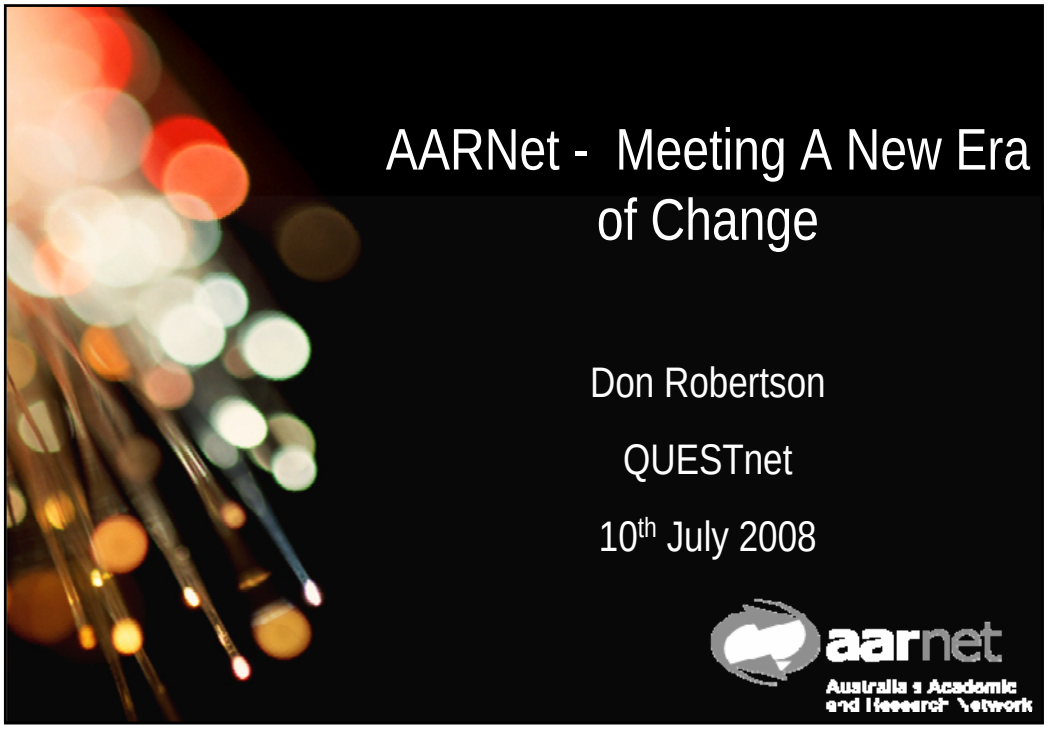
AARNet - Meeting A New Era of Change
Don Robertson
QUESTnet
10th July 2008
aarnet
Australia's Academic and Research Network


Agenda
1. Political Change
2. Upgrades & Product Announcements
3. Challenges Ahead
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# 1. Political Change

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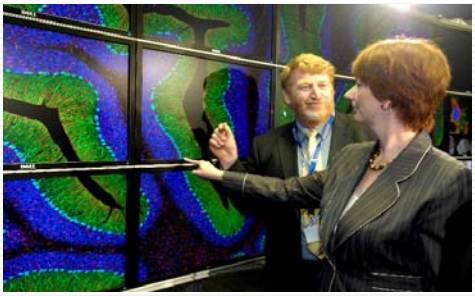
## Political Change



