Connecting Telescopes *Down-Under*
The Australian Research and Education Network

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Overview

- AARNet:
  - background,
  - national backbone:
    - routed,
    - optical,
  - international capacity,
  - future developments.
- Exploiting these networks to do VLBI:
  - ATNF network “internals”.
- Some thoughts about the future.

An Brief Introduction to AARNet

- Formed in 1989 under the the Australian Vice-Chancellor's Committee.
- December 1998: AARNet Pty Ltd (a not-for-profit company limited by shares).
- Shareholders: 38 Universities and CSIRO.
- Board: 12 members elected by the shareholders.
- Operational costs are fully funded by customer fees.
- AARNet is Australian Telecommunications Carrier #61.
- In 1997, the AARNet2 network was implemented.
- In 2006, the AARNet3 network launched.
- AARNet is the "for purpose" Telco for Australian Research and Education.
- Acceptable use policies:
  - who can connect,
  - what network paths can be used.

AARNet Services

- High speed, high availability connections for more than one million users, connecting customers together and to the global R&E networks.
- Services:
  - video conferencing including multipoint,
  - native multicast,
  - native IPv6.
- Civil works (managing fibre cabling installation).
- 1Gbit/s and10Gbit/s optical circuits:
  - limited coverage,
  - presented as Ethernet (i.e. layer 2), encapsulated into SDH on the backbone.
- International “lightpaths” (GLIF).
- Peering with more than 400 peering points around the world.

AARNet National Network

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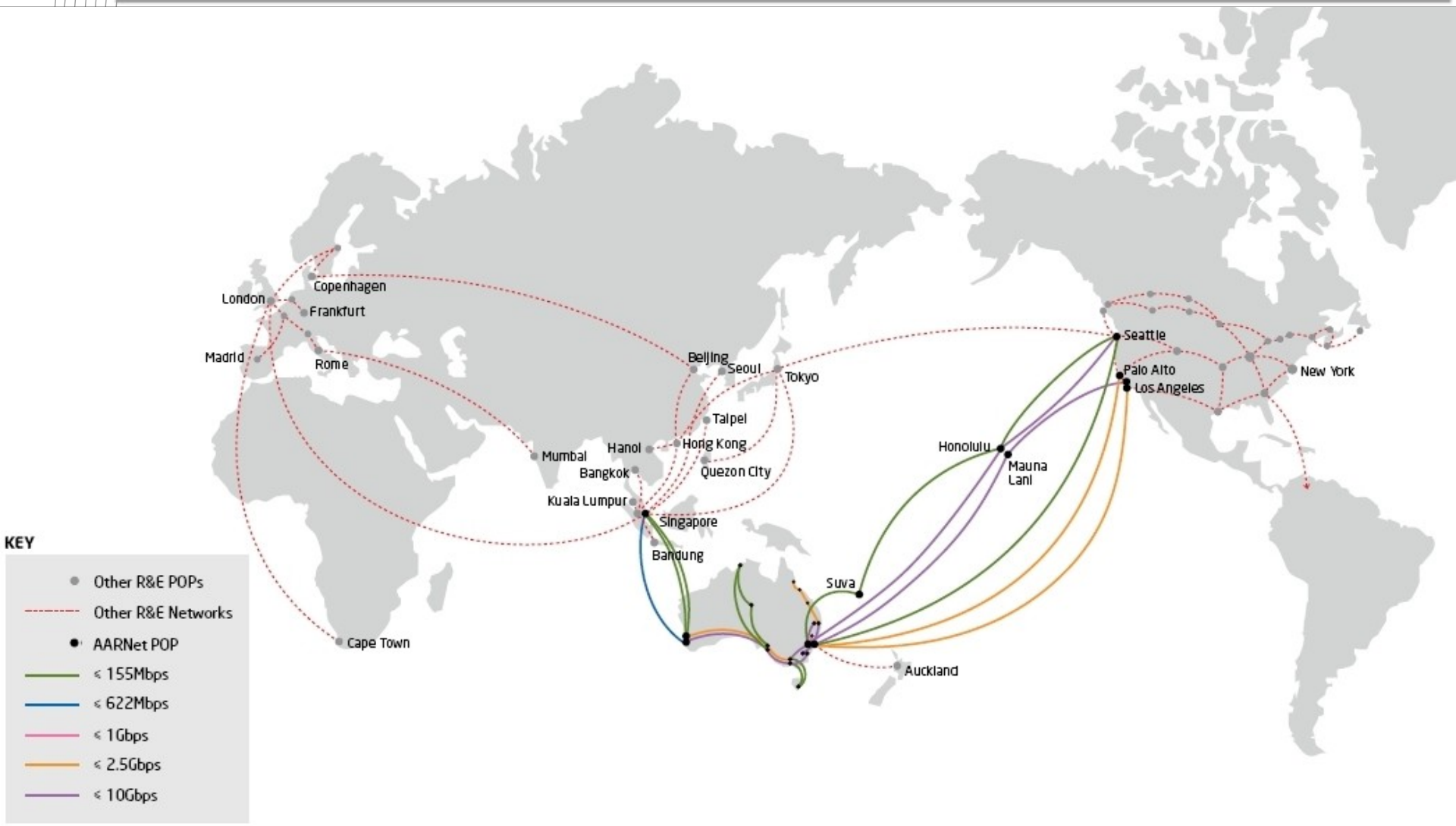
AARNet International Network



