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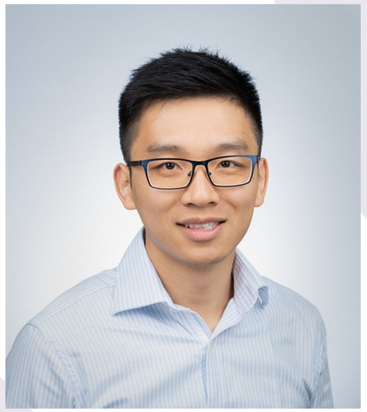
Robustness analysis of Australia's Internet



Ben Lang



Matt Roughan



Mengbin Ye



Hung Nguyen

Motivation

ABC NEWS

Log in

Tasmania's internet outage caused by damaged Telstra cables demonstrates the state's vulnerability

By Lydia Hales | Disasters, Accidents and Emergency Incidents

Wed 2 Mar 2022

Red Sea cable cuts disrupt internet across Asia and the Middle East

By Reuters

September 8, 2025 7:41 AM GMT+9:30 · Updated September 8, 2025

Two subsea communication cables damaged off Perth coast in 'concerning development'

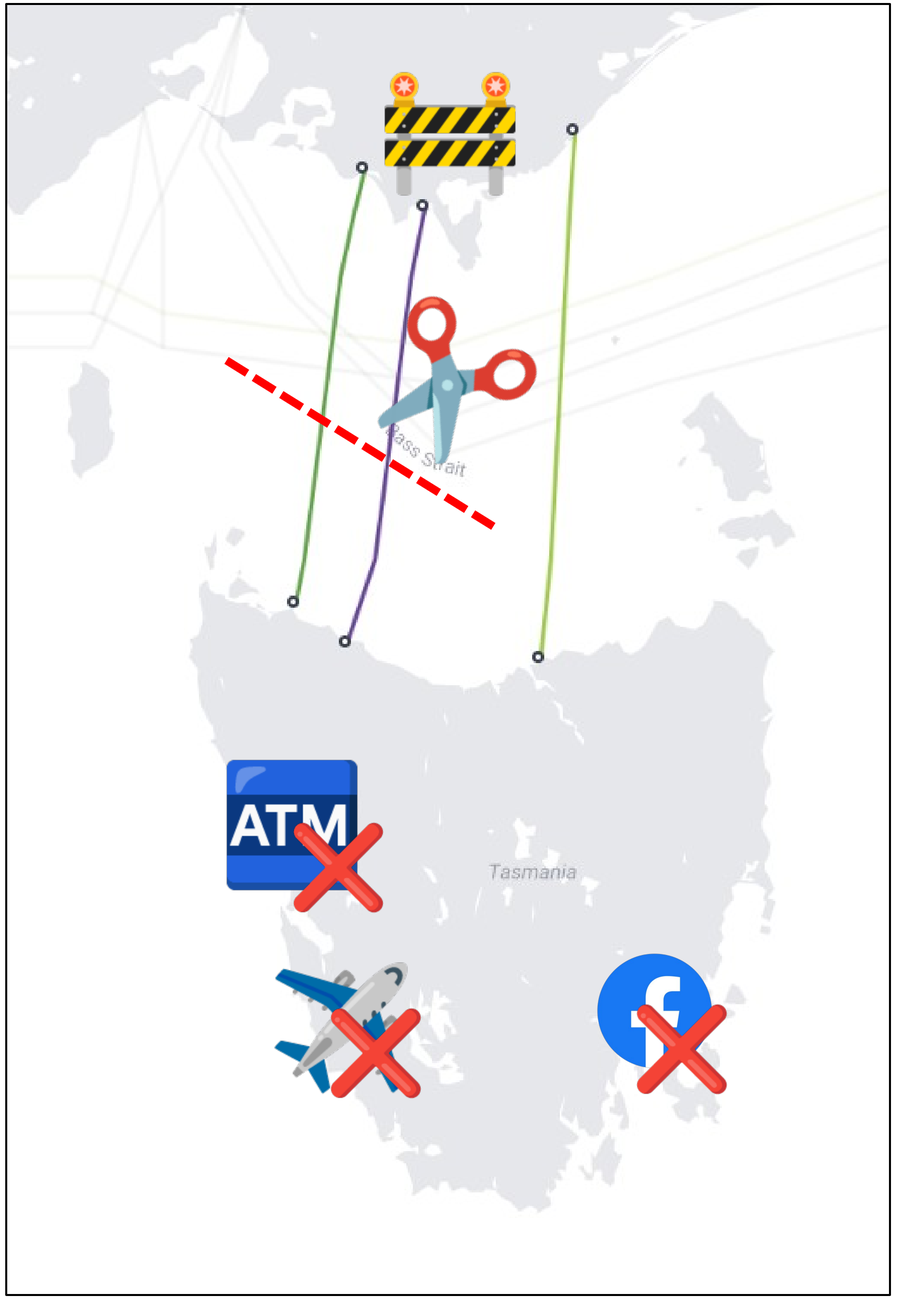
By Rachel Stowers and Emma Wynne

102.5 ABC Perth | Information and Communication

Posted 11 Aug 2026 at 8:06am, updated 11 Aug 2026 at 9:26am



Population: 580,000



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How robust is Australia's network to failures?

Modelling complexity

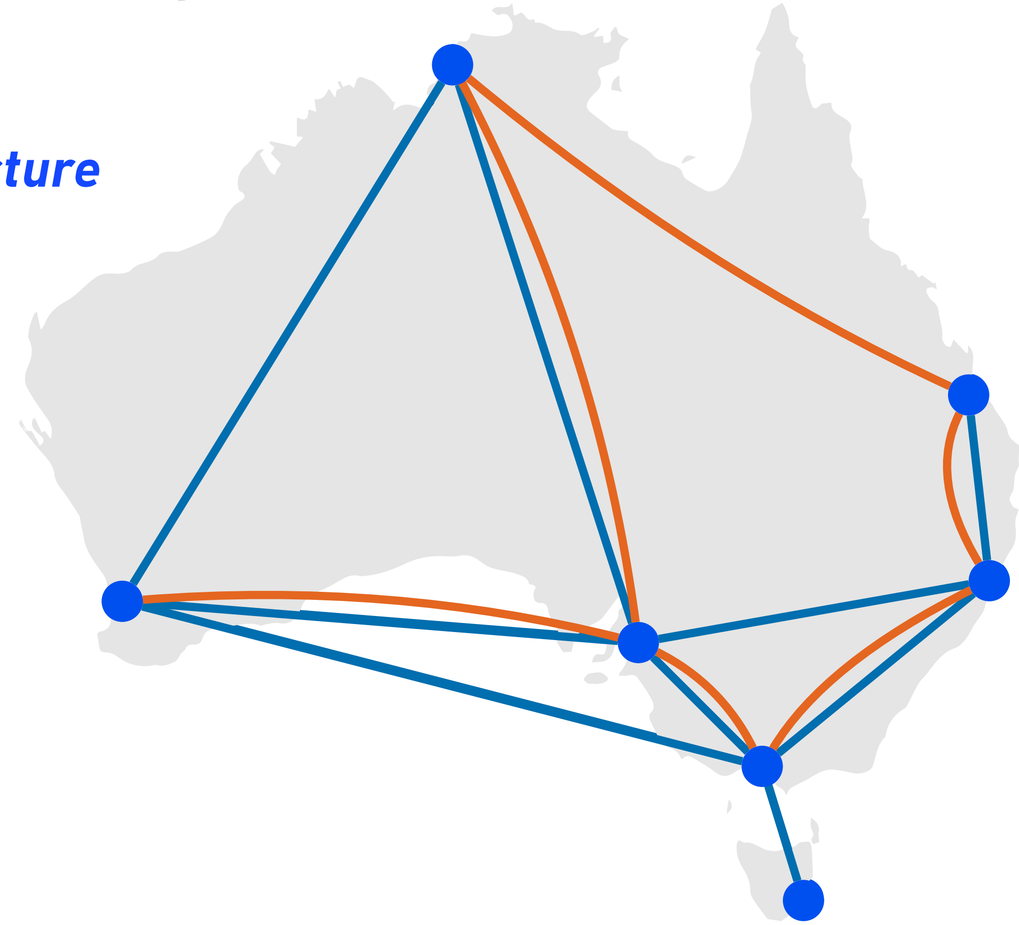
Focused on Australia's physical Internet infrastructure

Need a model of Australia's Layer 3 network

- *Previous models don't deal with dependencies between networks.*

Want to capture real-world complexity:

- **Internet Exchange Points (IXPs)**
- **Shared Risk Link Groups (SRLGs)**

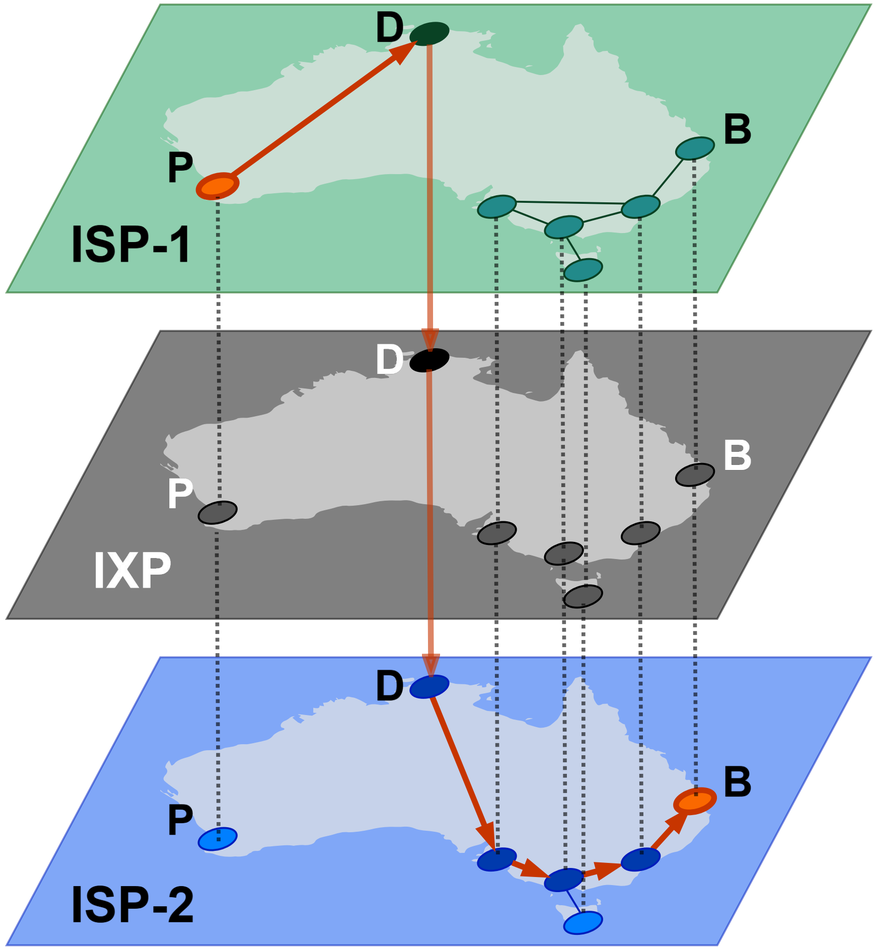


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IXPs

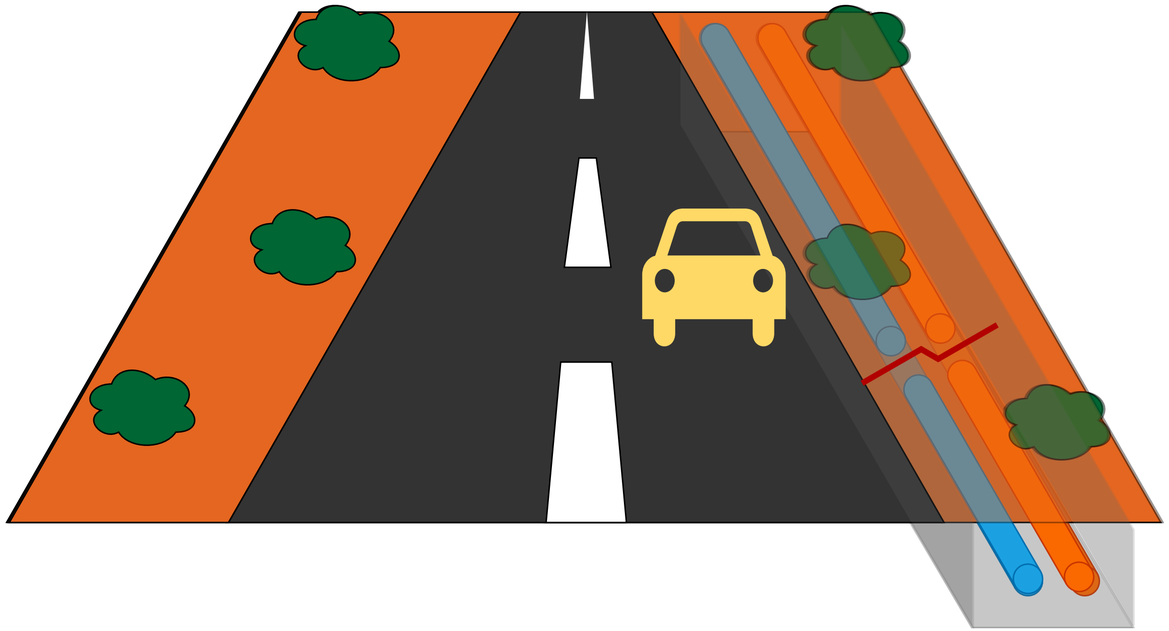
- Allow for peering between ISPs
- Creates more path diversity
  - Routes inaccessible by one ISP's network may be accessible using another ISP's network

