UNIVERSITY OF OSLO

Faculty of Mathematics and Natural Sciences

Exam in INF5150 / INF9150
Day of exam: 29. november 2011
Exam hours: 14:30 – 18:30 (4 hours)
This examination paper consists of 5 page(s).
Appendices:
Permitted materials: All written material.

Make sure that your copy of this examination paper is complete before answering.

NB: This exam text is only given in English since the course has been given in English this year. The candidate may, however, choose to answer in Bokmål or Nynorsk if he or she prefers.

The Optimal Traffic mobile app context

The application area for this exam is similar to the Obligatory Exercise 1 for INF5150 in 2011:

- Any individual car driver wants to know the optimal route to choose when traveling from A to B
- The "optraffic" community should improve the possibility to find the optimal route by providing data for the actual speed on the roads
- The traffic authorities would like to have accurate data on speed and customer choices to improve planning and their general advice to the public
- The means to achieve these goals is an Android app for the drivers and an advanced server application operated by the traffic authorities
- The Optraffic app users will provide position speed information at regular intervals and the central authorities will then provide optimal routing information when requested by the Optraffic app user.
- When the Optraffic user has reaches his/her destination, he/she will exit from the Optraffic app.

1 Modeling (35%)

The sequence diagram in Figure 1 shows the overall protocol of the Optraffic community similar to what we know from the obligatory exercise. (Note that the communication to and from the application server is done with named signals even though they in practice may be SMS messages. Thus you should *not* have any signals named *Sms* in this exercise and *no* parsing of the signal format.)

