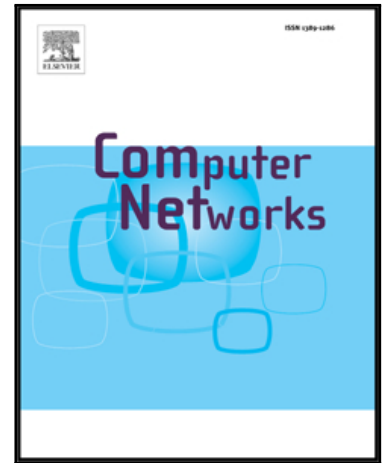# Accepted Manuscript

Multimedia Streaming in Information-Centric Networking: A Survey and Future Perspectives

Muhammad Faran Majeed, Syed Hassan Ahmed, Siraj Muhammad, Houbing Song, Danda B. Rawat

Please cite this article as: Muhammad Faran Majeed, Syed Hassan Ahmed, Siraj Muhammad, Houbing Song, Danda B. Rawat, Multimedia Streaming in Information-Centric Networking: A Survey and Future Perspectives, *Computer Networks* (2017), doi: 10.1016/j.comnet.2017.05.030

Multimedia Streaming in Information-Centric Networking: A Survey and Future Perspectives

Muhammad Faran Majeed[a,*], Syed Hassan Ahmed[b], Siraj Muhammad[c], Houbing Song[d], and Danda B. Rawat[e]

[a]*Department of Computer Science, S.B.B. University Sheringal, Pakistan.*
[b]*School of Computer Science and Engineering, Kyungpook National University, Republic of Korea.*
[c]*Computer Science and Information Management, School of Engineering and Technology, Asian Institute of Technology, Thailand.*
[d]*Department of Electrical, Computer, Software, and Systems Engineering, Embry-Riddle Aeronautical University, Daytona Beach, FL 32114 USA.*
[e]*Department of Electrical Engineering and Computer Science, Howard University, Washington DC, USA.*

Abstract

Information-centric networking (ICN) is considered to be a fresh solution to conventional IP-based networking issues. In ICN, instead of a host name or identifier the data are retrieved by a data name. This method of exchanging data quickly and effectively disseminates data in the network leveraging in-network caching capabilities, depending on the policy. Information-centric networking is known to be a third revolution in the field of telecommunications. In its design, implementation, and practical use, it considers the properties of a network that are studied in IP-based networking. Several recent attempts have been made to develop various applications supported by ICN, including multimedia streaming, with particular focus being placed on the popular video streaming. In this paper, we therefore, survey the recent advancements in the emerging field of ICN and its architectures along with the most recent literature concerning multimedia support. Furthermore, we identify the gray areas and provide a road map for the research community working in the same domain. To the best of our knowledge, our examination is the first attempt to provide a thorough survey of studies on multimedia streaming in ICN.

Keywords: Future internet architecture, information-centric networking, multimedia, video streaming.

1. Internet history and the limitations of legacy architecture

The internet initially came about as an end-to-end communication network. The paradigm was originally based on communication between devices for data and resource sharing [1]. Since then, the astounding growth in the technology (particularly regarding communication devices and content produced) during recent decades has shifted the paradigm from communication alone to content dissemination [2]. The internet was initially realized as an "internet of hosts," in which protocol design focused on establishing and maintaining communication and exchanging information between well-classified hosts. Now it has become an "internet of services," an "internet of people," an "internet of things," and most predominantly an "internet of media" [3]. The preeminence of the host is fading on the new internet, in which content is considered a priority.

Internet usage patterns in the last decade have concurrently shifted from browsing to content propagation. The mobility support provided by new communication devices with content distribution and retrieval capabilities has accelerated the death of host-to-host communication [4]. Today, users are more interested in the availability of content and content retrieval anywhere and any time. To manage this demand, alternatives such as peer-to-peer (P2P) networks and content delivery networks (CDNs) have been adopted, but these alternatives also have their own drawbacks and limitations, such as manageability, scalability, mobility, and security [5]. There are other hindrances as well, such as interoperability and incompatibility between similar solutions provided by others and the monopolies of stakeholders involved in providing services [6].

Almost none of the currently applied architectures provide optimum solutions to the root problem; i.e., they still rely on end-system addressing and data forwarding, while today's internet demand is entirely based on content that is published and consumed between end-systems. Five hundred exabytes of content was created in 2008 alone [7]. It was predicted that between 2010 to 2015, global IP traffic would increase exponentially from 80 exabytes/month, and mobile traffic would increase 26-fold during the same period, with 90% of global traffic consisting of video. According to the 2016 CISCO visual networking index forecast report, global IP traffic has surpassed the 1000 ex-

---

*Corresponding author.

Email addresses: m.faran.majeed@ieee.org (Muhammad Faran Majeed), s.h.ahmed@ieee.org (Syed Hassan Ahmed), siraj.muhammad@ait.asia (Siraj Muhammad), houbing.song@@mail.wvu.edu (Houbing Song), db.rawat@ieee.org (and Danda B. Rawat)