UNIVERSITY OF OSLO

Faculty of Mathematics and Natural Sciences

Exam in INF5120 – Model Based System Development

Day of exam: Monday June 6th, 2016

Exam hours: 1430 - 1830 **(4 hours = 240 minutes)**

This examination paper consists of 8 pages.

Appendices: 2 (A and B, included in the 8 pages).

Permitted materials: All printed and handwritten material.

The exam should be answered in English.

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

Introduction

In this exam you shall in Question 1 create a Business Model Canvas and a Value Proposition Canvas, user stories and a Use case model for a practical case of the development of the app "ELManagement" – an app connected to the new national ElHub system to be made operational in Norway as from February 2017 - described in Appendix A.

In Question 2 you shall create specification models for the "ELManagement" app, using UML /WebRatio Class Models, SoaML, BPMN and the approach of IFML for WebRatio Mobile platform.

You shall in Question 3 create an EMF metamodel for an Enterprise Architecture Language (ArchiMate) and describe how you can create a graphical editor with Sirius - with an additional model transformation for the generation of textual documentation of the model.

An overall description of the ElHub system to be connected to the "ELManagement" app is given in Appendix A. You can adapt the described scenario as you find suitable to illustrate your models. Appendix B contains one example showing the use of the main elements in the ArchiMate domain specific modeling language.

Tips: Plan your time with the % and time guidance for each question below, so that you are able to answer all questions. Use time to read Appendix A for question 1a) and Appendix B for question 3a). As a general guide, pay attention to the quality of your given answers based on the following factors: relevance, creativity, and degree of thoroughness with respect to the techniques being demonstrated through the question(s).

Question 1) (25% - 70 minutes, Business Architecture and Requirements model for "ELManagement"

a) Make a Business Model Canvas for the "ELManagement" app. – as described on a high level in Appendix A. (10% - 35 minutes - including time to read Appendix A)

b) Make a Value Proposition Canvas for the "ELManagement" app based on your Business Model Canvas created in part 1a). (5% - 10 minutes)

c) User stories and use cases (10% - 25 minutes)

c.1) Make a set of 3 (minimum) user stories for "ELManagement" (See also required functionality described below in c.3.)

c.2) Create a corresponding UML Use Case model for the interaction of a home/apartment owner and the services that can potentially be offered by the "ELManagement" app.

c.3) Create a use case description (based on the template presented in class/for oblig 1) for the use cases of comparing the hourly prices per KiloWatt Hour of electricity/power offered by different power/electricity providers with the average hourly usage history of the home/apartment owner – as a basis for the consideration in order to change to a new power/electricity provider, typically one whose prices may result in lower total future costs. (to be specified in BPMN and IFML later in Question 2d and e))

Question 2) (50% - 120 minutes, Domain model, user interface mockup, SoaML, BPMN and IFML for "ELManagement"

a) Make a Domain model for the app "ELManagement" (using UML class diagram or WebRatio ER model syntax), focusing on the information necessary to be handled for the "ELManagement" app, and particular as required by the use cases from 1c) (10% - 25 minutes)

b) Sketch a user interface mockup for some of the main user interface screens for the "ELManagement" app user interface,– in particular related to the use cases described in 1c). (5% -15 minutes)

c) Make a SoaML model for the architecture of the total system supporting the ELManagement App. (10% -25 minutes)

d) Make a BPMN model for the process of comparing and changing Power/Electricity supplier through the ELManagement App., to support the use cases from 1c) (10% -25 minutes)

e) Make an IFML model as supported by the Webratio Mobile App platform for the "ELManagement" app based on user interfaces from 2b), in particular showing the IFML

model for the main user dialogue related to the use cases of comparing and changing Power/Electricity supplier, (i.e. the use cases from Question 1c) (15% - 30 minutes)

Question 3) (25 % - 50 minutes, EA - Metamodel and editor support for an Enterprise Architecture Language (Archimate)

a) Create a metamodel for ArchiMate, described as an EMF compliant UML model, based on the information derived from the example given regarding the use of ArchiMate for Insurance claim processing from Appendix B. (15% - 30 minutes – including time to read Appendix B)

b) Describe and illustrate how you can create a graphical editor for ArchiMate using EMF and the associated tool Sirius. (5 % - 10 minutes)

c) Describe and sketch how you can create transformation code (i.e. Java-EMF, ATL, MOFScript, or similar) for the generation of a textual description of ArchiMate models. (5% - 10 minutes)

Contact during exam: Arne J. Berre (Phone: 92047452)

Appendix A –"ELManagement" description

The small IT company Concierge has decided to extend its portfolio of systems by developing a new app, "ELManagement", that can advise home/apartment owners on their needs for Electricity Management – taking advantage of the new national Norwegian Elhub system.

