ndnShare: File Sharing Application Based on NFD-Android*

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ABSTRACT

NDN proposes a data-centric communication model which makes it possible to fetch data identified by a name carried in Interest packets. We developed a file sharing application, called ndnShare, for mobile devices. It supports the name-based information retrieval and content acquisition between neighbors over Wi-Fi Direct. It also supports the fuzzy interest name matching based on a modified version of NFD-Android. The demo provides the basic flow of the application, from producing interest query to obtaining files between Android devices.

CCS CONCEPTS

• Networks → Naming and addressing; Mobile Ad hoc networks

KEYWORDS

NDN, NFD-Android, file sharing, Android application

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1 Introduction

The Named Data Networking (NDN) architecture provides a promising solution for efficient user-to-content communication in the framework of Information-Centric Networking (ICN) [1]. Its foundation is using hierarchical naming mechanism and name-based routing and forwarding to support upper-level applications to request desired data in contrast to IP address.

Lots of work has been done in designing and developing various utilities to support NDN communication in current TCP/IP networks, including forwarding daemon, libraries, applications, etc. For networking scenarios in mobile ad hoc networks, some APPs based on NFD-Android [2], like the NDN Whiteboard [3], ChronoChat application [4], and Multimedia sharing [5], show the potential of NDN in peer-to-peer data sharing and group messaging. In these ChronoSync-based applications, the data generated by the producer adopt the sequential naming convention and are pushed to the consumer by Sync interest [6].

In this work, we aim to investigate the feasibility of name-based information retrieval and content acquisition using the semantic knowledge of data namespace. We develop an NDN application, called ndnShare, to support file sharing between mobile devices over Wi-Fi Direct. It enables content discovery and retrieval of data using both exact and fuzzy semantic knowledge of names carried in Interest packets, and the latter can be beneficial in highly dynamic environments [7].

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2 Design

In ndnShare, the users or applications are supposed to know the semantics of the desired information. When retrieving data, applications construct Interest packets by adding the name of desired information at the end of specific prefixes, and express Interests to jNDN [8]. NFD-Android then forwards Interests to data producers and returns Data packets as the response to the consumers' request.

2.1 Basic Framework

The design of ndnShare consists of two phases: name query and file transfer. Name query is for the consumer to send request by packaging the name of desired information into Interest packets and get a name list of candidate files as the response. This process supports both the exact query and fuzzy query. File transfer is a pulling process from producer to send data back to the consumer. Fig. 1 illustrates the basic steps (a-h) in the communication between two Android devices.

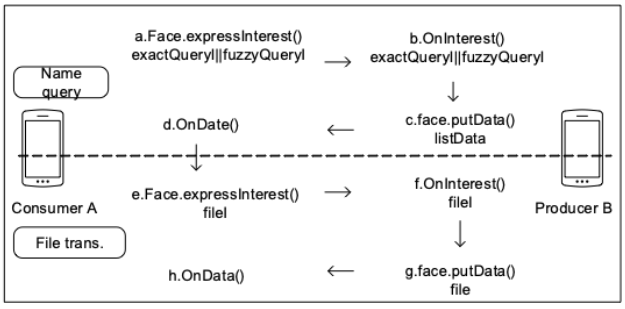

Figure 1: Communication model in ndnShare application

After the start of the application, three types of prefix including exactQuery Interest, fuzzyQuery Interest and file Interest, are registered in jNDN. Once a user inputs a file name in the search box and chooses exact query or fuzzy query, the name is assembled to the end of specific prefix and packaged into a query interest packet in step a. The producer will accept the interest and put a name list of candidate file as the returning data in step (b-d). If the user wants to continue to get one of the file in the name list, a file transfer interest will be generated and the retrieval result will be transferred back to the consumer in the following step (e-h).

