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Network analysis of Australian Internet traffic dynamics

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Abstract: Despite being essential in everyday life, the structure and dynamics of the Internet still remain only partially understood. Decades of studies investigating the Internet's topology have largely been limited by existing inference techniques and technical tools (e.g. traceroute), and are often constrained to mapping a single abstraction within Layer-3 (Autonomous Systems (ASes), Points of Presence (PoPs), routers and interfaces). While these maps are useful, simplifying Internet topologies to a simple graph model with binary relationships can obscure polyadic and hierarchical dependencies, and hide details on shared physical infrastructure. Furthermore, these maps are often unannotated, excluding measurements on the networks such as temporal traffic data, capacities, and utilisation of the network.

This work sits within a broader effort to build a multilayer representation of Australia's Internet infrastructure: the Australian Data Network Model (ADNM). This builds upon the University of Adelaide's Internet Topology Zoo (Knight et al., 2011), emphasising the collection of real-world data, but extending the dataset to incorporate physical infrastructure, organisational boundaries, logical routing and traffic. Furthermore, Australia's unique position as an island nation provides an ideal topic of study due to its constrained nature and limited infrastructure, with relatively few Internet Exchange Points (IXPs), a small set of regional ISPs, and a limited set of submarine cables. This provides a suitably constrained exploration space for the development of a comprehensive Internet topology model. By integrating advertised topologies supported by public measurement estimates (e.g. traceroute), and publicly available traffic data, this project will generate high-fidelity multilayer map of Australia's Internet infrastructure.

This specific study focuses on modelling traffic data: collecting and analysing temporal traffic data from over 400 Points of Interconnect (POIs) within Australia over a defined window. Analysis includes characterising traffic levels and weekly traffic patterns. Data is then used to infer end-to-end traffic flows such that utilisation across the Australian network can be assessed to characterise routing practices and identify potential capacity breaches. Outcomes include a cleaned temporal network dataset of Internet traffic across Australia with preliminary flow estimates, that can be later integrated with other layers of the multilayer ADNM.

Motivation for this work includes the detailed analysis of Australia's Internet ecosystem, providing unprecedented insights into the efficiency of Australia's network and identifying potential vulnerabilities requiring improved infrastructure or routing. The development of the ADNM would contribute to the network science and Internet research communities, providing a unique test set for network optimisation and traffic engineering algorithms. The underlying goal of this study is to ultimately improve the trustworthiness of data science applications for communications networks, such as the development of traffic analysis algorithms that incorporate semantic and structural understanding of the network on which the traffic resides.

This study will present the collected traffic-layer dataset for the ADNM, along with preliminary flow estimates and analysis. Data sources and methodology used will be outlined, including inference methods for end-to-end traffic flow. Limitations will be highlighted, including steps to integrate traffic data with a fully realised multilayer ADNM.

REFERENCES

Knight S, Nguyen H, Falkner N, Bowden R and Roughan M (2011), The Internet topology zoo, *IEEE Journal on Selected Areas in Communications* **29**(9), 1765–1775.

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