Norway and the other Nordic countries has decided to mandate the use of automatic smart meters for electricity usage readings – to be fully deployed by 2019. This will ensure automatic readings of the usage of electricity for all metering points every hour (with a possibility to do so every 15 minutes). Today the readings are mostly done manually and reported to the respective network distributor through phone or through a webpage - on a monthly basis by each home/apartment owner. The Norwegian Water Resources and Energy Directorate (NVE) has instructed Statnett to develop Elhub, which is scheduled to go live in February 2017.

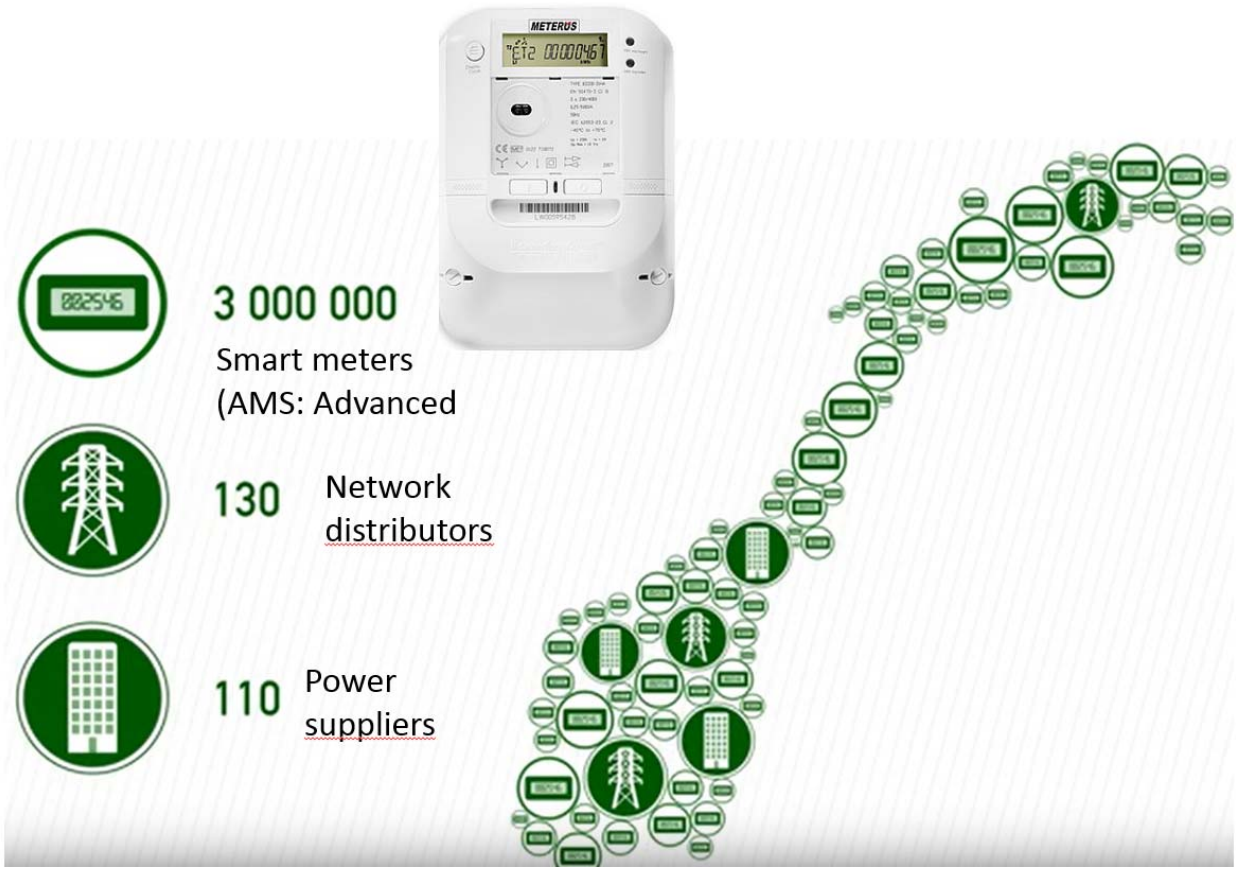

Figure 1 Overview of Smart meters, Network distributors and power suppliers in Norway

Norway has currently around 3 000 000 electricity metering points, 130 Distribution Network companies and around 110 Power (Electricity) suppliers. Every year there are around 400 000 changes from one Power supplier to another for the Norwegian customers.

