PMC: Publisher Mobility Support for Mobile Broadcasting in Content Centric Networks

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***Abstract*—As the high speed Internet and the smart devices become prevalent, it is expected that the traffic volume of the video conferencing/broadcasting on the mobile devices is increasing explosively. One of the promising solutions for the traffic explosion problem is the content centric networking (CCN), which solves the problem by focusing on the content instead of the location. Even though CCN can provide better delivery efficiency, robustness, security, and native subscriber mobility, little attention is paid to the publisher mobility problem, where the mobile devices produce the real-time traffic. In this paper, We propose PMC, a publisher mobility support protocol in CCN. By introducing two names and corresponding operations at the routers, PMC provides publisher mobility for the mobile video conferencing and broadcasting without violating the original CCN architecture. We believe that PMC is a validated and secured scheme following the philosophy of the CCN architecture to support mobile publisher.**

***Index Terms*—Content centric networking, Publisher Mobility, Mobile Broadcasting**

I. Introduction

As the high speed Internet and the smart devices become prevalent, the traffic volume of the Internet is tremendously increasing, expecting to reach 1.3 zettabytes per year in 2016 [1]. To solve this traffic explosion problem and to deliver the contents more efficiently, many architectures based on the content-oriented paradigm are proposed [2], [3], [4]. Recently, among them, content centric networking (CCN) architecture [2] is gaining momentum in the research community and the industry due to its merits. With the self-certifying content name, name-based routing, and in-network caching, CCN provides the enhanced content delivery, content-based security, and so on.

Meanwhile, the constantly increasing number of mobile devices also raises challenging issues: the publisher and the subscriber mobility support. In CCN, the subscriber mobility is easily supported by nature. The subscriber who has moved to another location and still wants to download the same content file simply reissues the interest packets. Then the interest packets are routed towards the publisher and the requested content will be forwarded to the subscriber. Also, a cached content along the path can be utilized for the fast delivery. However, supporting the publisher mobility is not a trivial problem, since the routing table should be changed.

Assume the situation where Alice, a mobile publisher, is moving around while broadcasting the real-time contents (e.g., on-the-spot newscasting with her smart-phone). A subscriber, Bob, wants to keep receiving Alice's contents. In this situation, main challenges to support mobility of Alice can be summarized as follows.

Fast FIB Establishment : To forward interest packets properly to the publisher who moved to a new location, the FIBs in the routers along the path should be updated properly and quickly. For the mobility support, we cannot rely on the ordinary routing protocols (e.g., OSPF) due to the timing constraints. If the application between Alice and Bob requires less delay than the routing table convergence time or Alice moves continuously before the routing table is converged, Bob may not be able to download the contents.

Maintaining a valid path to the mobile publisher : As the mobile publisher, Alice, changes her point of attachment (PoA) continuously, a new path should be updated in the network so that a subscriber can download the Alice's contents. For this, temporal entry should be inserted in the FIB to forward the interest to the mobile publisher. Since the publisher moves frequently, the unused FIB entry should be expired to prevent the FIB table overflow. Also, we should maintain a path to the publisher regardless of the frequent PoA changes.

In this paper, We propose PMC, a publisher mobility support protocol in CCN. By introducing two names and corresponding operations at the routers, PMC provides publisher mobility for the mobile video conferencing and broadcasting without violating the original CCN architecture.

II. PMC: publisher mobility protocol in CCN

In this section, we describe PMC, a publisher mobility support protocol in CCN. To support the mobility, we classify two types of entries in the forwarding information base (FIB): original entry and mobility entry. The original entry is an ordinary FIB entry for the stable and long-lived destination (e.g., a publisher in the wired environment) while the mobility entry maintains the next hop information for the mobile and temporal destination. The original entries are maintained by the routing protocol and the timer value is relatively long while the mobility entries are maintained by the PMC protocol and the timer value is relatively small. The original and mobility entries for the same prefix can be integrated as a single entry in the FIB with the priority. Since both entries within an FIB means that the publisher moved from the home to other places, the mobility entry should have higher priority than

