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Title

Toward A Secure and Scalable Internet and Economic Incentives for Evolvable Internet Architecture

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Abstract

The Internet consists of tens of thousands of interconnected diverse, self-owned smaller networks. These networks engage in strategic decision making to maximize their own performance or benefits. In this thesis, I study the routing process and the economics of the decentralized system formed by these networks. Any decentralized system must find the right balance between centralized management and the freedom of individual parties. Internet protocol designers make a choice to give enough trust and flexibility to the autonomous networks. This decision helps the Internet evolve into a system with a tremendous size and a variety of novel applications and services. However, the Internet faces several problems that constrain its further development. In this thesis, I focus on three issues related to routing security, routing scalability and economic incentives. First, Internet routing is vulnerable to malicious behaviors because the protocol design is based on trust. Even though researchers have studied a variety of security solutions for the last decade, protocol attacks can still disrupt the connections of thousands of networks. Second, the rapidly growing Internet challenges the scalability of routing systems with fourfold routing table size increase in 10 years. The Internet routing system is so fragile that router flaps caused by a software bug can disrupt of the connectivity for a portion of the Internet. Third, the Internet forms a unique supply chain for content delivery. It is of great interest to understand the competition under the unique market. This thesis aims to improve the sustainability of the Internet. For the routing security concern, we identify a protocol manipulation attack in the Internet routing system, and propose a simple solution. To improve routing scalability, we design a resilient routing protocol to assistant a new routing addressing scheme that significantly reduces the routing table size. In the last piece of the thesis, we discuss Internet economics. We propose incentive-compatible pricing and investment strategies for self-owned networks to obtain a high social utility under the dynamic and unique Internet market.

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