand movements. Although upgrading to an intermediate capacity of 384Kbps is an option, it must be noted that this would be a temporary measure for only some 6 months, and would not effectively address the load issues in so doing. From this perspective this is not seen as a viable course of action for AARNet.

There is a lead time for orders for upgrades of capacity of some 10 weeks or so, and it is noted that OTC are waiving establishment charges of some \$2,500 if the order is placed before 25 December 1991 (OTC advice attached).

Future years should be considered in the context of a comprehensive business plan for AARNet. Certainly there appears to be a medium term requirement for additional bandwidth, but within the same timeframe the PACRIM East undersea fibre cable is anticipated to be commissioned which may offer opportunities to jointly purchase capacity with New Zealand at considerably reduced tariff levels (certainly the reduction of capacity unit charges has occurred in other parts of the world where undersea fibre has been deployed in competition with Intelsat services). Additionally it should be noted that such a growth in demand will be accompanied by a growth in demand for domestic capacity, and the task of mapping out a strategic direction to accommodate this demand within an acceptable policy, funding and operational framework is very much the subject of consideration in the preparation of the AARNet business plan.

The current costs of the 256Kbps facility are some \$19,900 per month, paid to OTC. The US half circuit is funded via the PACCOM program, with major funding from NASA. The costs of the 512Kbps circuit are some \$35,000 per month to OTC for the Australian half circuit, together with a requirement to provide funding support to PACCOM of some \$US 3,000 per month. For calendar year 1992, assuming a start date of 1 March 1992 for the 512Kbps circuit this is a link cost of \$432,775.

It is recommended that this upgrade proceed with a target implementation date of 1 March 1992.

Daily Link Utilization (Kbps), Australia - USA