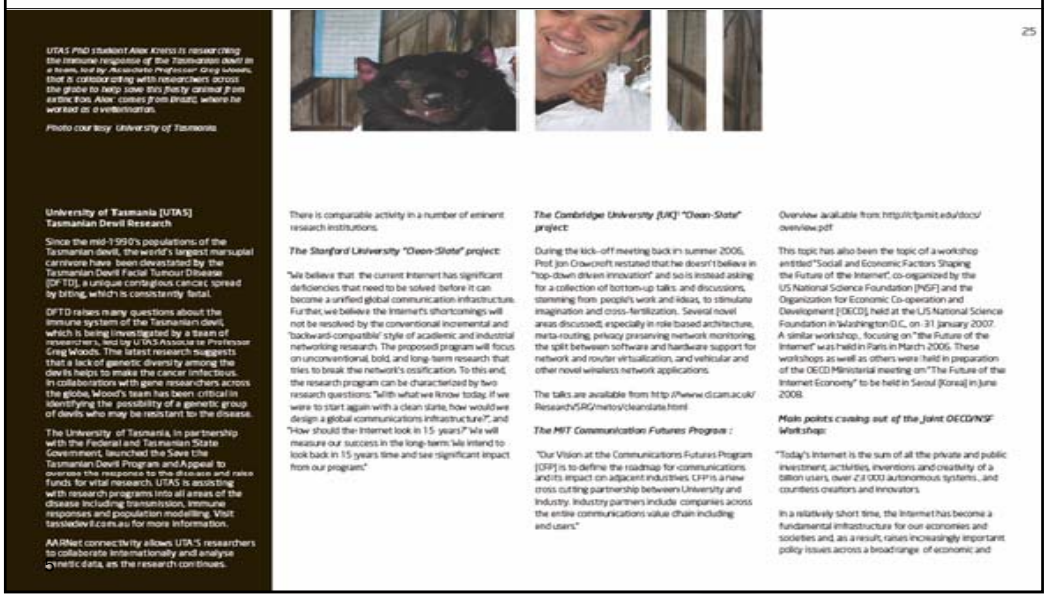
Julia Gillard, Minister for Education

- New Federal Government 2007
- National Innovation Review
- Focus on 2020 Vision
- NCRIS Phase 2
- Digital Education Revolution
- National Broadband Network
  - Last & middle mile is the issue and carriers including AARNet are looking for true wholesale open access

*"This year the Minister is keen to explore the potential for AARNet to support the Digital Education Revolution for schools".*

***- AARNet 2007 Annual Report***

# Submission to the National Innovation Review



*UTAS PhD student Alex Kreiss is researching the immune response of the Tasmanian devil in a team, led by Associate Professor Greg Woods, that is collaborating with researchers across the globe to help save this feisty carnivor from extinction. Alex comes from Bristol, where he worked as a veterinarian.*

*Photo courtesy University of Tasmania*



**University of Tasmania [UTAS] Tasmanian Devil Research**

Since the mid-1990's populations of the Tasmanian devil, the world's largest marsupial carnivore have been devastated by the Tasmanian Devil Facial Tumour Disease [DFTD], a unique contagious cancer, spread by biting, which is consistently fatal.

DFTD raises many questions about the immune system of the Tasmanian devil, which is being investigated by a team of researchers, led by UTAS Associate Professor Greg Woods. The latest research suggests that a lack of genetic diversity among the devils helps to make the cancer infectious. In collaborations with gene researchers across the globe, Wood's team has been critical in identifying the possibility of a genetic group of devils who may be resistant to the disease.

The University of Tasmania, in partnership with the Federal and Tasmanian State Government, launched the Save the Tasmanian Devil Program and Appeal to oversee the response to the disease and raise funds for vital research. UTAS is assisting with research programs into all areas of the disease including transmission, immune responses and population modelling. Visit tassiedevil.com.au for more information.

AARNet connectivity allows UTAS researchers to collaborate internationally and analyse genetic data, as the research continues.

There is comparable activity in a number of eminent research institutions.

***The Stanford University "Clean-Slate" project:***

"We believe that the current Internet has significant deficiencies that need to be solved before it can become a unified global communication infrastructure. Further, we believe the Internet's shortcomings will not be resolved by the conventional incremental and "backward-compatible" style of academic and industrial networking research. The proposed program will focus on unconventional, bold, and long-term research that tries to break the network's ossification. To this end, the research program can be characterized by two research questions: "With what we know today, if we were to start again with a clean slate, how would we design a global communications infrastructure?", and "How should the Internet look in 15 years?" We will measure our success in the long-term: We intend to look back in 15 years time and see significant impact from our program."

***The Cambridge University (UK)' "Clean-Slate" project:***

During the kick-off meeting back in summer 2006, Prof. Jon Crowcroft restated that he doesn't believe in "top-down driven innovation" and so is instead asking for a collection of bottom-up talks and discussions, stemming from people's work and ideas, to stimulate imagination and cross-fertilization. Several novel areas discussed, especially in role based architecture, meta-routing, privacy preserving network monitoring, the split between software and hardware support for network and router virtualization, and vehicular and other novel wireless network applications.