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AARNet Optical Network (Eastern Australia)

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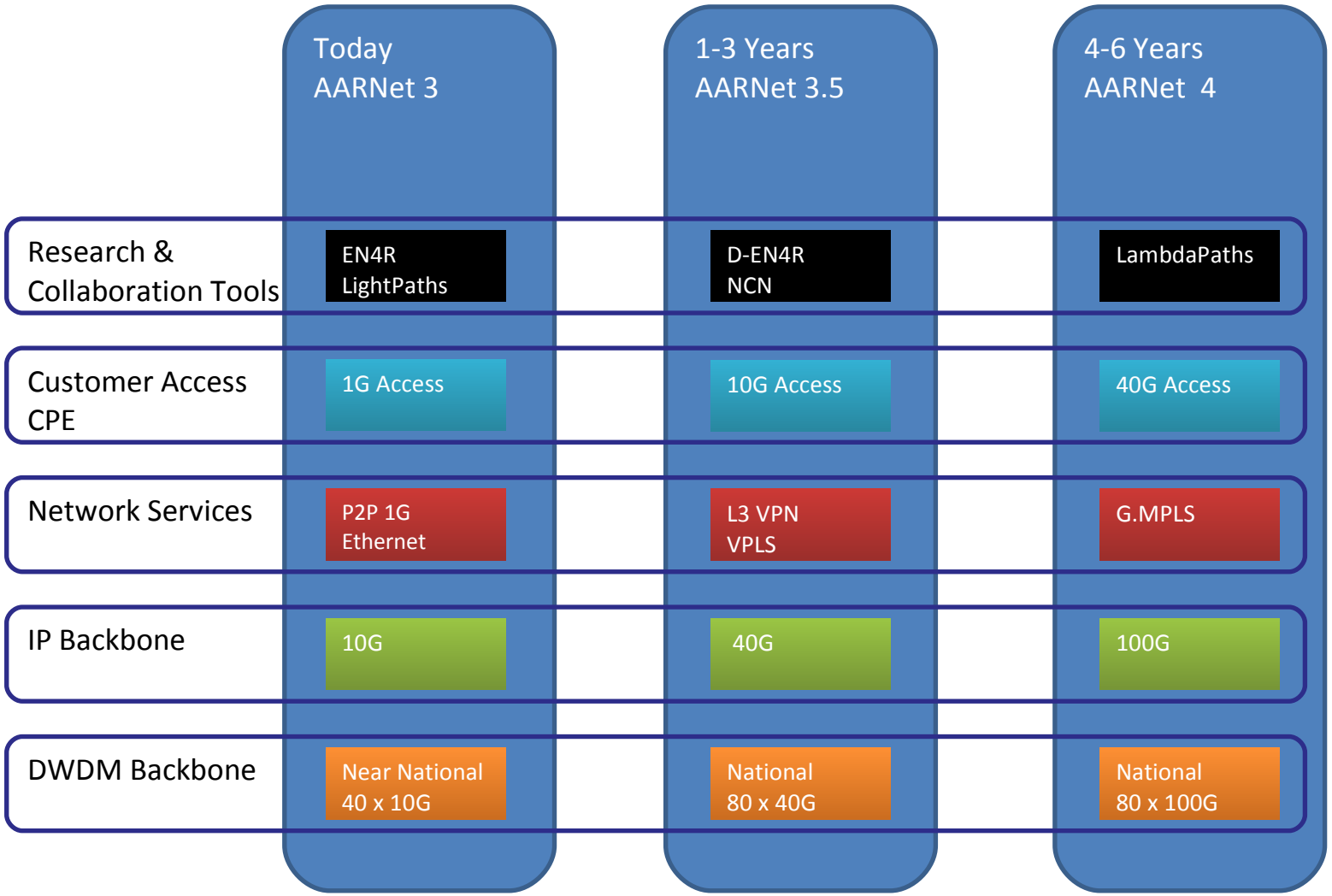
AARNet Roadmap



