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APCBEE Procedia 00 (2013) 000–000

APCBEE Procedia

www.elsevier.com/locate/procedia

The 2013 4th International Conference on Agriculture and Animal Science (CAAS 2013)

Applying Information-Centric Networking in Today's Agriculture

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Abstract

Under the title of agriculture, Information and Communication Technologies (ICTs) enmesh the globe and represent a transformational opportunity for the livelihoods of smallholders to connect with the knowledge, institutions necessary, as well as sharing information on networking. With respect to information sharing, the Information-Centric Networking (ICN) is the Future Internet which has been recently proposed for efficiently accessing and distributing of content by replace the current host-oriented communication model toward a content-centric model. This article provides an overview of the novel of ICN architecture that is better suited to today's use, with a particular spotlight on content distribution and mobility technologies, which make ICN an excellent networking community for agriculture sector.

Keywords: AGRICULTURE DEVELOPMENT, FUTURE INTERNET, ICTs, ICN, MOBILITY

1. Introduction

Agriculture that continues grows also changes its structure. The question is: how can growth of the information networks help make development more sustainable? ICTs [1] in development agriculture effort have their own landscapes for sharing content [2], and central to sustainable development to meet the user-centric system where information is readily available to users when they interested it [3].

This work was supported by NSC, under Grant NSC 102-2218-E-020-003

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With the demand for content distribution and replication of many sources, they generally fall into two main developments: Peer-to-Peer (P2P) overlays and content distribution networks (CDNs). P2P has been used informally to facilitate payments between small traders and farmers [4]. Nevertheless, there exists inability to effectively leverage in-network storage to reduce overhead. Even more importantly, suboptimal P2P peer selection that leads to expensive inter-provider traffic [5], and do not leverage the knowledge of the underlying network topology to achieve optimal performance [6]. While the relative position of the CDNs offers the high prices for caching services in economic incentives perspective, and there are very far away in small towns and rural areas [7].

Currently the ICN approaches placing as a heart paradigm, gaining increasing attention and departing from the host-to-host communication model. Typical examples are DONA [8], PSIRP [9], 4WARD [10], and CCN [11]. Interestingly, ICN assumes that users, programs and hosts are in general untrustworthy and mobile, communication is often multi-access, and primarily interested in retrieving, processing, and sharing information bits, instead of sharing processing and storage resources with others [12].

Mobile technologies rapid development with the various embedded features (i.e. messaging, browsing, cameras, media players, and the convergences of wireless) that facilitate the users have capable to creating and sharing their own content easily and fast, as an extension of the human need for communication with other people. That is, content dissemination to mobile devices has attracted much attention. Accordingly, mobile devices play roles as content consumers as well as content sources. Moreover, content consumers do not care where and how to obtain a piece of content [13]. Instead, they make much of how fast and reliably the requested content can be accessed [14].

Thus, this article presents the solution to content source mobility in CCN management that can apply into agriculture sector. In the next section, we present a compact overview of ICN, followed by a detailed discussion based on the CCN components, a real scenario are presented. We conclude with a discussion of remaining challenges.

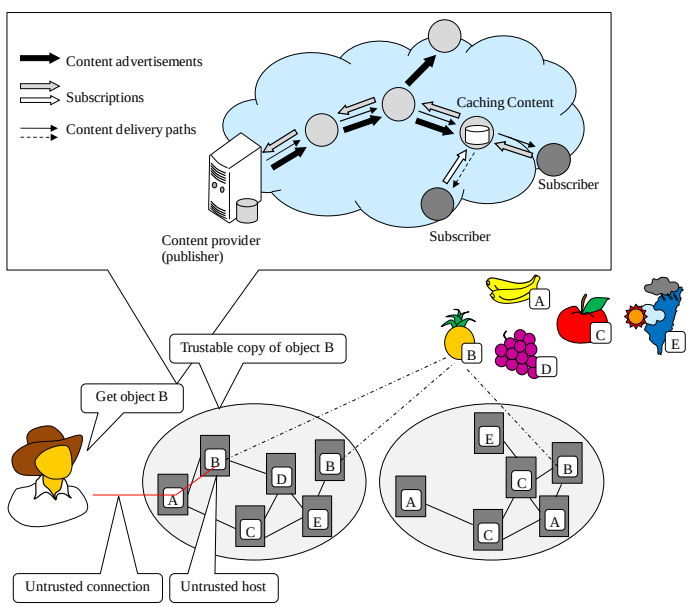

Fig. 1. ICN communication model: client side [5][15]

2. Information-Centric Agriculture Networking

This section introduces and illustrated the ICN communication model to networking from a generic perspective by describing the main components of content-centric networking (CCN), which particularly on mobile devices.

2.1. ICN Communication Model

Efficient accessing and distribution content are two advantaged of the ICN approach. Communication is driven by users requesting content/data/information, namely named data objects (NDOs) such as web pages, videos, songs, photos, documents, streaming and interactive media, or other pieces of information. Senders make NDOs available to users by publishing the objects. As illustrate in Fig. 1, the network can satisfy user requests with information from any source that holding a copy of object, enabling efficient and application-independent caching as part of the network service. The information then follows the reverse path send back the information to the user requested, without knowledge of the delivering host, which thus can be untrusted [5].

2.2. Mobility Management in CCN

CCN network is one collections of ICN networking that outperform on multicast and streaming function [16], designed by the Palo Alto Research Center (PARC). The CCN protocol is based on two message types, one with an *Interest message* and one with a *Data message*. Fundamentally, the end user sends an Interest message for the content in which she/he is interested. This Interest message is only identified by the content name to desired data. A Data message is returned back to her/him as a response.