The talks are available from http://www.cl.cam.ac.uk/Research/SRG/netos/cleanslate.html

***The MIT Communication Futures Program :***

"Our Vision at the Communications Futures Program [CFP] is to define the roadmap for communications and its impact on adjacent industries. CFP is a new cross cutting partnership between University and Industry. Industry partners include companies across the entire communications value chain including end users."

Overview available from: http://ictpamit.edu/docs/overview.pdf

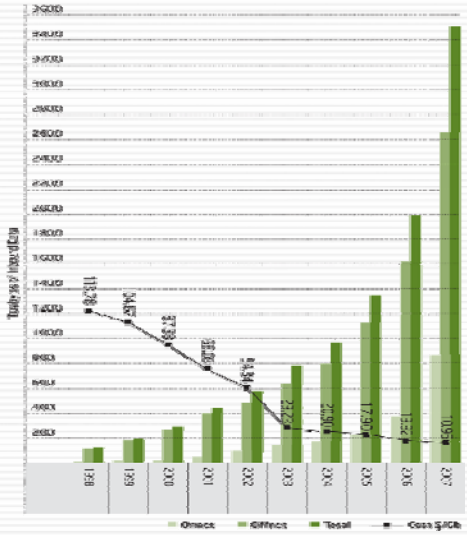
This topic has also been the topic of a workshop entitled "Social and Economic Factors Shaping the Future of the Internet", co-organized by the US National Science Foundation [NSF] and the Organization for Economic Co-operation and Development [OECD], held at the US National Science Foundation in Washington D.C. on 31 January 2007. A similar workshop, focusing on "the Future of the Internet" was held in Paris in March 2006. These workshops as well as others were held in preparation of the OECD Ministerial meeting on "The Future of the Internet Economy" to be held in Seoul (Korea) in June 2008.

***Main points coming out of the Joint OECD/NSF Workshop:***

"Today's Internet is the sum of all the private and public investment, activities, inventions and creativity of a billion users, over 2.8 000 autonomous systems, and countless creators and innovators.

In a relatively short time, the Internet has become a fundamental infrastructure for our economies and societies and, as a result, raises increasingly important policy issues across a broad range of economic and

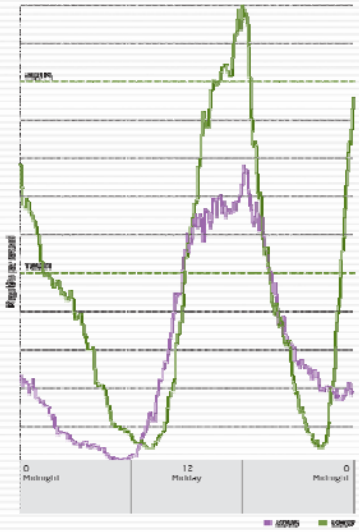
# Traffic Growth like never before!



