S-38.3156 Delay-tolerant Networking Jörg Ott, Teemu Kärkkäinen

Exam 22 October 2012

Please write readably and answer in English.

There are three classes of questions: (a) expecting (relatively) short answers, (b) expecting more elaborate answers, and (c) a small design task. The questions are marked accordingly.

Questions:

1. [6p, b] a) What is the main difference between "traditional" IP-based MANETs (Mobile Ad-hoc Networks) and DTNs?

   b) How does this difference affect routing?

   c) Does the underlying node movement affect both of them similarly or differently? Why?

2. [6p, b] Which (three) levels of human mobility modeling can we differentiate? Give for each of them an example when they are relevant for DTN simulations.

3. [6p, a] Why is fragmentation used in DTN networks? Explain the difference between proactive and reactive fragmentation and when they are appropriate.

4. [6p, a] Outline the custody transfer process of the Bundle Protocol.

5. [6p, b] Which aspects do you have to consider when defining "IMAP4 over DTN" to ultimately talk to a legacy IMAP server? Which issues arise? Which ones are easy to tackle (how?), which ones are more difficult?

6. [6p, a] Give examples of why clock synchronization is required or useful in DTNs.

7. [6p, a] What desirable properties does Spray and Wait routing have in relation to unrestricted flooding schemes?

8. [12p,c] Consider a highway running through an otherwise fairly deserted area (maybe some trees and some meadows and, of course, many small lakes alongside it, but no real communication infrastructure around). Assume further that at each lake has at least one mökki located on its shore, but some also have multiple. Assume 50 mökkis in total. If there are multiple ones, they are connected in some graph using wireless links across the respective lake at 96 Mbit/s. Each mökki has a low energy DTN node (always turned on) with some application gateways and a connected laptop for user applications. The mökki closest to the highway (or the only mökki of a lake) has wireless connectivity to WLAN-enabled cars passing by through some large antenna, delivering 24 Mbit/s mean net data rate for 30s for each car. The car density varies with, on average one car per minute during peak times in each direction and one car per hour at night. This density is not enough to enable instant connectivity between any two nodes but DTN allows constructing a *MökkiNet*. Not all people are technology-savvy so that there are groups of ten mökki owners who entrust their system maintenance to one mökki admin per such group.

   While people seek their privacy, they may occasionally meet or exchange information about what they are up to (or what they caught fishing). For this purpose they use a DTN-style social media application that supports different degrees of friendship management through flexible group communications, some kind of *MökkiBook*.

   a) Sketch the system topology.

   b) Discuss what kind of a routing protocol you would use for exchanging data. What kind of RTTs would you expect for a ping-style monitoring a remote system.

   c) You are living in one mökki and are the system administrator of one mökki group. For maintenance, you'll need some kind of *dtn-ssh* application. How would you design this kind of application given the expected RTTs?

   d) Which security mechanisms would you apply for the system administration and the social networking application? Explain why your design will work in this environment.

(Note: there are many possible solutions.)