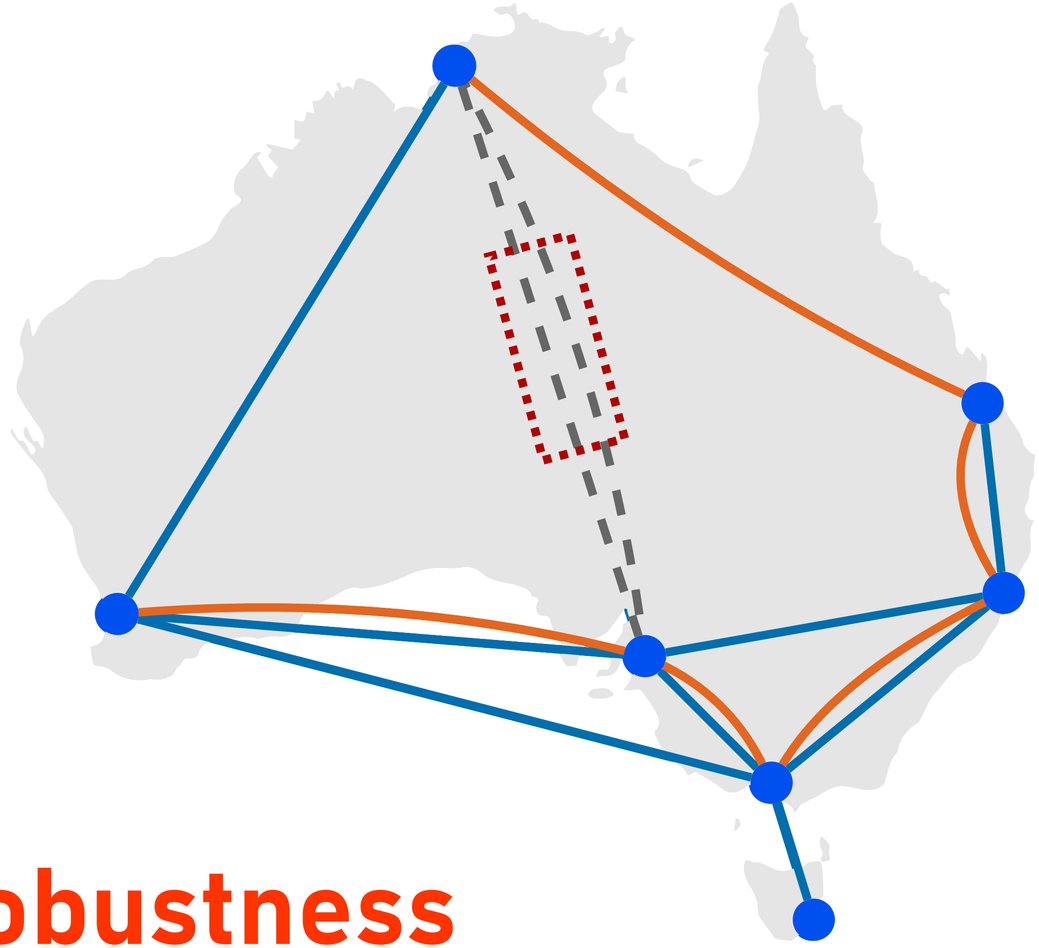
Increases robustness



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Shared Risk Link Groups (SRLGs)