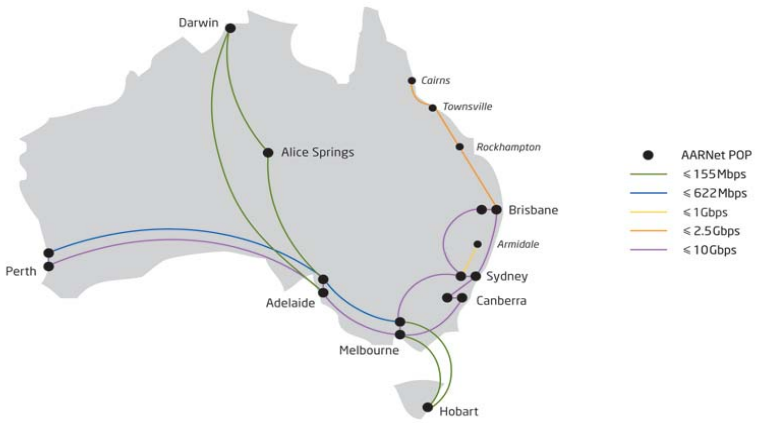




# Traffic from YouTube on a typical day

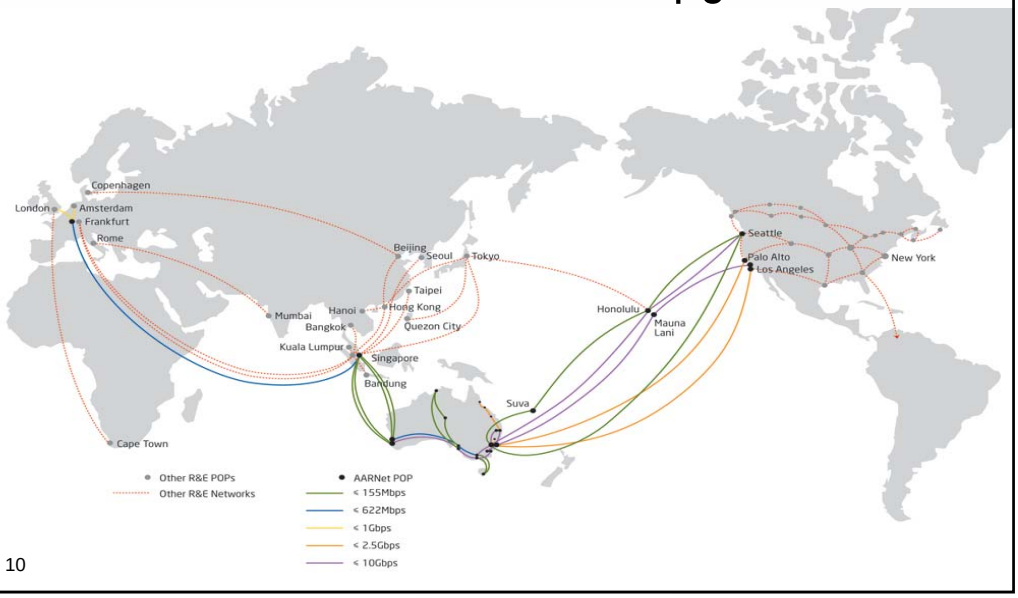


# National – 2x STM64 + STM16 Upgrades






# International – STM16 upgrade



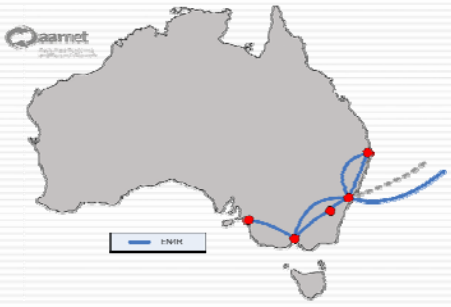
# 10Gbps Access Product is here!!!

- HD and other high bandwidth applications combined with “big research” pushing large data sets means 1 Gbps is no longer adequate for all users
- Will permit researchers to exchange large amounts data within Australia, and internationally via SXTransPORT
- In use at AARNet’s Canberra & Perth offices
- Option to separate on-net & off-net traffic (available ‘09)
- Rate limited to a maximum of 5 Gbps in either direction but can do more
- Cost is $40K pa + one off charge for 10G optics + 10G capable tail connection





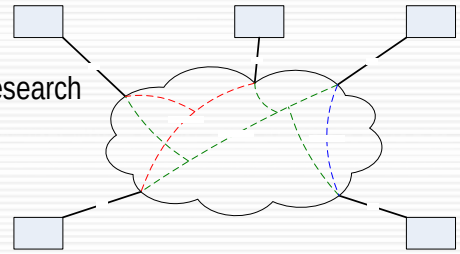
# EN4R (Experimental Network for Researchers)




- Encourage researchers to think ‘differently’ about transferring data
- Dedicated gigabit circuits (“lightpaths”) between two geographically disparate locations (on Optical Network)
- Free access for up to 12 months
- Access to North America, Europe & Asia via. SXTransPORT
- 10G EN4R available now!

# National Collaboration Network - supporting NCRIS

- Point to Point or Multipoint national Ethernet service
- Allows researchers to collaborate at Layer 2.
  - For use with applications that don't tolerate IP Networks (eVLBI)
  - Assists in mitigating firewalling and security concerns
- Based on MPLS Virtual Private LAN Service (VPLS)
- Requires upgrades (software and hardware) of AARNet backbone
- *Ready for service by Q4'08*
- Partnering with CSIRO to develop services to support research