2.2 Fuzzy Query and Matching

In NDN interest processing, an intermediate node uses name prefixes carried in Interests to decide where to forward each incoming interest. If the requested data is not hit the local content store (CS), an entry indexed by the name prefix is created in the pending interest table (PIT). This entry will be deleted when the desired data being returned to the consumer along the reverse path of interest propagation. In ndnShare, an exact query is enabled by standard Interest routing and forwarding. Besides, fuzzy match using semantic approximation of name is implemented in NFD-Android, inspired by the idea of fuzzy Interest forwarding [7].

When a user chooses a fuzzy search in the application, a flag (fuzzy) is inserted into the Interest name field to indicate it is a semantic-aware query. When underlying NFD-Android receives a fuzzyQuery Interest, it conducts a semantic-aware conversion operation and produces a new word which has similar meaning to the original name. Then the new name will be appended as the name suffix to the original prefix. At the same time, another flag (fuzzied) is added between the original request name and new name to indicate the semantic operating has been done. The new name can be used to find a match in CS. If it failed, a new entry using original prefix is created and the Interest packet is forwarded according to the information of routing table. If the desired data are found in CS, or desired data are returned, the name field in the packet can be easily restored to the original one by using the two flags. The changes of prefix are shown in Fig. 2.

Original prefix	Prefix in a Fuzzyl	Prefix with a new name
/ndnshare/<name>	/ndnshare/fuzzy/<name>	/ndnshare/fuzzy/<name>/fuzzied/<new name>

Figure 2: Prefix in ndnShare daemon

3 Implementation

We have developed a prototype with the basic function of file sharing and tested on Android mobile phones over Wi-Fi Direct, which code is available on GitHub[1]. For example, a user wants to search "singer"-related documents. As shown upper subfigures in Fig. 3, he inputs "singer" as the desired name in the search box, and then choose exact or fuzzy match. After the name list of candidate files is returned to the user, he can choose which one to download. The lower subfigures show the name list of candidate data of both exact and fuzzy match results. Compared with the left one of exact matching, the right shows more options including both singer and musician are retrieved by using fuzzy matching.

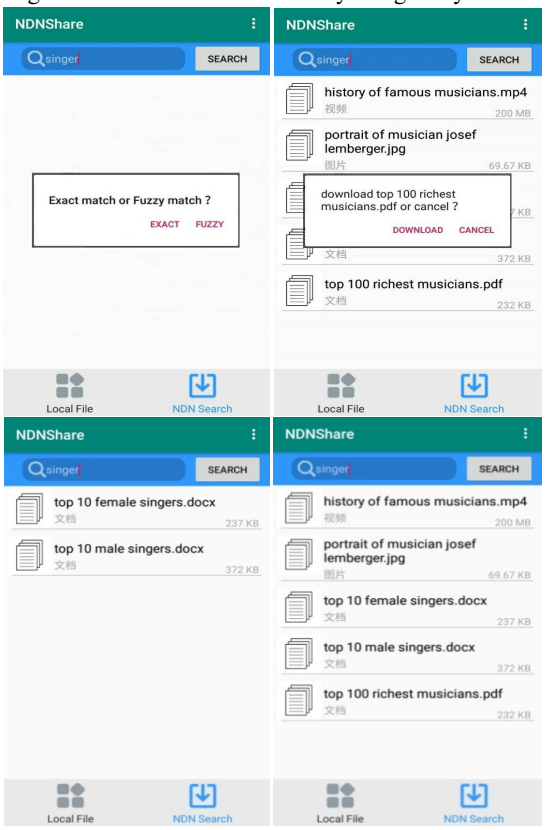

Figure 3: Exact search and fuzzy search results for "singer"

The semantical similarity is calculated using google word2vec [9]. We train word2vector using Skip-Gram on text8 and store the results as a vector base around 1.77MB in SIM card. When ndnShare running, the CPU and memory consumption are almost the same as NDN Whiteboard. On Snapdragon 845 with 8G RAM, Android 8.0.1, CPU consumption is 10.4% and 14% for interest matching and file transferring, while the Whiteboard is 11.7%.

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