Decreases robustness

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Multilayer Network

Layers: 6 ISP topologies

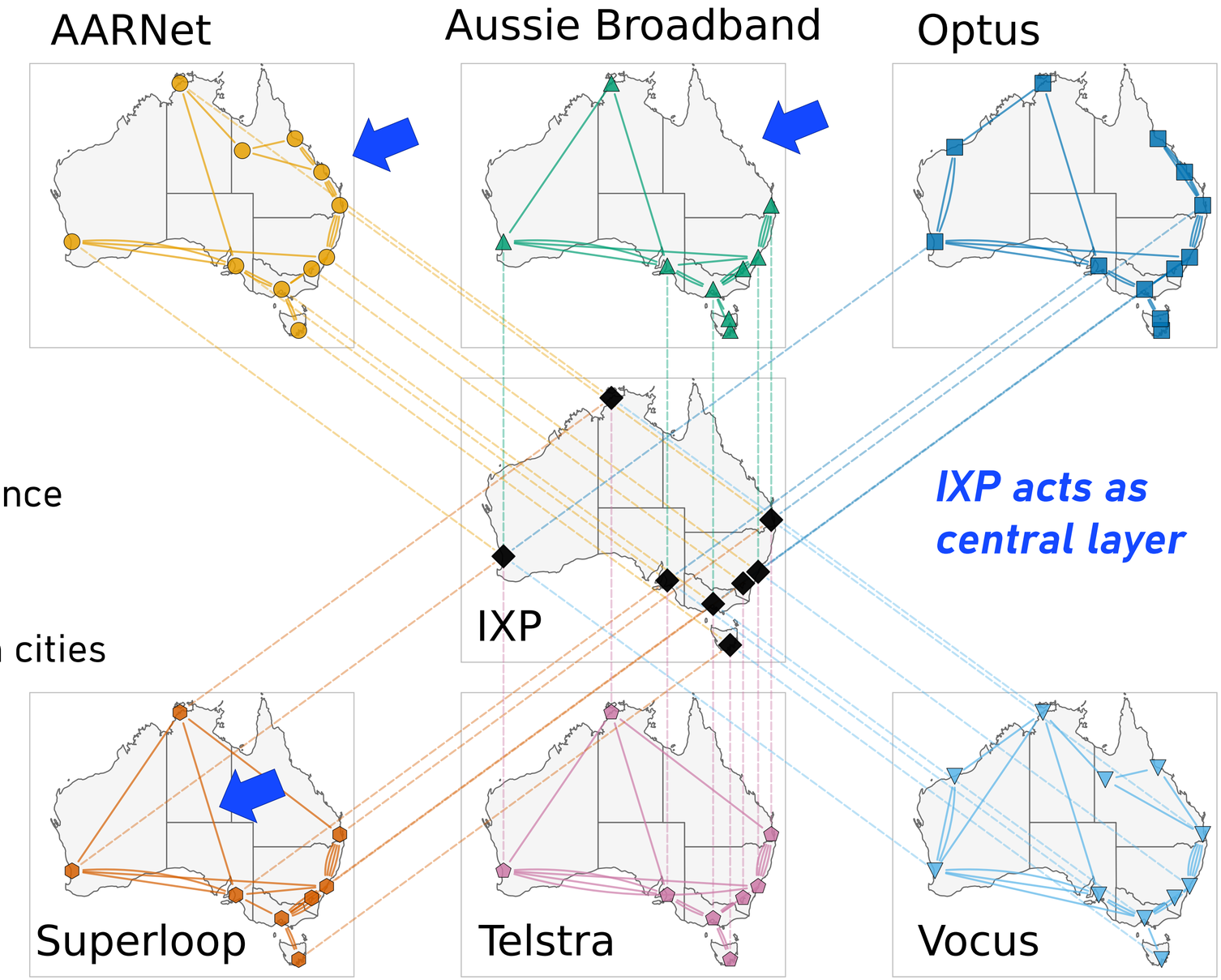
- Collected using public network maps

Nodes: 13 Metropolitan Points of Presence (cities) (around 80% of population)

Intra-layer links: Layer 3 links between cities

Inter-layer links: use a single IXP layer

- connections through **8 IXP nodes**



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IXPs & Peering

Determining IXP locations

- *Source: Internet Society's IXP Tracker*
  - ➡ IXP node in each capital city
  - 8 nodes in total
- One "IXP node" per MPoP

Determining Interlayer Links

Public peering relationships

- *Source: PeeringDB*
- If ISP present at IXP, add interlayer link at that location