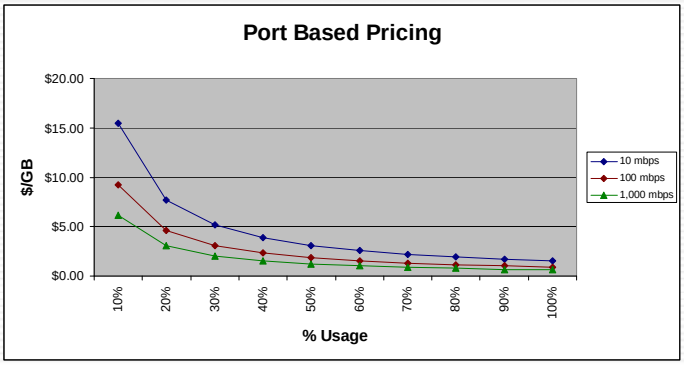




# Port Based Option - Moving away from Volume Charges

- Available immediately and reviewed at the end of 2008;
- Designed for student residences and schools, but will not be restricted just to these applications;
- Three connection options:
  - a standard AARNet3 CPE (for larger users);
  - a port on an existing AARNet3 CPE (only if technically feasible);
  - a port on a shared AARNet3 CPE (for smaller users).
- Bandwidth options will be limited to multiples of 10 Mbps up to 100 Mbps, and then multiples of 100 Mbps up to 1 Gbps;
- Increases in capacity allowed monthly, but reductions only allowed quarterly;
- No separation of On Net and Off Net traffic – till '09;
- Available to both subscription and volume based customers;
- It cannot replace the existing membership Fee or Off Net subscription.

# Port Based Pricing Option




Example - 100Mbps @ 50% utilisation = $1.85 per GB



# Domestic Peers

- AARNet receives traffic from a variety of sources – customers, peers, transit service providers, both domestically and internationally;
- The cost of each source varies considerably;
- Traffic from some sources is charged on a subscription basis (On Net), and other traffic is charged on a volume basis (Off Net);
- The cost of domestic peer traffic is very low, whereas the cost of international peer traffic is relatively high;
- AARNet has been considering including domestic peering traffic in the Membership Fee (i.e.. as On Net);
- *As of July 1st, Domestic Peer traffic will be classified as On Net;*
- From 2009, there will be a one-off corresponding increase in the Membership Fee;
- However, not all traffic from Domestic Peer organisations traverses these peering links.

# "EVO": Enabling Virtual Organisations

- EVO is a distributed collaboration tool incorporating:
  - Video
  - Audio
  - White Board
  - File Sharing

- Developed by Caltech for and funded by the High Energy Physics community (LHC)
- Gaining acceptance outside the HEP community
  - Support contracts available



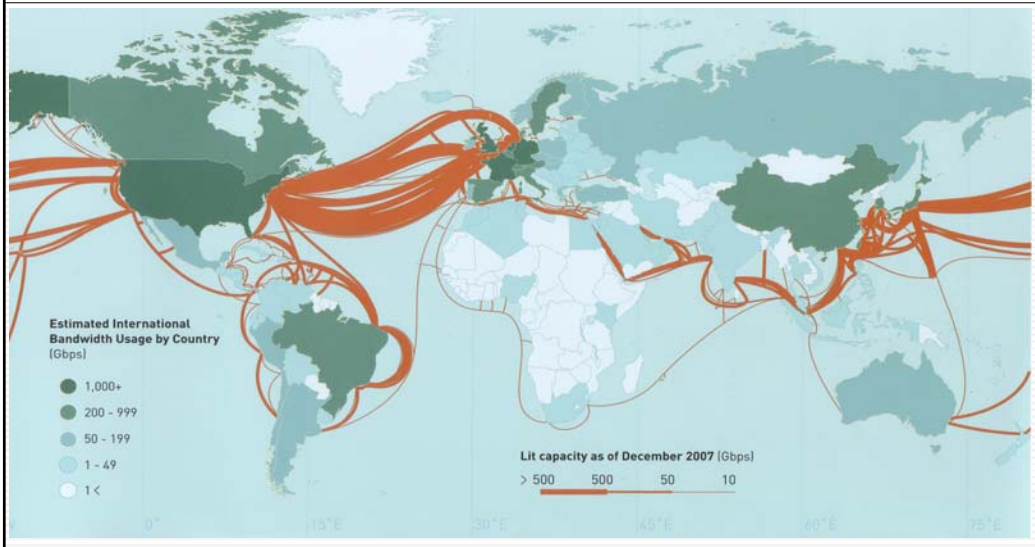


# ARCS & AARNet in partnership!

- ARCS:
  - has chosen to support the collaboration tools EVO and AG
  - In partnership with AARNet bringing EVO to Australian Research Community
  - Will operate a level 2 help desk:
    - Level 1 support from within each the institution
    - Level 3 support from Caltech
- The outcome:
  - $50k investment from both AARNet and ARCS
  - *Free to use for all researchers in Australia*



