Paper Review: Networking Named Content

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1 Summary

The paper [2] describes a new Internet communication model and protocol called Content-Centric Networking (CCN). It is proposed as an alternative to the traditional network stack; often represented as a layered hourglass shape with the IP protocol at the thin waste that all communication must adhere by. This layer connects the network links and applications, and is the one that routers operate on. CCN suggests we push the IP packets further down the stack, introducing content-aware packets as the fundamental unit of communication. The system claims to be compatible with some existing infrastructure, but with requirements of different routing software, the approach has suggested advantages that includes improved bandwidth, latency and embedded security.

2 Problem

It is argued that some of today's Internet infrastructure are results of decisions based on past requirements. It is a fundamental aspect of the IP protocol that it serves as a communication channel between two end-points that require a globally registered address. This was an effective solution for the needs of the time it was invented, namely *resource sharing* and communication between two parties, which was the prevalent mode. Later, end-to-end communication methods have been adapted to serve several clients that request identical content from the same server. This results in similar data travelling along the same links, and consuming unnecessary bandwidth. It has been difficult to solve this problem with the current protocol layers because the IP protocol fundamentally encodes the end-to-end principle.

Another design aspect of the existing network stack is that the IP packets themselves do not carry knowledge about their payload. Specifically with respect to security it makes demands on the end-points to encrypt the content, or otherwise, to make it secure.

A central part of the problem is the shift of the main usages of the internet, many features of network communication is content orientated, speaking about *what* content is, rather than destination orientated approaches about *where* content comes from, which mas most applicable in the past.

3 Described Solution

Since there has been a main shift in the usage of the Internet towards content delivery between many participating nodes. The suggested solution proposes a replacement of the fundamental packet of communication, the IP packet. There are two types of CCN packets; Interest and Data, which matches the assumption that all communication requires a client requesting information, and a server responding to it. The Interest packets, similar to URLs, have descriptors that can match a unique piece of data. Clients submit their Interest packets into the network, that become

consumed once a matching data is found. Data packets find their way back to the client by a trail left between each of the connecting nodes generated by the path of the Interest. Given this approach, the main feature of innovation is the possibility of caching data at intermediate nodes. Data is sent downstream towards potential clients, reducing bandwidth since the same data doesn't always need to be retransmitted, and reducing server loads at the source.

The other mayor advantage of CCN is the security model, which can be added at the packet level. Current implementation over IP requires that security is built into the connection which the communication travels. In the CCN approach security may be embedded with each content chunk. These chunks are encoded, the private keys are distributed by challenge-response mechanisms from the server to each indicating client.

4 Evaluation

The evaluations performed in the paper shows that for network connectivity that is still based on point-to-point transfers traditional TCP/IP outperforms CCN by a performance margin that is due to some additional overhead and lack of sliding-window optimisations in the CCN protocol. For all communication that is between two hosts the performance margin is expected. The benefits of CCN communication takes effect in networks with two clients or more. In the evaluation provided a VoIP application is demonstrated between 1 to 6 clients. Bandwidth usage is proportional in the TCP/IP case, and linear with CCN.

5 My Opinion

A promising aspect is the that is solves a potentially great problem of on-demand scaling, such as in the case of a server experiencing traffic spikes. This problem has been described and attempted solved by other projects, for example the Coral project[1].

The arguments regarding the advantages in the properties of security may not be that strong because security enabled content is usually intended for a specific client, and would need to be generated by the server on each request. Although security may be easier implemented in the content-orientated networking, it is not a compelling proposition for wide-scale infrastructure changes in itself.

It was not perfectly clear what the demands on the existing routers are. Old routers may not have technical ability to adapt and must be replaced, software upgrades are certainly necessary. It is evident though that the two network paradigm may co-exist, which would seem to be way to proceed in a transition to the new technology. Since trials also indicate the TCP/IP is still superior in point-to-point communication, initial nodes or clients should make an effort to know which system is the better for a given task. Whether CCN will gain wide-spread emergence will depend in limitations imposed by bandwidth restrictions. Current technological trends in carriers capacities have been increasing steadily over the last few years, and would have drawn attention from re-organising fundamental protocols. If carrier capacities cannot keep up with pace of bandwidth demands a focus towards CCN may become appropriate.

References

[1] Freedman M., Freudenthal E., Mazires D., and Eres D.M. Democratizing content publication with coral. *NSDI*, 2004.

[2] Jacobsen V. and et al. Networking named content. *Communications of the ACM*, 55, Jan 2012.