

Content centric networking

From Wikipedia, the free encyclopedia

In contrast to today's IP-based, host-oriented, Internet architecture, Content Centric Networking (CCN) emphasizes content by making it directly addressable and routable. Endpoints communicate based on named data instead of IP addresses. CCN is characterized by the basic exchange of content request messages (called "Interests") and content return messages (called "Content Objects"). It is considered an Information Centric Networking (ICN) architecture.

The goals of CCN are to provide a more secure, flexible and scalable network thereby addressing the Internet's modern-day requirements for secure content distribution on a massive scale to a diverse set of end devices. CCN embodies a security model that explicitly secures individual pieces of content rather than securing the connection or "pipe". It provides flexibility by using names instead of IP addresses. Additionally, named and secured content resides in distributed caches automatically populated on demand or selectively pre-populated. When requested by name, CCN delivers named content to the user from the nearest cache, traversing fewer network hops, eliminating redundant requests, and consuming less resources overall. CCN began as a research project at the Palo Alto Research Center (PARC) in 2007. The first software release (CCNx 0.1) was made available in 2009.^[1] The current software release is CCNx 0.8.2 with specifications for CCNx 1.0 now available.^[2] There are a number of derivative and related works (e.g. Named Data Networking).

Contents

- 1 History
- 2 Current Status
- 3 Motivation and benefits
- 4 Basic Concepts
- 5 CCNx Releases
 - 5.1 CCNx 0.x
 - 5.2 CCNx 1.x
- 6 Derivative works
- 7 Related Projects
- 8 See also
- 9 References

History

The principles behind Information Centric Networks were first described in the original 17 rules of Ted Nelson's Project Xanadu in 1979. In 2002, Brent Baccala submitted an Internet Draft differentiating between connection-oriented and data-oriented networking and suggested that the Internet web architecture

was rapidly becoming more data oriented.^[3] In 2006, the DONA^[4] project at UC Berkeley and ICSI proposed an information centric network architecture, which improved TRIAD^[5] by incorporating security (authenticity) and persistence as first-class primitives in the architecture. On August 30, 2006, PARC Research Fellow Van Jacobson gave a talk titled “A new way to look at Networking” at Google.^[6] The CCN project was officially launched at PARC in 2007. In 2009, PARC announced the CCNx project (Content Centric Network), publishing the interoperability specifications and an open source implementation on the Project CCNx website (<http://ccnx.org>) on September 21, 2009. The original CCN design was described in a paper published at the International Conference on emerging Networking Experiments and Technologies (CoNEXT) in December 2009.^[7]

Annual CCNx Community meetings have been held in 2011 (<http://www.ccnx.org/events/ccnxcon-2011/>), 2012 (<http://www.ccnx.org/events/ccnxcon-2012/>), and 2013 (<http://www.ccnx.org/events/ccnxcon-2013/>).

Current Status

The available CCNx software release is currently at rev 0.8.2. It is available for download (<http://www.ccnx.org/download/>) at the Project CCNx website.

The protocol specification (<http://www.ccnx.org/publications/>) for CCNx 1.0 has been made for comment.

Motivation and benefits

The functional goal of the Internet Protocol as conceived and created in the 1970s was to enable two machines, one comprising resources and the other desiring access to those resources, to have a conversation with each other. The operating principle was to assign addresses to end-points, thereby enabling these end-points to locate and connect with one another.

Since those early days, there have been fundamental changes in the way the Internet is used — from the proliferation of social networking services to viewing and sharing digital content such as videos, photographs, documents, etc. Instead of providing basic connectivity, the Internet has become largely a distribution network with massive amounts of video and web page content flowing from content providers to viewers. Internet users of today are demanding faster, more efficient, and more secure access to content without being concerned with where that content might be located.

Networks are also used in many environments where the traditional TCP/IP communication model doesn't fit. The Internet of Things (IoT) and sensor networks are environments where the source-destination communication model doesn't always provide the best solution.

CCN was designed to work in many environments from high-speed data centers to resource constrained sensors. CCN aims to be:

- Secure - The CCN communication model secures data and not the communication pipe between two specific end-hosts.
- Flexible - CCN uses names to communicate. Names can be location independent and are much more adaptable than IP addresses. Network elements can make more advanced choices based on the named

requests and data.

- Scalable - CCN enables the network to scale by allowing caching, enabling native multicast traffic, providing native load balancing and facilitating resource planning.

Basic Concepts

Content Object messages are named payloads that are the network-sized chunks of data. Names are a hierarchical series of binary name segments that are assigned to Content Objects by content publishers. Signatures are cryptographic bindings between a name, a payload, and the Key Id of the publisher. This is used for provenance. Interest messages are requests for Content Objects that match the name along with some optional restrictions on that object.