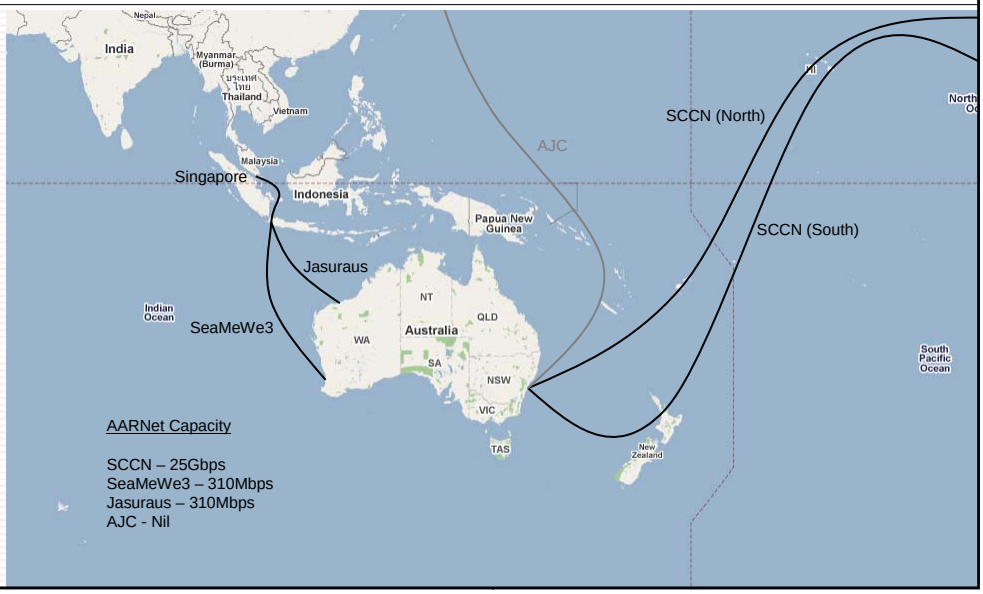

# Challenge # 1 - *Lit Capacity is restrictive*






Source: TeleGeography, Inc

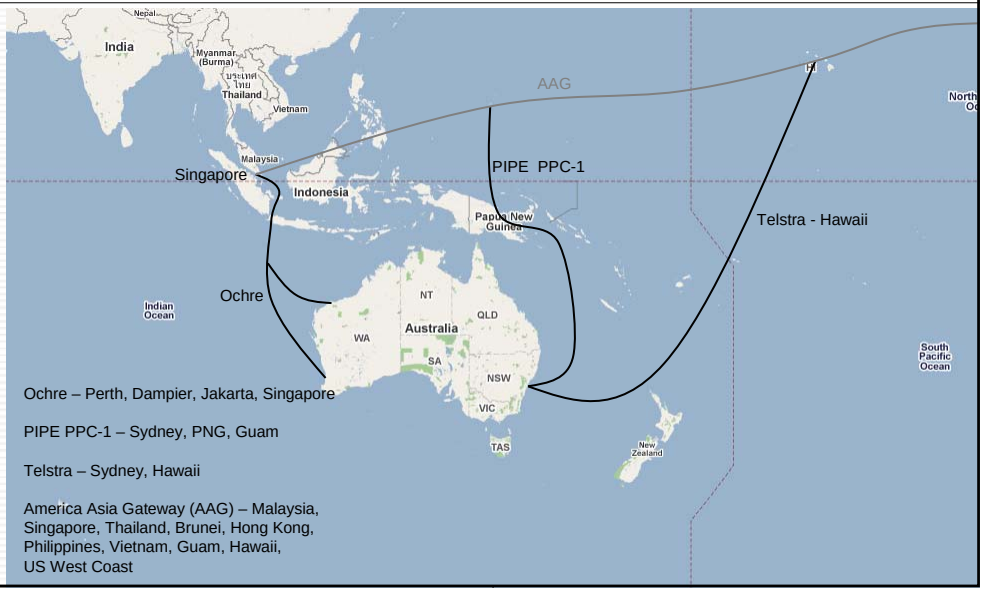
# Australia has Minimal Competition








# International Cable Systems Proposed?



# What $60,000/mth Can Buy


Source: TeleGeography, Inc

2.5 x STM-1 (400Mbps) SYDNEY – CALIFORNIA $150.00/Mbps





# Challenge # 2 – Completing the Network

AARNet continues to plan to address the regional areas of:

1. North Queensland
2. Tasmania and
3. Lighting WA Optical Network

*International connectivity will remain a challenge until long term 'effective ownership' of infrastructure can be achieved*

# Challenge # 3 - India chasing China

- India are driving a knowledge economy.
- Future skills shortages and public institutions reform in India are important to enable a developed country by 2020.
- Competition for higher education services access to PhD students is a growing, lucrative market
- There are 57,000 Indian students based in Australia (no.2 preferred location)
- The Australia-India Strategic Research Fund (AISRF) received 151 applications for A$56 million in funding with Indian counterparts esp. in Science and Technology and Biotechnology areas (Source: DEST)
- **Current Internet traffic between AARNet & India is low, AARNet are building a case for connectivity via AIBC/Govt/Universities.**



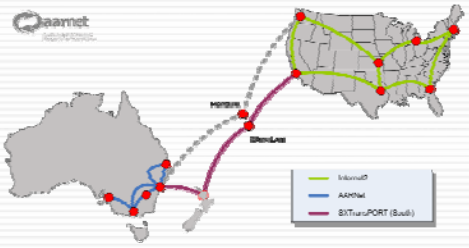



# Challenge # 4 – Making *Light* Easier

- Significant efforts required to setup
  - Manual operation
  - 4 NRENs (AARNet, CENIC, CaNARIE & SURFNet)
  - 100+ emails
- Hard to maintain
  - Planned and unplanned outages
  - End to end performance monitoring very hard
- But very effective eVLBI & OptiPuter community, with proven results
  - Better throughput results compared to conventional L3 network
- Suitability:
  - High bandwidth short duration data transfers

# The solution could be the *DCN*

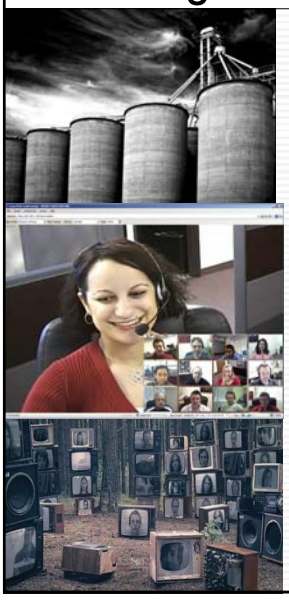
- Dynamic Circuit Network (DCN)
  - Adhoc real time configuration of circuits
  - Technologies:
    - DRAGON
      (Dynamic Resource Allocation via GMPLS Optical Networks)
    - UCLP
      (User Controlled Light Paths)
  - The goal is inter-domain dynamic circuits:
    - AU to Europe (via US)







# Challenge # 5 - Delivering Video Conferencing



- Bringing *disparate 'silos'* of video communities to one collaboration space – negotiating the 'common ground' in P2P apps/AG/H.323 integration
- There are camps of *network/knowledge/expertise* – technology & teaching/learning should equally lead
- *Desktop video conference products* can deliver better performance/resolution than higher priced traditional VC endpoints increasing opportunities for collaboration.
- *Legacy technology is common* place and the complexity in integration and support to deliver user friendly video services is not easy.

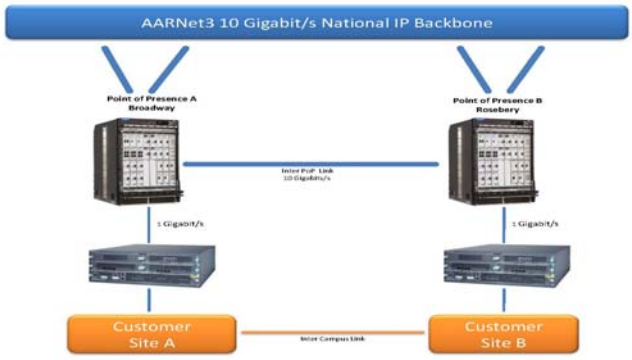
# Challenge # 6 - End-to-End Performance

- Network performance is an 'end-to-end' metric
- AARNet is in the middle
- A very complex problem requiring every aspect of the connected equipment and intermediate networks to be appropriately configured
- If this was easy if would have been fixed by now!
  - Many NRENs working on the problem
  - E.g. Internet2 have a End to End Performance Initiative with 9 staff
  - A wealth of information and measurement tools available
  - see http://e2epi.internet2.edu/
- AARNet is deploying measurement equipment on A3
- AARNet will assist as much as possible with resolving performance issues
- Sustained 9Gbps Perth to Canberra!