Non-public peering relationships

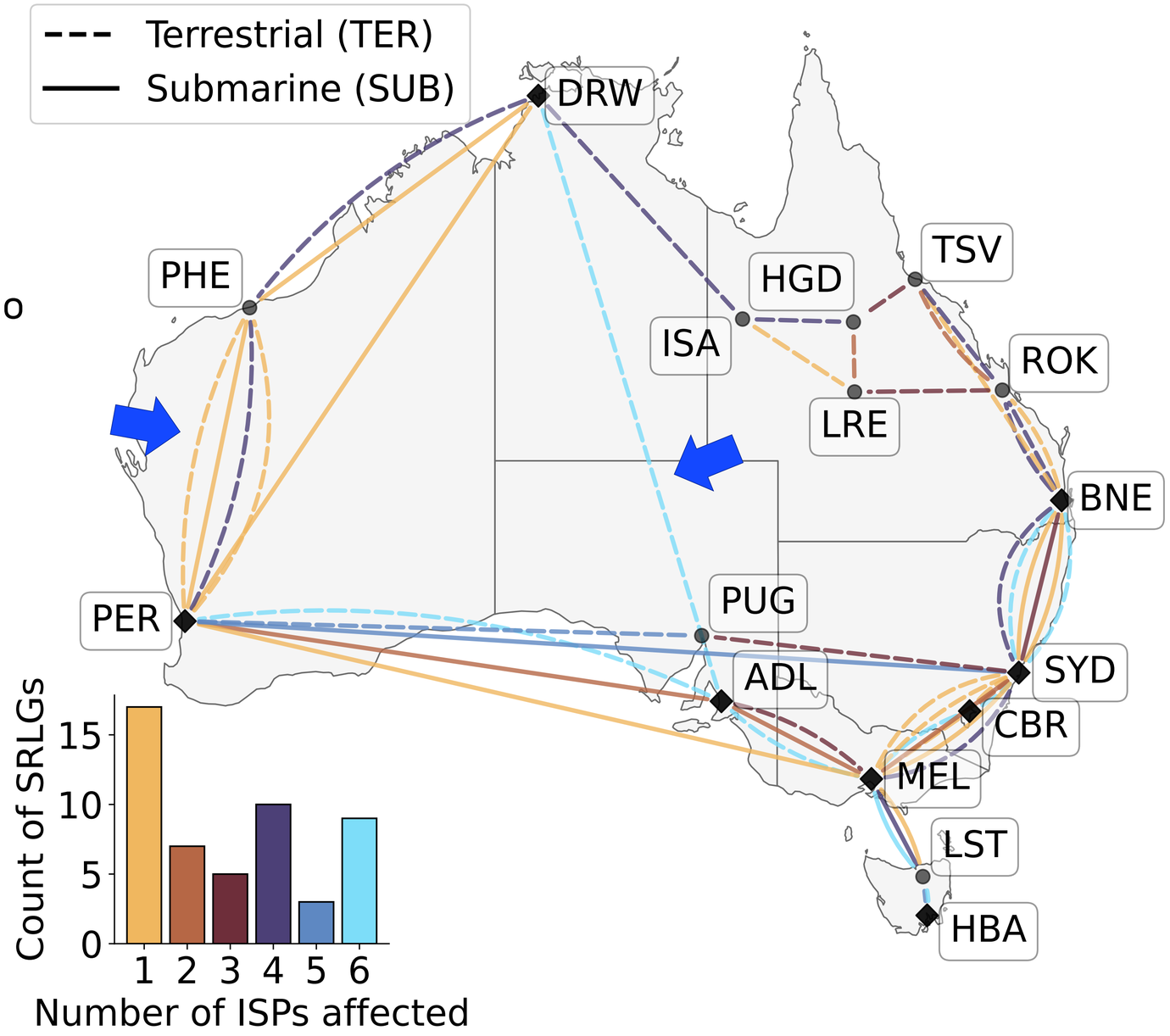
- Telstra and Optus
- *IXP presence: Public Peering Agreement Policies*
- *Peering: public resources (media releases, websites)*

Assume all ISPs present at IXP peer with one another

SRLGs

- Grouped intra-layer links from the topologies into conservative SRLGs (using real-world maps)
- SRLGs based on transport routes
  - **Terrestrial:** roadway or railway infrastructure
  - **Submarine:** submarine cables
- 51 SRLGs identified:
  - 20 roadways, 15 joint road/rail, 16 submarine
  - 9 SRLGs used by all 6 ISPs (light blue)

