Internet architecture is at odds with its use

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The largest manmade structure is now used much differently than was originally intended by its designers. Of all Internet communication, only a fraction of traffic is intended to be exchanged between specific network elements anymore. Instead, the network should find the content desired by end users.

In his doctoral dissertation for the Department of Computer Science and Engineering in Aalto University, Jarno Rajahalme argues that this contradiction is due to the inability to evolve the network architecture to better match its use. The present structure of the Internet is a result of commercial activity and competition. Rajahalme affirms that this should be taken into account when designing and modelling alternative Internet architectures.

"There is a mismatch between the way the Internet functions and the ways in which it is actually used," Rajahalme pinpoints one of the main issues of Internet communication research.

Information travels in the Internet through and between different autonomous network systems, or domains. To forward traffic from one domain to another, inter-domain routing is needed. By following the inter-domain routing messages, it is possible to deduce the inter-domain relationships and construct models of inter-domain traffic in the Internet.

"I modelled the traffic with economic inter-domain incentives. Some domains exchange traffic flows without any monetary compensation

while some routes, for instance from a service provider to a smaller operator or to an end user, have to be paid for," describes Rajahalme.

The routes of data packets are, to a significant extent, dictated by the inter-domain incentives involved in forwarding each individual packet. In his research Rajahalme modelled different ways to deliver packets across inter-domain links.

"Often it is beneficial for network owners to handle multiple copies of individual packets than to try to optimise by reducing inter-domain traffic redundancy. This is due to inter-domain traffic rates, which are mainly based on the traffic volume. The effects can be seen both in multicast service and on document level in information caching."

"The traffic routes thus become longer than the theoretically shortest routes. Economic incentives really play a crucial role in directing information traffic in the Internet."

In network telecommunication research domains have been categorised into a three-tier hierarchy. The so called Tier-1 domains do not buy Internet services from others, but exchange traffic with each other and sell service to regional level domains, among other customers. Rajahalme suggests that for Tier-1 domains it could be best to first route all packages to the top level and only on the way down forward them to the numerous end users.

"The overall network load might even decline, even though single links would experience more traffic than before. Most importantly, every domain would be able to decide locally which way to forward the packets is the most profitable," Rajahalme explains the results of his model.

Rajahalme also looked into new approaches to Internet architecture and

traffic.

"It would be possible to make use of the Internet's topology: to let the network itself decide the best routes to move information around. The traffic would then not be coordinated on the basis of the packets' destinations. Instead, every user would tell the network what information she requires. Packets would be named based on their content, not according to individual network devices," proposes Rajahalme.

Known as content-oriented networking, the approach is currently actively researched. The new service model it provides may also create novel business roles for domains and other actors.

"The traffic on the top of the domain hierarchy would probably diminish. Pure packet delivery is a highly competitive field and in the hold of few large companies. I would expect content producers and local service providers to be intrigued by the possibilities of content-oriented networking. This already shows in the increased role of content distribution networks in Internet traffic."

More information: Jarno Rajahalme's doctoral dissertation Inter-Domain Incentives and Internet Architecture soon online at: otalib.aalto.fi/en/collections … tions/dissertations/

Provided by Aalto University

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