Challenges in Opportunistic Networking

February 11, 2011

Mikko Pitkänen and Teemu Kärkkäinen

The EU funded SCAMPI [1] project aims to provide a service platform for pervasive and opportunistic networks formed between mobile smartphone users. The project has started few months ago and is today actively crafting the service architecture for challenging opportunistic environments. The results of the work will be actively used for experimentation during three following years.

The service architecture of the SCAMPI platform will be built form scratch. There has been interest to use RESTful like approach; however, the opportunistic aspects of the network impose several challenges on the approach. Thus, one of our major interests in this workshop is to hear more about recent work in Constrained RESTful Environments (CORE) working group. Moreover, energy efficiency is a workshop theme that is highly relevant to our usage scenario where humans carry mobile nodes.

To tackle challenges of opportunistic communication, first implementation of the SCAMPI platform will build on top of DTN architecture [2] as defined in IRTF's DTNRG. We have already implemented majority of the opportunistic communication stack.

The following sections briefly describe some of the main challenges faced this far.

1. Challenges in Service Discovery

When two nodes meet in our envisioned usage scenario, they become aware of each other by means of an IP Neighbor Discovery (IPND) [3] beaconing mechanism. The IPND beacons advertise the node's capability to communicate by the means of DTN Bundle Protocol [3], and information about possible convergence layer adapters, for example, TCP convergence layer (TCPCL) [4].

This approach is problematic because of at least following two aspects. First, the service advertisements in an IPND message are limited to capacity of a single UDP message. Second, the advertisements should carry rich enough information to allow neighboring nodes to decide whether connections should be established, for example, if a neighbor provides the specific sought service.

Because of above, we are especially interested on service mechanisms discussed on CoRE working group.

2. Challenges in Routing

After having established an appropriate convergence layer, two neighboring SCAMPI nodes can exchange messages formatted according to DTNRG Bundle Protocol specification [5]. The messages in the Bundle protocol are currently addressed according to endpoint identifier (EID) conventions so that they define a network endpoint (a node) as their source and destination.

Some of the designs of the Bundle Protocol bear similarity to RESTful architecture, for example, in a sense that the messages should be meaningful for intermediate nodes (proxies, caches, etc.). However, the convention to address bundles based on end-point nodes rather than resources they carry has lead to some less optimal workarounds.

Because of several routing challenges, we would be very interested to hear about work done in the Routing over Low Power and Lossy Networks (ROLL).

In addition to above, workshop topics “scalability”, “power efficiency”, and “security and privacy” seem particularly interesting to our work.

Out of the three presented working groups the IP6 over Low power WPAN is currently least topical to our work. However, recent interest in our research group to work in future with some “Internet of Things” topics suggests that it would be valuable to hear about the progress in this working group too.

References:

[1] http://www.ict-scampi.eu
[2] DTN Architecture
[3] DTN IP Neighbor Discovery
[4] TCP Convergence Layer
[5] DTN Bundle Protocol

The authors currently work in Aalto University in Finland in a research group lead by Professor Joerg Ott.

Contact: mikko.pitkanen@aalto.fi