Low diversity routes = shared by more ISPs

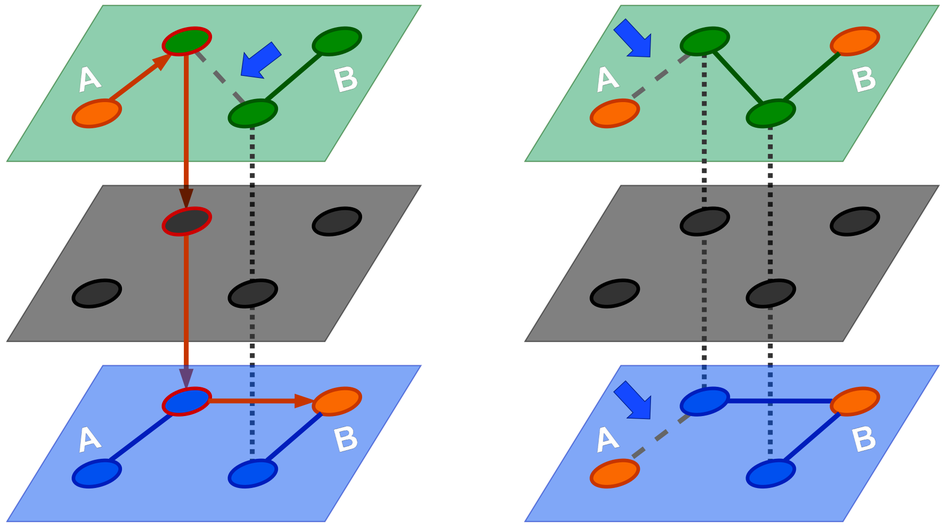


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Failure Analysis

Assessed connectivity after removing SRLGs

- **Double SRLG failures** (two failing at the same time)
  - Considered all pairs:
    - 91.3% caused **no disconnects**
    - 7.5% caused a **disconnect for a single layer (local)** ⬅
      - But inter-layer links prevented full disconnect.
    - 1.2% caused a **full network disconnect** ⬅



Single Layer Disconnect

Full Network Disconnect

86% of potential disconnects were prevented by redundancies through the IXP layer!

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Conclusion

- Developed a multilayer model of Australia's Internet ecosystem and performed a failure analysis
- IXPs and diversity improve robustness, despite SRLGs
- More complex models can reveal greater insights!

Future Work

- Examine performance after removing specific layers
- Incorporating likelihoods of SRLGs and failures
- Add Internet traffic flow over the network
- Incorporating routing paths

GitHub

Feel free to reach out at:

benjamin.lang@adelaide.edu.au

Thanks for listening!

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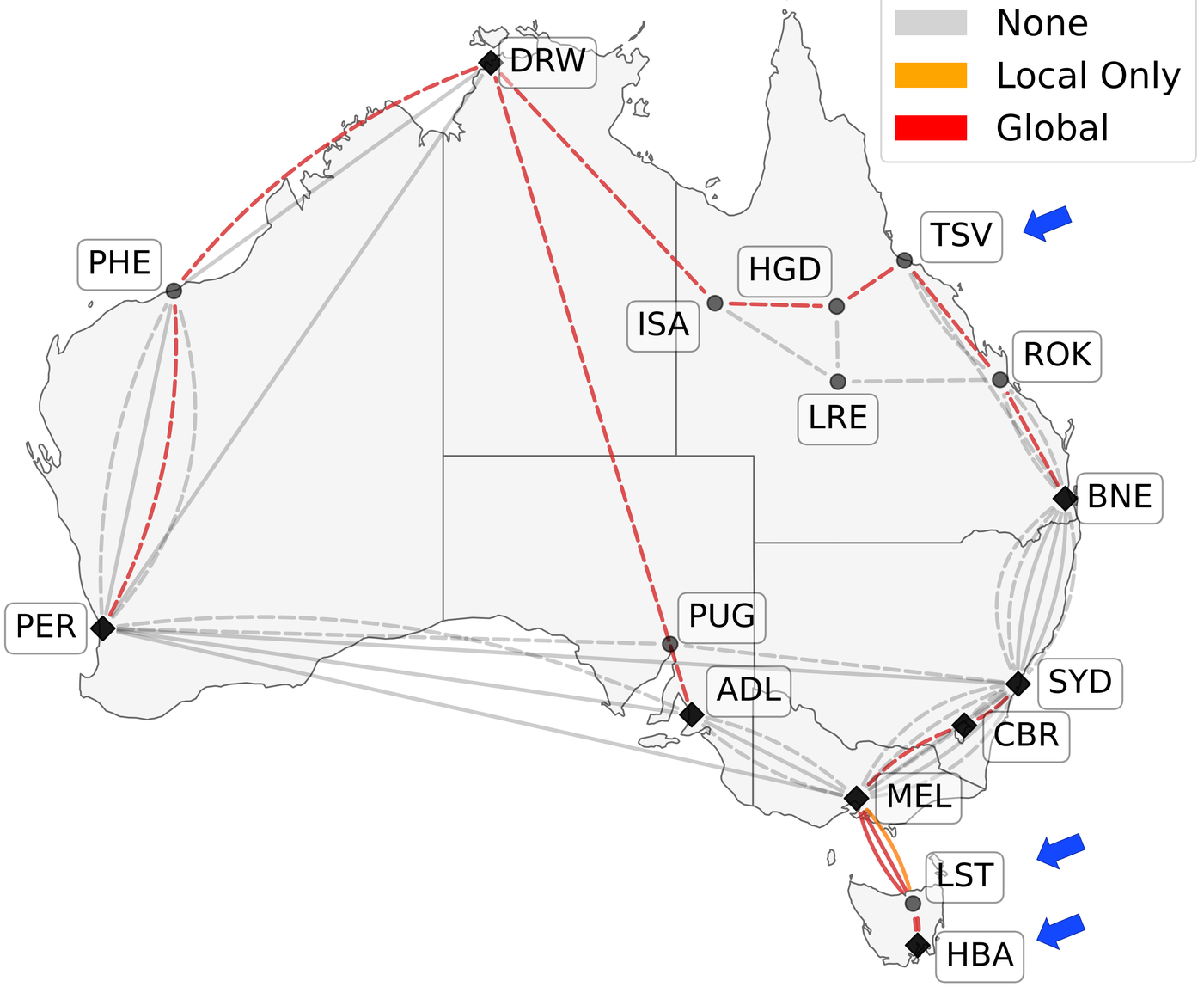
Appendix

