Information-centric Routing for Opportunistic Wireless Networks

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ABSTRACT

Abstract This poster describes DABBER, a protocol developed to extend the reach of Named Data Networking into wireless environments. Our key contribution lies in the fact that DABBER supports communication in opportunistic wireless environments by relying on routing metrics that take into consideration node availability and centrality measures; data reachability metrics. The poster provides an overview to the DABBER architecture, and to the available open-source implementation.

KEYWORDS

ICN, wireless, routing.

1 INTRODUCTION

In a networking scenario where an increasing number of wireless systems are being deployed, there are two networking paradigms that are highly correlated to the efficiency of pervasive data sharing: *Information-Centric Networking (ICN)*, and opportunistic wireless networking.

Combining opportunistic networking with ICN principles is relevant to efficiently extend the applicability of information-centric networking to novel scenarios, such as affordable pervasive access; low cost extension of access networks; edge computing; vehicular networks.

The Data reAchability BasEd Routing (DABBER) [1] has been developed in this context. One of the key requirements to support end-to-end ICN communication is, in our opinion, ***interoperability*** [2]. Therefore, the DABBER design took into consideration the routing that is currently deployed within ICN networks, and considered new principles that concern data reachability aspects related with contextual-awareness on the network [3] to ensure adaptation to wireless environments.

2 DABBER ARCHITECTURE

The four major considerations driving the design of the DABBER architecture are: i) in opportunistic networks it is not possible to know the complete network topology; ii) in opportunistic networks it is not efficient to flood the network; iii) selecting the best set of neighbors to transmit Interest packets may not be efficient if based only on inter-contact times and contact duration; iv) DABBER needs to be interoperable to other existing routing solutions. In terms of fixed networks, the de facto routing solution for ICN environments is the Named Data Link State Routing Protocol (NLSR) [4]. DABBER has therefore been designed to be compatible to NLSR, as it has been implemented to consider the same message format and same data structures (RIB and FIB) made available by NDN. Currently, it relies on ChronoSync [5] to exchange messages among neighbours. Since DABBER only requires the dissemination of Prefix LSAs, it does not require the computation of shortest paths: DABBER replaces the path cost with a data reachability cost metric reducing the impact that topological changes would have on the stability of routing information.

2.1 Data Reachability Metrics

DABBER relies on four different categories of weights to assist data transmission in opportunistic wireless environments.

From a node perspective, it considers node availability (A) and node centrality (C). While A provides a measure of the internal status of a node (e.g., low battery, not enough storage), C provides a measure of the external (neighborhood) status.

From a link perspective, it considers node similarity (I), which measures the clustering similarity between nodes.

DABBER considers also a path weight cost to measure the availability of different data sources, T, which is based on the dissemination of Name Prefixes and validity as well as based on the time-to-completion (time lapse

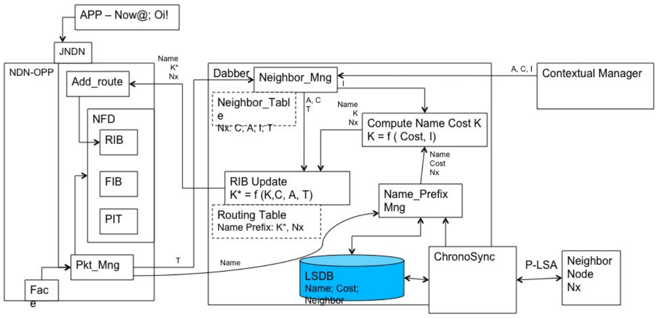

Figure 1: DABBER Architecture.

between forwarding of an Interest packet and reception of the respective data packet).

A, C, and I are weights that are periodically obtained by the routing via internal communication with a software-based agent that runs in background in wireless devices, the Contextual Manager (CM) [3]. The CM seamlessly captures wireless network smart data and computes different costs that characterize aspects such as the neighborhood of a node; the internal usage of a node.

2.2 Operation

The DABBER operation is illustrated in Figure 1. It starts with the synchronization of its LSDB, by Chronosync, after the contact with a neighbour N_a: the LSDB is updated with the tuple $<NP, k, j>$, where NP stands for Name Prefix; k for the reachability cost to that name prefix; j to the respective Face (for neighbor j). k is based on the j node weights C and A, as well as on T, time-to-competion. Once costs are updated, DABBER interacts with the Named-Data Forwarding Daemon NFD aiming to update the RIB based on the *Downward Path Criterion*. The FIB is updated from the RIB, following the regular NDN operation (a multicast forwarding strategy is used). Periodically, DABBER recomputes the cost of all name prefixes in its internal routing table followed by the needed updates of the RIB.

2.3 Naming Aspects

DABBER routing messages are carried in NDN data packets containing a signature. Hence, a DABBER node can verify the signature of each routing message to ensure that it was generated by the claimed origin node and was not tampered with during dissemination. For this propose, DABBER makes use of a trust model for routing to verify the keys used to sign the routing messages, based on the following hierarchical name structure: */<network>/<operator>/<home>/<node>*, where <network> represents the international transit network allowing roaming services for the mobile operator; <operator> refers to the operator providing the mobile service; <home> is the network site of the mobile operator where the node is registered; <node> is the mobile equipment. Each node can create a DABBER process that produces LSAs.

With this hierarchical trust model, one can establish a chain of keys to authenticate LSAs. Since keys must be retrieved in order to verify routing updates, DABBER allows each node to retrieve keys from its neighbors. This means that a DABBER node will use the NDN Interest/Data exchange process to gathers keys from all its direct neighbors. In case a neighbor does not have the requested key, the neighbor can further query its neighbors for such key.

A DABBER implementation is available[1]. Open-source code is available via GitHub [2]. DABBER has been tested in emergency scenarios with intermittent connectivity in the context of the H2020 UMOBILE project [3], to assist data transmission with a novel ICN instant messenger, Oi! [6].

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