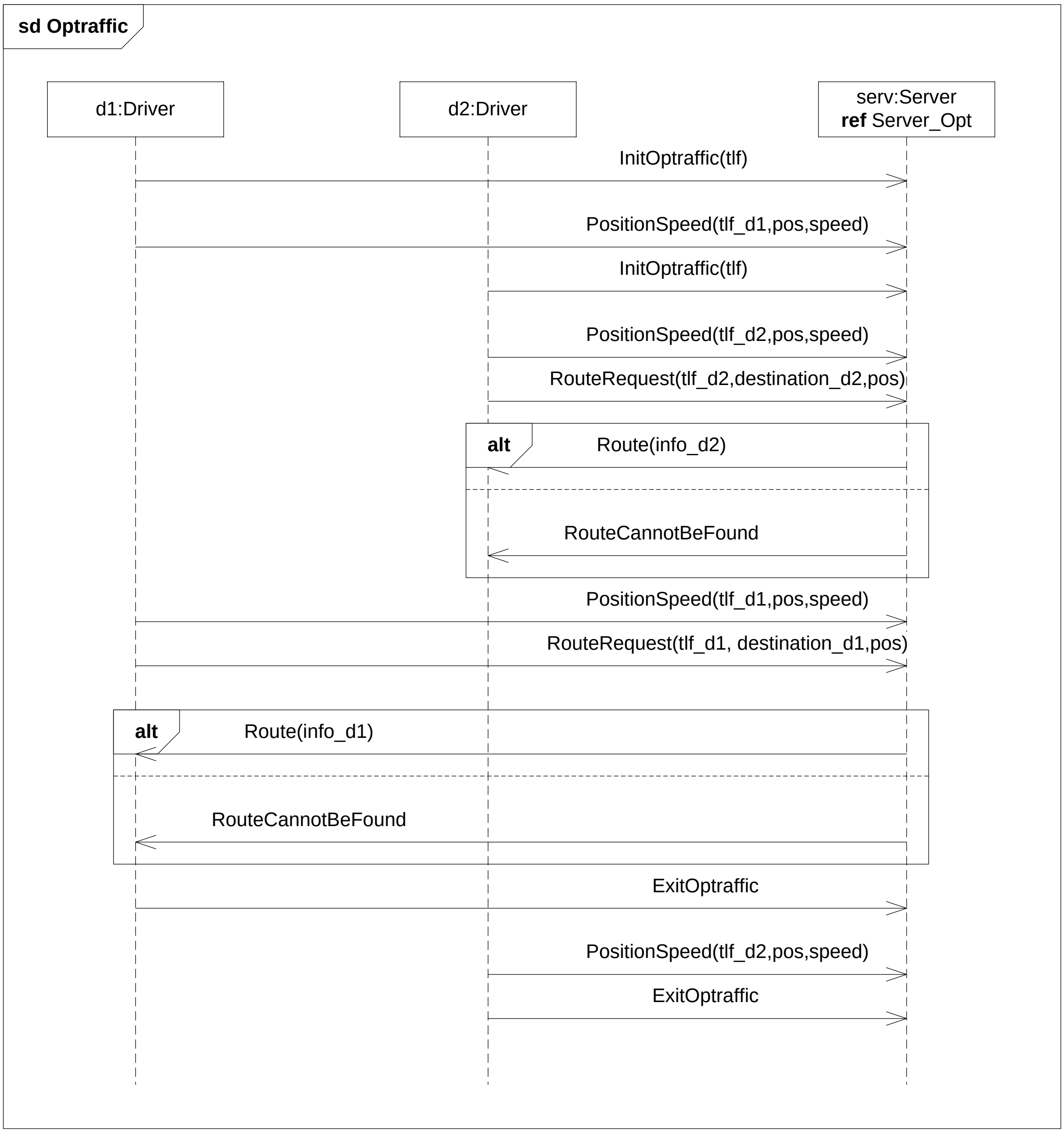

Figure 1 *Optraffic* behavior

The behavior is defined for a simple situation of two drivers using the Optraffic mobile app. The advanced traffic server application is modeled as one lifeline (*serv:Server*) that we will ask you to decompose relative to a composite structure of the server application given in Figure 2.

- 2a) How many positive traces are there in each of the two **alt**-constructs? Explain your answer.
- 2b) How many negative traces are there in each of the two **alt**-constructs? Explain your answer.
- 2c) Show how Optraffic can be changed into Optraffic1 such that Optraffic1 is a <u>pure</u> supplementing of Optraffic?
- 2d) Show how Optraffic can be changed into Optraffic2 such that Optraffic2 is a <u>pure</u> narrowing of Optraffic?

In the general case, the semantics of a sequence diagram is a set of interaction obligations.

- 2e) What is the number of interaction obligations in the set representing the semantics of Optraffic? Explain your answer.

Let Optraffic3 be the result of substituting **xalt** for the two occurrences of **alt** in Optraffic.

- 2f) What is the number of interaction obligations in the set representing the semantics of Optraffic3? Explain your answer.
- 2g) Is Optraffic3 a general refinement of Optraffic? Explain your answer.

Let Optraffic4 be the result of applying an **assert** to Optraffic3. In other words, Optraffic4 = **assert** Optraffic3.

- 2h) Is Optraffic4 a general refinement of Optraffic? Explain your answer.

3 Risk Analysis (30%)

Consider the CORAS threat diagram in Figure 3 written in the so-called before-after style.

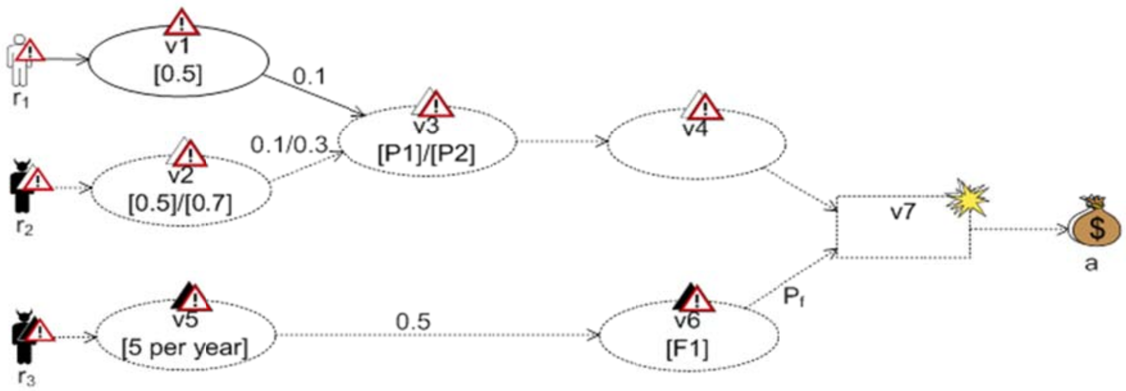

Figure 3 Threat diagram

- 3a) How many threats are there in the before-state? Explain your answer.
- 3b) How many threat scenarios exist only in the after-state? Explain your answer.
- 3c) Calculate the frequency F1 under the assumption that the threat diagram is complete. Explain your answer.
- 3d) What is the least possible probability for P2 under the assumption that the threat diagram is not complete? Explain your answer.
- 3e) What is the highest possible probability for P2 under the assumption that the threat diagram is not complete? Explain your answer.