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Named Data Networking

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Abstract-To cope with today's communication needs, named data networking (NDN) has been introduced as a promising candidate for the future Internet. NDN is a new architecture, which is compatible with today's Internet. The elegance of its architecture and its adequateness to today's Internet usage make it a good candidate for the next generation of networks. This paper provides a brief introduction to NDN.

Keywords: *Named data networking, content-centric networking, content-based networking, data-oriented networking, information-centric networking*

I. Introduction

Today's Internet's architecture is based on a network layer, IP. The dramatic growth in e-commerce, online video, smart phones, and social networking has led to dominant use of the Internet as a distribution network. The limitations of the present Internet are becoming more and more pronounced as network services and applications become increasingly mobile and data-centric. The lack of IP addresses is a challenging issue facing the Internet community for long.

Named data networking (NDN) is a brand new architecture, but one whose design principles are based on the successes of today's Internet and which facilitates user choice and competition. It has several advantages such as transfer efficiency, security, and mobility support. With it, communication is more secure, infrastructure is more efficiently utilized, and applications are simpler.

The philosophy behind NDN was pioneered by Ted Nelson in 1979 and later by Brent Baccala in 2002 [1]. The NDN project formally started in 2010 as one of the U.S. National Science Foundation's Future Internet Architecture (FIA) projects.

II. NDN Background

NDN can be characterized as follows. First, NDN uses *named data* instead of named hosts for the communication model. Packets carry data names rather than source or destination IP addresses. NDN allows in-network caching as a built-in functionality and provide name-based routing capability. Secondly, routers are equipped with the cache function. Thirdly, NDN replaces the traditional channel-based transmission mode with a hop-by-hop one [2]. Security in the present Internet is an afterthought, but NDN provides a built-in security into data itself. This data-centric security can be extended to infrastructure security [3].

NDN has shifted the communication paradigm from host-oriented model into content-oriented model. The data-centric model is meant to enhance the security protection on the end-to-end applications. This shift has far-reaching effects on how we design, develop, deploy networks. The key built-in features of NDN include in-network caching, sessionless communication, and hop-by-hop forwarding.

III. NDN Architecture

NDN support two kinds of packets: interest packet and data packet, as illustrated in Figure 1. In NDN, every chunk of data (either Interest or Data) is uniquely named and the data name provides essential context for security. All data is signed by data producers and verified by the consumers. In NDN the consumer sends Interest packets to request data and the corresponding data packets flow back along the same path in reverse direction [4]. Data must have globally unique names in order to be retrieved globally. NDN routes and forwards data based on names instead of IP addresses. This eliminates address space exhaustion and address management.

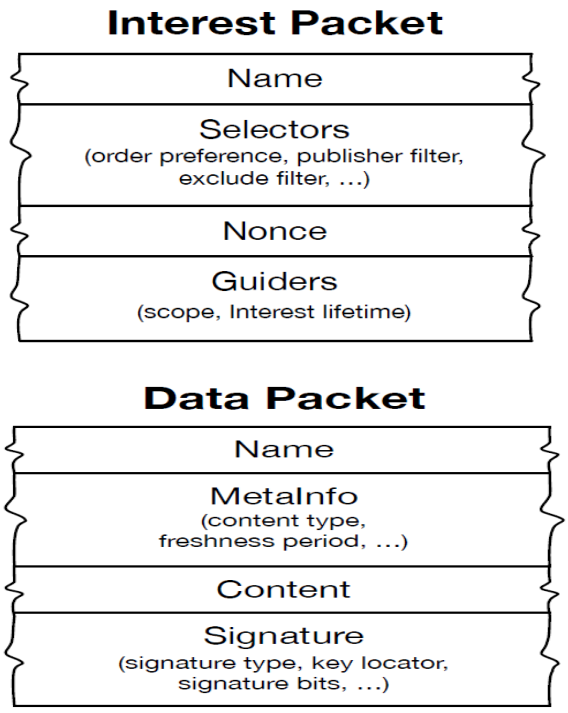

Figure 1. Two types of NDN packets.

The NDN architecture builds data authentication into the network layer by demanding that all applications sign and authenticate every data packet. It mandates that each network-layer data packet carries a cryptographic signature for authentication. Data retrieving is in a hop-by-hop manner

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instead of connection-oriented, end-to-end way of TCP/IP. Communication in NDN is initiated by the requester, which requests desired content from the network by sending an interest packet [5]. When an Interest packet is received, a router can forward the Interest to a neighboring router. Packets cannot loop in NDN, which means there is no need for time-to-live policy. In NDN, there is built-in security as security primitives are integrated into the protocol from the start.

IV. Conclusion

NDN is an information-centric Internet architecture, which offers better support for content distribution applications such as video playback application and video streaming application. But with the current Internet architecture being so entrenched, is it reasonable to even deploy a new one?

The realization of NDN faces a number of challenges. One challenging issue is being able to evolve existing applications. Another one is replacing IP addresses with names is time-consuming and memory-consuming. For NDN to become successful and widely deployed, it must have a robust and efficient congestion control mechanism.

NDN is a universal overlay: it can run efficiently on top of anything that can forward datagrams (Ethernet, WiFi, Bluetooth, cellular, IP, TCP, etc.). Its advantages in content distribution, application-friendly communication and naming, robust security, support for mobility and broadcast can be realized gradually [6]. One of the preliminary applications of NDN is in smart-homes [7]. NDN appears as a key enabling paradigm for Internet of Things (IoT). Its content-centric feature suits the IoT deployment. Other applications include wireless sensor networks (WSN), vehicular communication, multimedia systems, conferencing, educational systems, entertainment, gaming, smart city, and traffic control for power saving [8].

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