Most disconnected locations

Most disconnected node: Hobart

- 123 single layer disconnects
- 6 full network disconnects

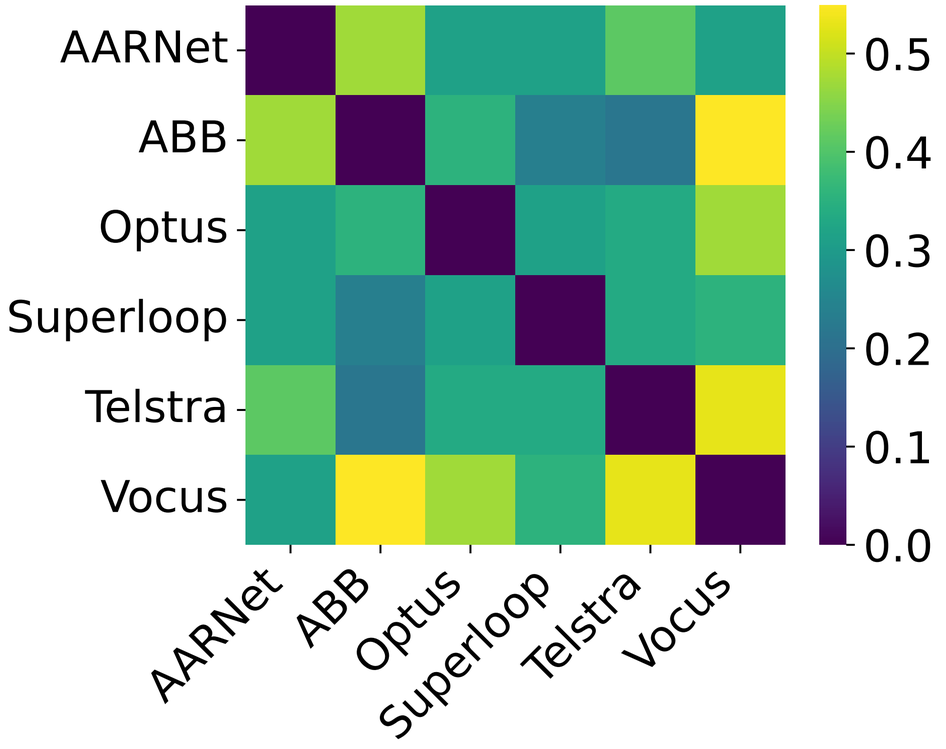
The 5 most populated cities were never disconnected



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Shared Risk

- *How dissimilar are each ISP's SRLGs to others?*
  - Calculate Hamming Distance
  - Most similar: Telstra + Aussie Broadband (ABB)
  - Most independent: Vocus



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