The core protocol operates as follows: Consumers issue a request for content by sending an Interest message with the name of the desired content. The network routes the interest based on the name using longest prefix match. The interest leaves state as it traverses the network. This state is stored in the Pending Interest Table (PIT). When a match is found (when an Interest matches a Content Object) the content is sent back on the reverse path of the Interest, following the PIT state created by the Interest. Because the content is self identifiable (via the name and the security binding) any Content Object can be cached. Interest messages may be matched against caches along the way, not only at the publishers.

CCNx Releases

CCNx 0.x

Interests match Content Objects based on name prefixes. For example, an Interest for /a/b would match a Content Object named /a/b/c/d or /a/b. Interests include restrictions in the form of selectors. These help the network select which of the possible prefix matches are an actual match. For example, an Interest might exclude certain names, ask for a minimum or maximum number of extra name segments, etc.

Content Objects have an implicit final name component that is equal to the hash of the Content Object. This may be used for matching to a name.

Packet encoding is done using ccnb (a proprietary format based on a type of binary XML).

The current version is 0.8.2 Software is available (<http://www.ccnx.org/download/>) under a GPL license. Specifications and documentation (<http://www.ccnx.org/releases/ccnx-0.8.2/doc/>) are also available.

CCNx 1.x

CCNx 1.x differs from CCNx 0.x in the following ways:^[8]

Interests match Content Objects on exact names, not name prefixes. Therefore, an Interest for /a/b/ will only match a Content Object with the name /a/b).

Interests can restrict matches on the publisher KeyID or the object's ContentObjectHash.

A nested Type-Length-Value (TLV) format is used to encode all messages on the wire. Each message is composed of a set of packet headers and a protocol message that includes the name, the content (or payload), and information used to cryptographically validate the message – all contained in nested TLVs.

The specification of CCNx 1.0 is available at: <http://www.ccnx.org/publications/>

Derivative works

- Named data networking is an NSF funded project based on the original CCNx 0.x code.
- CCN-lite (<http://www.ccn-lite.net>) is a lightweight version of CCNx functionally interoperable with CCN 0.x.

Related Projects

- GreenICN (<http://greenicn.org>) is a project focused on disaster recovery scenarios using an Information Centric Networking paradigm.

See also

- Information-centric networking
- Named data networking

References

1. ^ CCNx Current Code Release (<http://www.ccnx.org/download/>), Retrieved 1 August 2014.
2. ^ Mosko, Marc (July 2014). “CCNx 1.0 protocol specification”, Retrieved 1 August 2014.
3. ^ Baccala, Brent (Aug 2002). “Data Oriented Networking Internet Draft.” Retrieved 1 August 2014.
4. ^ Koponen, Teemu; Chawla, Mohit; Chun, Byung-Gon; Ermolinskiy, Andrey; Kim, Kye Hyun; Shenker, Scott; and Stoica, Ion. (August 2007). “A data-oriented (and beyond) network architecture.” SIGCOMM Comput. Commun. Rev. 37, 4, 181-192.
5. ^ TRIAD project page (<http://gregorio.stanford.edu/triad/>), Stanford University Distributed Systems Group, Retrieved 1 August 2014.
6. ^ Jacobson, Van. (Aug 30, 2006). “A new way of looking at networking.” (<https://www.youtube.com/watch?v=oCZMoY3q2uM>)
7. ^ Jacobson, Van; Smetters, Diana K.; Thornton, James D.; Plass, Michael F.; Briggs, Nicholas H.; Braynard, Rebecca L. (Dec 1-4, 2009). “Networking named content.” (<http://dl.acm.org/citation.cfm?id=1658941&CFID=515870947&CFTOKEN=33230744>) Proceedings of the 5th International Conference on Emerging Networking Experiments and Technologies. Rome, Italy. Retrieved 1 August 2014.
8. ^ Solis, Ignacio (July 2014). “CCNx 1.0 Changes from 0.x” (<http://www.ietf.org/proceedings/90/slides/slides-90-icnrg-10.pdf>), IETF-90 Proceedings. Toronto, Ontario. Retrieved 1 August 2014.

Retrieved from "http://en.wikipedia.org/w/index.php?title=Content_centric_networking&oldid=625492247"

Categories: Computer networking

- This page was last modified on 14 September 2014, at 07:44.
- Text is available under the Creative Commons Attribution-ShareAlike License; additional terms may apply. By using this site, you agree to the Terms of Use and Privacy Policy. Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a non-profit organization.