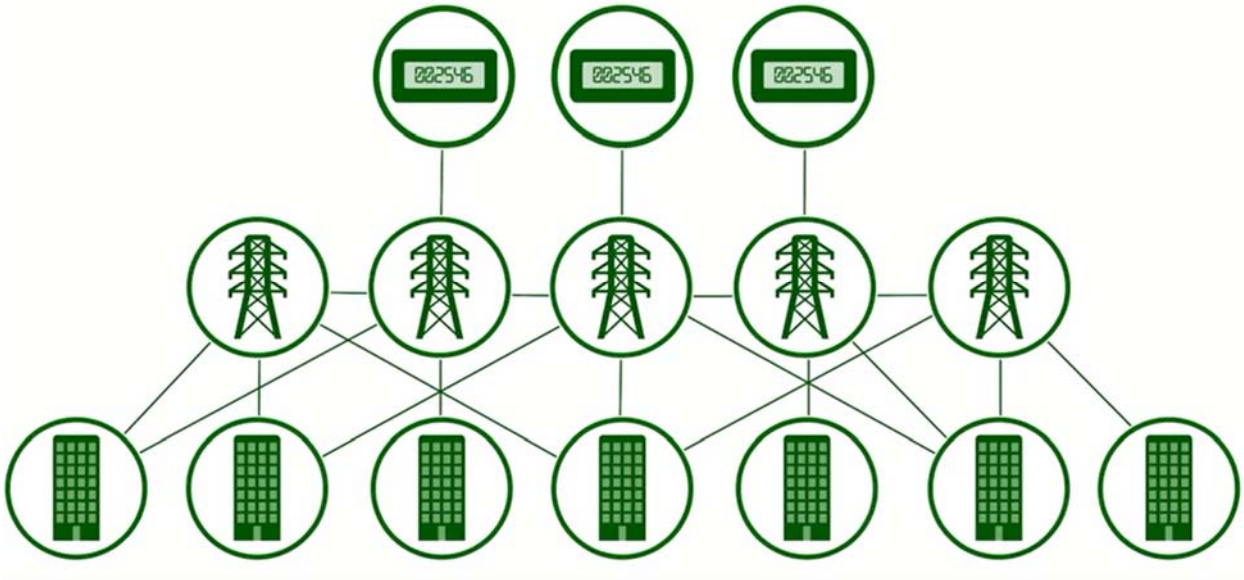

Figure 2 Metering points with one network distributor and many possible power suppliers

The electric power for each metering point will be provided by one of the 110 (or more) power supplier companies producing electricity, and delivered through the local network distributor managing the local electricity network.

Smart meters will give consumers better information about their own consumption and provide more accurate billing information so that customers are billed for their actual consumption. Electricity customers will get an improved overview of their electricity consumption and have the opportunity to use electricity in a more flexible, efficient and environmentally aware manner.

All customers will have access to the personal data of electricity usage that is stored in Elhub and will have the ability to manage third party access to the information through a private web portal. This portal will be available on the website of every company that is linked to Elhub. The information about each customer will primarily be name, national identification number, address, contact details and historical electricity consumption for the past three years.

Figure 3 Some of the services that the Elhub will support

As shown in figure 3, Elhub will provide a number of services that can be interacted with, - and provide new opportunities for both home owners, network distributors and power providers, including the "change of suppliers' service" that is the focus for ElManagement in the context of this exam.

The ElHub will contain or provide access to hourly prices per KiloWatt Hour of offered electricity/power by different power/electricity providers and also transport costs (nettleie) per

kilowatt hour for the different hours of the day by network distributors. Hourly variations of nettleie prices is foreseen in the future, motivating users to use less electricity during peak hours, reducing the total load of the network.

Concierge's plan for its ELManagement App

Figure 4 ELManagement App interacting with ElHub supporting end user customers

Concierge aims to become a third party company that can be provided access to the Elhub data of their customers and provide various relevant ElManagement services through an app. In the future Concierge can be enhanced to provide different services for Energy management and efficiency, and to control various units and devices in the home and/or offices to be on or off at different times during the day to optimise the usage of energy, and minimise the cost, related to how the prices of electricity and network usage is changing throughout the hours in the day. Typically, it will in the future become more expensive to use energy just after the end of the working day, and maybe at certain peak points during the day. Different power providers might also have different price offerings distributed over the day – including solar-based power which might be less expensive during daytime. We might thus in the future see more changes of power providers during the year – even if it already now before Smart meters are in place more than 400 000 changes taking place every year. Today this is handled with more interactions between the network distributor and the power providers involved, while this will be handled more centrally through the ElHub in the future.

Appendix B – ArchiMate example

ArchiMate is a domain specific Enterprise Architecture Modeling language customised for the description of Enterprise architectures for the Business, Application and Technology layers. It is adopted as a standard modeling language for the TOGAF Enterprise Architecture Framework.