# Challenge # 7 - Building in Redundancy is key!

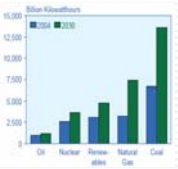
- AARNet backbone has 'five 9s' reliability (99.999%)
- AARNet has dual POPs in each major capital city
- Major improvement to the reliability of customers internet service can be achieved by making dual diverse connections to the AARNet backbone



# Challenge # 8 - Why Care About Energy?

1. Electricity costs rose 88% in US since 2003 (US EIA data)
   Intl Energy Outlook '07 predicts doubling energy generation by 2030

2. Worldwide legislation changes and public support for energy efficiency and climate control
   *EMEA:* reduce $CO_2$ by 20% by 2020
   *UK:* reduce $CO_2$ by 20% by 2010
   *Japan:* reduce $CO_2$ to 6% under 1990 level by 2010



3. Carriers and businesses are setting new targets
   - reduced energy consumption
   - reduced heat dissipation
   - reduced space requirements (compact footprint)

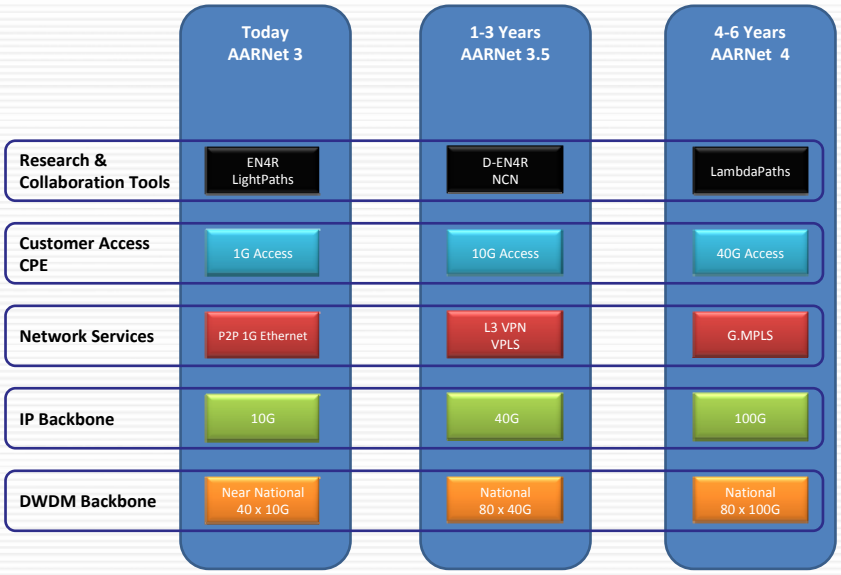




# 'Green' AARNet

- Stakeholder questionnaire
  - Ensure we meet our customer's requirement
  - Communication
- Measure and verify AARNet's carbon footprint
  - Develop an AARNet Carbon Manual
  - Independent audit to appropriate standard (like ISO14064)
- Develop carbon management Plan
  - Based on Carbon Manual and our stakeholder requirements
- 'Green' procurement policy
  - Future equipment and services

# AARNet Network Roadmap




## *“ our goal is to remain ahead of the curve ”*

- As “fibre” continues to dominate, civil works will continue
- EN4R & NCN have replaced GrangeNet as the ‘experimental research network’ – an excess of research capacity!!!
- Upgrading the backbone to support 40Gbps and beyond
- Dynamic light paths
- Applications and services will need to provide the tool kits for trust relationships, grid and web services, security, service oriented architectures and stimulating the use of these services
- Complete the Network to WA, Nth QLD & Tasmania
- Expanding the network to support all research & education



## AARNet – Building YOUR network


Questions?