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Networks within ATNF

ATNF Network Overview (1)

- Six 1Gbit/s “production” network links:
  - shared infrastructure,
  - Layer 2/Layer 3 hybrid.
- Cisco 6500-class core switch/router at each site:
  - e-VLBI hosts connected directly to the core, or
  - e-VLBI hosts connect to an access switch which has a 10Gbit/s trunk to the core (preferred if possible).
- All network infrastructure is jumbo-frame enabled.
- Each e-VLBI data recorder and each e-VLBI data receiving node has four 1Gbit/s interfaces.
- Traffic flows managed by “juggling” VLANs (we don’t want failover to a different path!); typical rates are around 540Mbit/s (for a 512Mbit/s experiment).
- The all sites behind a CSIRO firewall!

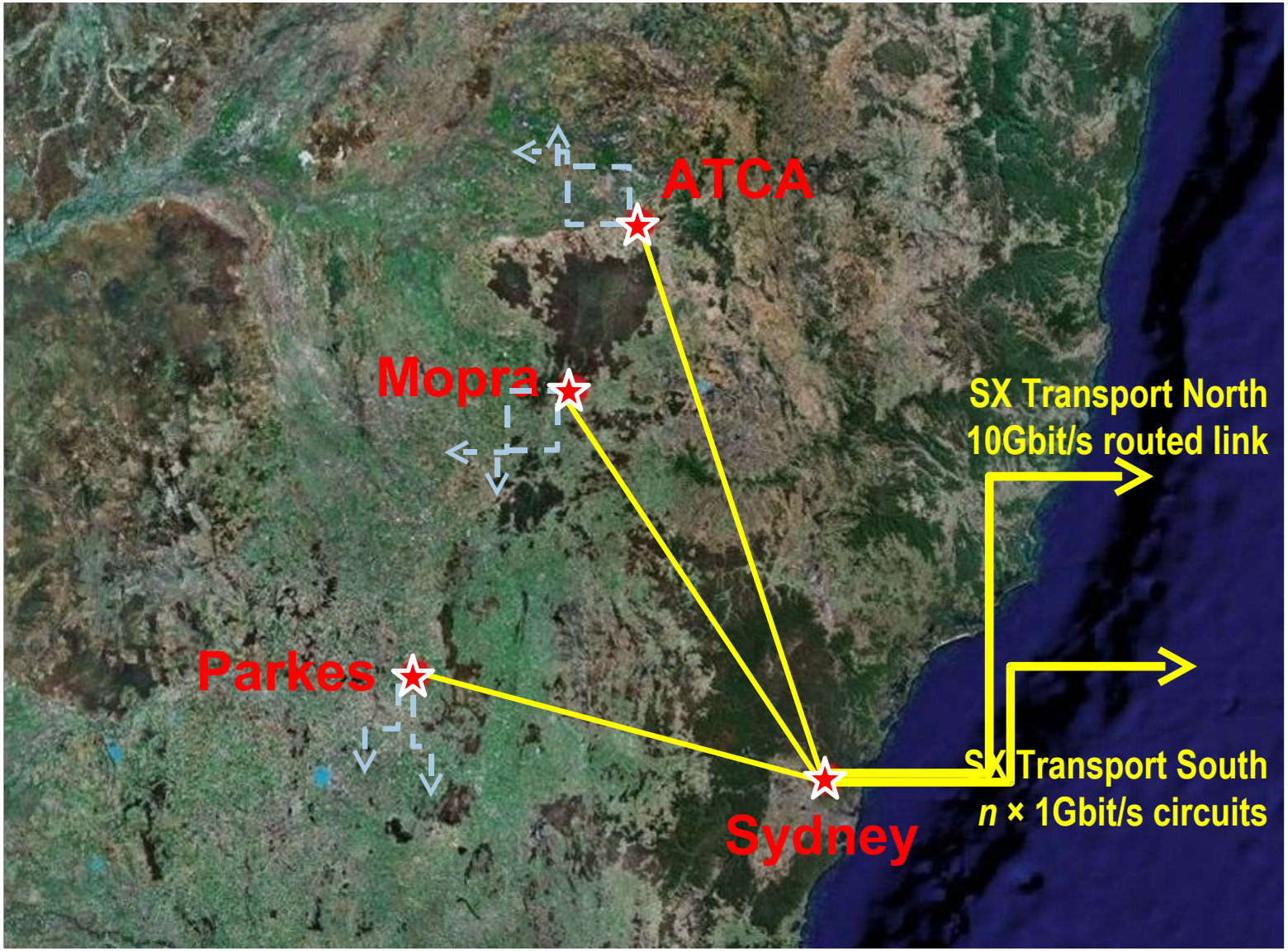
ATNF Network Overview (2)