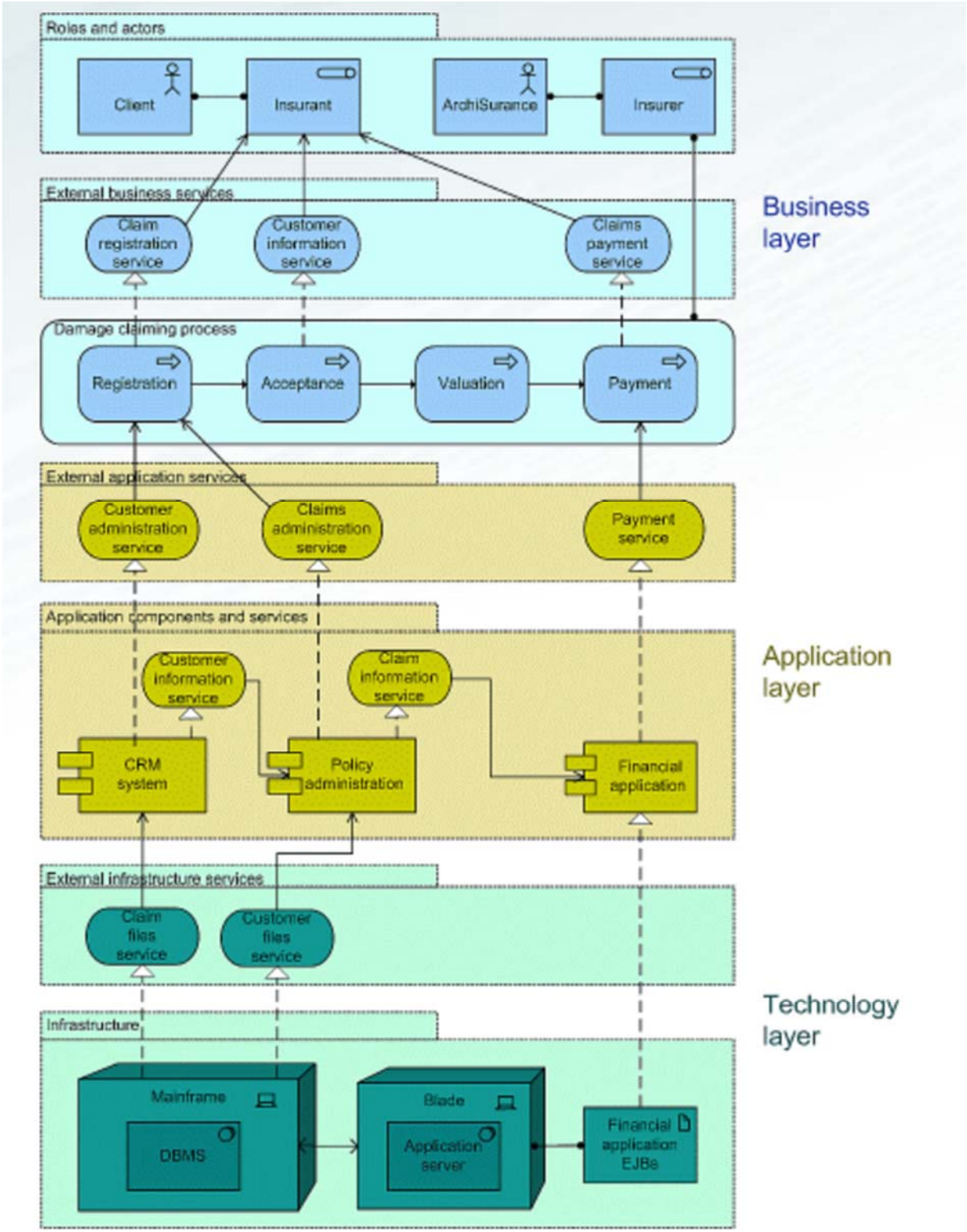

Figure 5 ArchiMate – example of Insurance claim processing

Figure 5 shows an illustrative ArchiMate diagram for an Insurance company example (**ArchiSurance**) that can be used as a reference point for a typical ArchiMate diagram, as asked for in Question 3, - with the example of an Insurance company and services for claim registration, claims payment and customer information. The modeling approach separates models into three layers: business, application and technology. Within each layer it is possible to model information, behaviour and structure.

The concepts of the language are illustrated by the examples in the three layers as follows:

In the Business layer, a Client is a business actor playing the role of insurant. ArchiSurance is a business actor playing the role of insurer. Claim registration, customer interaction and claims payment are business services supported by business processes for registration, acceptance, valuation and payment. Events can trigger business processes and processes can also be associated with business information objects.

In the Application layer, customer administration, claims administration and payment are defined as application services. These are supported by the application components: CRM system, Policy administration and Financial application. Application services and application components can also access data objects.

In the Technology layer, there is a claim files service and a customer file service supported by Mainframe and Blade devices with DBMS and Application server system software, which also can access data artifacts.