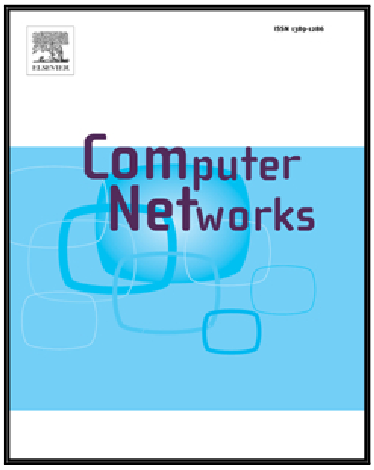

Characteristic Time Routing in Information Centric Networks

Bitan Banerjee, Anand Seetharam, Amitava Mukherjee,
Mrinal Kanti Naskar

PII: S1389-1286(16)30424-8
DOI: 10.1016/j.comnet.2016.12.009
Reference: COMPNW 6072

To appear in: *Computer Networks*

Received date: 17 February 2016
Revised date: 5 November 2016
Accepted date: 16 December 2016

Characteristic Time Routing in Information Centric Networks

[1]Bitan Banerjee*, [2]Anand Seetharam, [3]Amitava Mukherjee, [4]Mrinal Kanti Naskar

[1]*Department of Electrical and Computer Engineering, University of Alberta, Canada*
[2]*Computer Science Department, SUNY Binghamton, USA*
[3]*IBM India Pvt. Ltd., India*
[4]*Department of Electronics and Telecommunication Engineering, Jadavpur University, India*

Abstract

Information centric networking (ICN) aims to transform today's Internet from a host-centric model to a content-centric one by caching content internally within the network at storage-enabled nodes. Recently, multiple routing and cache management strategies have been proposed [1–6] to improve the user-level performance, primarily latency in ICN. In this paper, we define *latency* as the download time for a piece of content. In this paper, we propose a simple routing strategy that leverages the concept of characteristic time to improve latency. Characteristic time for a content in a cache indicates the amount of time in future a recently accessed content is likely to remain in that cache. Our proposed algorithm namely, Characteristic Time Routing (CTR) uses characteristic time information to forward requests to caches where the content is likely to be found. CTR augments native routing strategies (e.g., Dijkstra's algorithm), works with existing cache management and cache replacement policies and thus can be implemented in ICN prototypes with minimal effort. We perform exhaustive simulation in the Icarus simulator [7] using realistic Internet topologies (e.g., GEANT, WIDE, TISCALI, ROCKETFUEL [8]) and demonstrate that the CTR algorithm provides approximately 10-50% improvement in latency over state-of-the-art routing and caching management strategies for ICN for a wide range of simulation parameters.

Keywords: Characteristic time, routing, Information-Centric Networks, Latency.

1. Introduction

An exponential increase in content in recent years has resulted in the development of a flexible network architecture called Information Centric Networking (ICN) which proposes to evolve the current Internet from a host-centric model to a content-centric one. By caching content at storage-enabled nodes (also referred to as caches), requests for content can be served not only from the content custodian (origin servers), but also from intermediate caches. With the primary emphasis being content, if a cache en-route to the custodian has the requested content, the content will be returned to the requester from the cache itself, thereby improving user performance.

One of the main challenges in ICN is to develop efficient routing and cache management policies that improve user performance (e.g., decreasing latency and increasing throughput). In this paper, we develop a simple routing strategy that leverages the concept of characteristic time to decrease latency. In this paper, we define *latency* as the download time for a piece of content. Characteristic time for a content in a cache indicates the expected amount of time a content remains in that cache, given that it has been requested recently. Each requester maintains a time-to-live (TTL) based lookup table that is populated using characteristic time information. The requesters use their lookup tables to direct requests for content to caches, where the content is likely to be found, apart from the custodian. The proposed algorithm can be implemented on top of a native routing algorithm and works with any cache management policy. In contrast to our work, most prior research has focused primarily on shortest path routing, with different variants of en-route caching to improve performance [4, 6, 9].

We propose a characteristic time based routing algorithm (CTR) which executes on top of existing shortest path routing algorithms (e.g., Dijkstra's algorithm) and alongside existing cache management policies (e.g., Leave Copy Everywhere (LCE) [10], Leave Copy Down (LCD) [9]) and decreases latency. Figure 1 illustrates the primitives of the CTR algorithm. Let us consider a network of cache-enabled routers with two requesters U_1 and U_2 and a custodian C. Let us assume that U_1 initiates a request for content ID_1. If an entry corresponding to ID_1 is found in its lookup table, U_1 forwards the request towards that node. In case of an unsuccessful search, U_1 searches the lookup table of neighboring requesters (in this case U_2) for entries corresponding to ID_1. In case of an unsuccessful neighbor search, U_1 forwards the request towards the custodian C. A more detailed explanation of the CTR algorithm is given in Section 3.3.

The main contributions of this paper are summarized below.

*Corresponding author

Email addresses: bitan@ualberta.ca ([1]Bitan Banerjee), anand@cs.binghamton.edu ([2]Anand Seetharam), amitava.mukherjee@in.ibm.com ([3]Amitava Mukherjee), mrinaletce@gmail.com ([4]Mrinal Kanti Naskar)