- We have had up to three 1Gbit/s “lightpaths” to JIVE and have maintained one that can be “switched” to any ATNF observatory.
- Each observatory has two additional links that can be enabled as needed for demonstrations or events:
  - presented as 1Gbit/s but typically provisioned as 622Mbit/s on the SDH backbone,
  - usually terminate in a dedicated switch at the AARNet Rosebery POP (Sydney) which has been connected at 10Gbit/s into the AARNet core,
  - one of these six links is the current ATNF-JIVE “lightpath”,
  - Parkes has an additional two links patched but shutdown.
- ATNF Marsfield has an additional 1Gbit/s IP link to AARNet that is “outside” of the standard CSIRO network infrastructure (i.e. not firewalled, very useful for testing and data transfer).

ATNF VLBI VLANs

VLAN	Description
630	**ATNF-eVLBI-DMZ**
631	ATNF-eVLBI-DMZ-2
632	ATNF-eVLBI-Pks-Mop
640	ATNF-eVLBI-EXPReS
641	ATNF-eVLBI-EXPReS-L2
642	ATNF-AARNET-ER-NAR-1
643	*ATNF-eVLBI-China-1*
644	*ATNF-eVLBI-China-2*
645	ATNF-AARNET-ER-NAR-2
646	ATNF-AARNET-ER-PKS-1
647	ATNF-AARNET-ER-PKS-2
648	ATNF-AARNET-ER-MOP-1
649	ATNF-AARNET-ER-MOP-2

Some (Network) Geography



Where to Next!

Some thoughts…

- We would like to start experimenting with 10Gbit/s WAN once we have suitable DAS:
  - AARNet do offer a “try before you buy” service.
- “Lightpaths” are extremely useful but there is a huge overhead in setting them up (and debugging them):
  - still have the periodic drops on the ATNF-JIVE path, first seen almost two years ago!
  - AARNet no longer seen keen on the implementation of a DCN-like infrastructure.
  - No native optical network to Western Australia (so no “lightpaths” to the West).
- Routed connections:
  - Most AARNet members in Australia only have a single 1Gbit/s IP connection; AARNet have a rate-limited 10Gbit/s “product”.
- Would like to use routed IP R&E networks, but these still

Questions…

- Cross-NREN “lightpath” setup remains complex; lack of trust although people are keen to help. Is there any significant progress on this “holy grail” of networking?
- Have we made much progress in the last couple of years on network fault-finding and measurement? Why aren’t Internet2 style test boxes deployed by NRENs?
- Is there the need for an “expert” VLBI Network Group, drawing on people and experiences from around the globe?

It goes without saying…

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Thank you