Modelling the interactions between the Internet backbone and the BGP network

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ABSTRACT

Given the importance of the Internet network in our society, it is relevant to understand its behaviour under adverse scenarios. The Internet can be studied through different angles: by studying the Border Gateway Protocol (BGP) network, the Internet Backbone, the complete physical network, etc. However, these networks do not exist in isolation, but rather interact with one another (see figure 1). Furthermore, the robustness behaviour of interacting networks is different compared to their single network counterpart. In particular, it has been shown that networks can be more fragile when coupled [3]. The single network approach to study the Internet's behaviour has been criticized in the past by Willinger et al. [6]. Thus, to properly study the Internet we should model it as an interdependent network system.

An interesting approach, is to pair together the Internet Backbone and the BGP network. However, as far as the author's knowledge, the articles applying interdependent networks models to the Internet case, to study its robustness, have not paired these two networks together [1, 5, 7, 8].

The purpose of this ongoing study is to model the Internet as an interdependent network system composed by the Internet Backbone and the BGP network coupled together, and measure the Internet behaviour and robustness under adverse scenarios, such as failures, or attacks. An initial model has been previously presented by the author [2]. However, in this model the interconnections between both networks are established at random, and thus, do not represent the actual network pairing nature of the Internet. In order to further develop this model, the relation between Internet Backbone nodes, and BGP nodes must be studied. Here, the hypothesis is that the number of Internet Backbone nodes interacting with a BGP node is proportional to the degree of such node. To test this hypothesis, data is being collected to determine whether high degree nodes on the BGP network are coupled to a proportional number of nodes on the Internet backbone, or not. Other information to be extracted from this data is how coupled nodes in the Internet backbone are distributed into space.

The information to determine the relation between BGP nodes and Internet backbone nodes has been obtained from RIPE Probes [4]. This information is currently being processed, and the results are expected to be available during the course of 2018.

After the completion of this work, further studies about the Internet Backbone, and the BGP network will be performed to continue the model development, and the possibility of adding other network infrastructures to the interdependent networks system, that allow a better understanding of the Internet, will be evaluated.

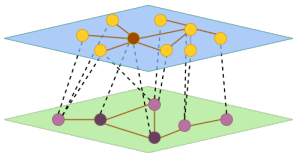

Figure 1: Interdependent networks example. Dotted lines represent interactions nodes of both networks.

KEYWORDS

Interdependent networks, Robustness, Internet Backbone, BGP network

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REFERENCES

[1] Abdulaziz Alashaikh, David Tipper, and Teresa Gomes. 2016. Supporting differentiated resilience classes in multilayer networks. In *2016 12th International Conference on the Design of Reliable Communication Networks (DRCN).* IEEE, 31–38.
[2] Ivana Bachmann and Javier Bustos-Jiménez. 2017. Improving the Chilean Internet Robustness: Increase the Interdependencies or Change the Shape of the Country?. In *International Workshop on Complex Networks and their Applications.* Springer, 646–657.
[3] Sergey V Buldyrev, Roni Parshani, Gerald Paul, H Eugene Stanley, and Shlomo Havlin. 2010. Catastrophic cascade of failures in interdependent networks. *Nature* 464, 7291 (2010), 1025–1028.
[4] ripeprobes [n. d.]. RIPE Probes. https://atlas.ripe.net/probes/. Accessed: 09-05-2018.
[5] Xiangrong Wang, Robert E Kooij, and Piet Van Mieghem. 2016. Modeling region-based interconnection for interdependent networks. *Physical Review E* 94, 4 (2016), 042315.
[6] Walter Willinger and Matthew Roughan. 2013. Internet topology research redux. *ACM SIGCOMM eBook: Recent Advances in Networking* (2013).
[7] Xian Zhang, Chris Phillips, and Xiuzhong Chen. 2011. An overlay mapping model for achieving enhanced QoS and resilience performance. In *Ultra Modern Telecommunications and Control Systems and Workshops (ICUMT), 2011 3rd International Congress on.* IEEE, 1–7.
[8] Qian Zhu, Zhiliang Zhu, Yifan Wang, and Hai Yu. 2016. Fuzzy-information-based robustness of interconnected networks against attacks and failures. *Physica A: Statistical Mechanics and its Applications* 458 (2016), 194–203.

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