The content delivery for each CCN node consists of three main components. First, *forwarding information base* (FIB), the FIB is used to forward Interest message and contains the identifiers of the content as well as determines the outgoing face where the Interest message should be forwarded, which totally instead of the IP addresses.

Secondly, *pending interest table* (PIT), the PIT is used to keep track of Interest message, before consulting the FIB table and forwarding the Interest to the next hop(s). When this CCN node receives the response (the Data message matching the Interest message), it looks up in the PIT the interface(s) information through which the exactly matching Interest(s) came. Content is then forwarded through all the matching interface(s). After forwarding of the Data massage, the entry for this content is removed from the PIT. In case of multiple interests in the same content, the CCN node will forward only the first Interest message once, but keeps track of all the interfaces from which it received such Interest messages in order to forward/duplicate the corresponding Data message to all the interfaces when it gets the response. Doing so, the CCN network then naturally offers a native multicast function, called *on-path caching* [5].

Finally, the last of main component is the *content store* (CS). The CS is a cache for contents. Received Data message will be cached locally in the CS. Since an Interest message is received for content already cached in the CS, the CCN node will just deliver it form the CS without filling the PIT table and without forwarding the Interest message upstream. The larger the CS, the more contents can be cached. The three main functional components of a CCN node are showed in Fig. 2 with the example of four faces.

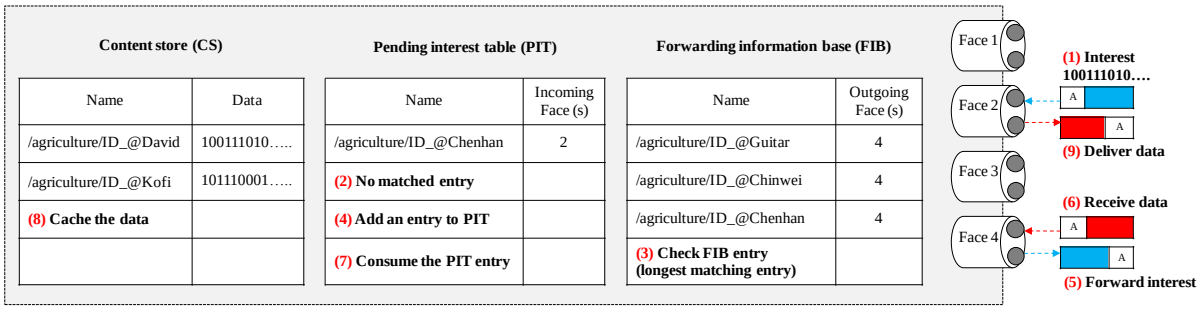

Fig. 2. An example of CCN forwarding model

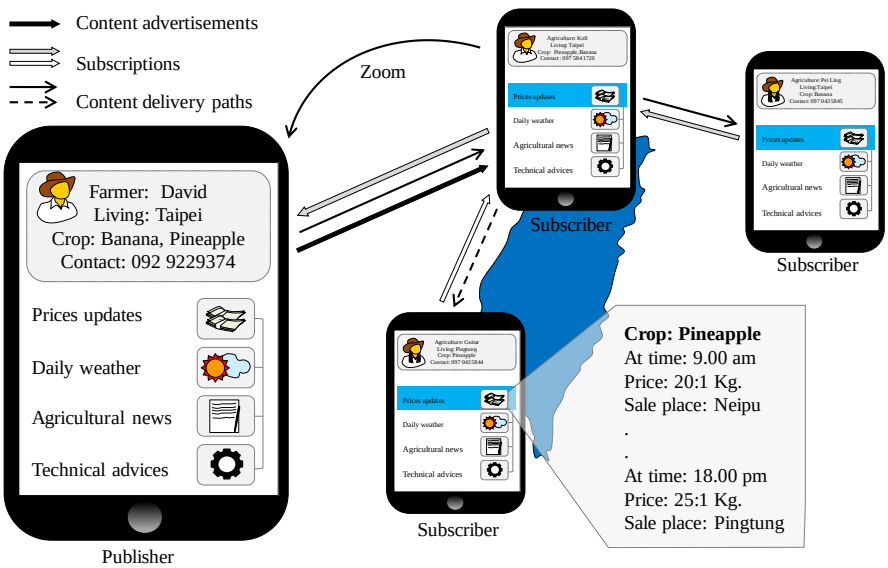

Fig. 3. A real scenario on mobile device

2.3. A Real Scenario of ICN in Agriculture Sector

In this subsection we shows how agriculture is benefited from ICN by provides a real scenario for helping people can be used with a simple technologies like mobile device. With a real scenario in Fig. 3, we provide an informations as a fundamental need of farmers, for example, prices updates, daily weather, agricultural news, and technical advices, which detailing described as below:

- Prices updates: we given an example for four crops selected by the farmers, which already subscribed (henceforth referred to as subscriber) and published by publisher.
- Daily weather: the crops are very sensitive to weather conditions so we provide the typical weather information (e.g., sunny, windy, stormy, raining, and earthquake) to suitable planning (e.g., undertake/withheld the sowing, irrigate, apply fertilizer, and helps in transportation and storage of

product).

- Agricultural news, report as real time and linkage with the radio/television station.
- Technical advices by sectors necessary such as institutions, private or government sector as well as from the subscribers.

3. Conclusion

As the agriculture development is connected with the ICTs, regarding to accessing and sharing content, the current workarounds for content diffusion on host-to-host IP principles, typically requiring synchronous, always on, end-to-end connections, stretches beyond its capacity to deliver, introducing further inefficiencies. ICN is an exciting new area for Internet architecture to directly route content based on users' interests. We hope that similar extensions would be valid and will act as a catalyst of ICN architectures in agriculture development.

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