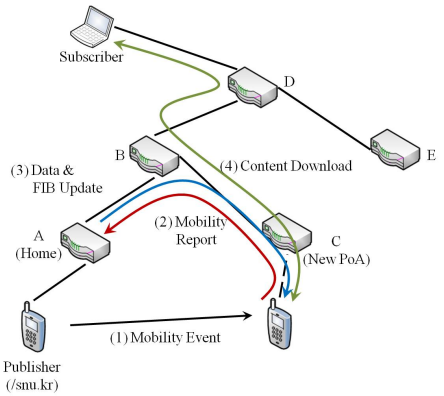

Fig. 1. PMC operation: When the publisher moves from the home to a PoA

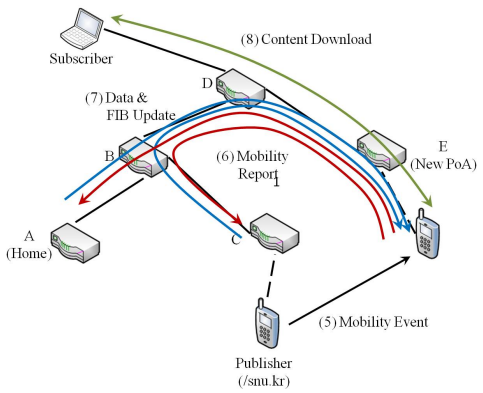

Fig. 2. PMC operation: When the publisher moves from a PoA to another PoA

the original entry to forward the interest packets to the newly moved location.

To handle the mobility, we introduce the "home" router of a publisher which announces the original entry of the publisher to the network. Therefore, when the publisher does not move, all interest packets are forwarded to the publisher through the home router. To create and maintain the mobility entry for the mobile publisher, we introduce two reserved names: `(publisher's URL)/mobilityReport/Home` and `(publisher's URL)/mobilityReport/PrevPoA`. These names are used to report the publisher's mobility event to the home and the previous point of attachment (PoA) location. The publisher sends an interest with the name "`mobilityReport/Home`" to keep the home updated with the path information to the publisher. On the other hand, the publisher sends an interest with the name "`mobilityReport/PrevPoA`" to make a path from the previous PoA to the new PoA and to receive the missing interest packets arrived at the previous PoA while the publisher is moving.

The overall operation of the PMC is depicted in Fig. 1. (1) When the publisher moves from the home (i.e., router A) to a new PoA (i.e., router C), (2) it sends an interest with the name "`/snu.kr/mobilityReport/PrevPoA`" to inform the home of its mobility (we assume that the publisher's URL is `/snu.kr`). Since the original entries for the `/snu.kr` are already established in router A, B, and C, the interest packet is forwarded to the home of the publisher easily. (3) On receiving the interest with the mobility report, the router A sends the Data to establish the mobility entries along the returning path. After forwarding back the Data towards the publisher, the intermediate routers (i.e., router A, B, and C) will update their FIBs by adding the next hop face with the highest priority in the entry for `/snu.kr`. (4) When a subscriber (or an end host) tries to download a content file from the mobile publisher, it will send an interest towards the publisher. Since router B updated the entry for `/snu.kr` with the mobility information, router B forwards the interest to router C, which in turn forward it to the publisher. By tracing the PIT entries, the Data from the publisher will be successfully forwarded to the subscriber.

Fig. 2 describes the operation when the publisher moves to another PoA, again. (5) In this example, the publisher moves from a PoA to a new PoA (i.e., router E). (6) Since the publisher moved from a PoA, it sends interest packets to the home and the previous PoA (We assume that the publisher can perceive whether the previous PoA is home or not). Note that the interest packets will be forwarded to router C by default since the FIB was updated with the mobility entries. To make the interest with "`mobilityReport/Home`" to be forwarded to the home, we specify the face selection criteria in the Selector field in the interest packet (to follow the face with the second priority). Then, "`mobilityReport/Home`" and "`mobilityReport/PrevPoA`" interest packets are forwarded to the home and router C, respectively. (7) Router A and C send the Data to establish the new path. If there are buffered interest packets during the publisher's mobility, router C forwards the interest packets to the publisher using the updated path for the fast handoff. (8) The following interest packets will be forwarded using the updated path.

III. Discussion & Future Work

In this paper, we propose PMC, a publisher mobility support protocol in CCN. To set up the path from the old location to the new location of the mobile publisher, the publisher sends interest packets with the reserved names. We also defined the operations at the routers to update the FIB entries for the mobility support without violating the CCN architecture. As our future work, we will conduct simulations under various scenarios where both the publisher and the subscriber have the mobility.

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