Contribution to the Standardization of the Modelling Complex Telecommunication Processes

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***Abstract*- Most telecommunication processes used for the service provisioning are the complex telecommunication processes. Specification of these processes is practically impossible without any kind of modelling. Modelling could be done in different forms, but a diagram is the most appropriate, which provides a visual representation of the activities needed to achieve the necessary conditions for the realization of the telecommunication services. A visual representation is the easiest way for the human perception and best defining the business processes.**

This work gives proposal for standardization of the modelling of the complex telecommunication processes. Modelling is based on the diagrams, possible scenarios in the service provisioning and defining of the processes through the modules. This kind of the modelling was used in practice and the results showed that this can be an efficient solution to the optimal specification of the complex telecommunications services.

Keywords- Modelling, System Support, Complex Business Process, Telecommunication Service

I. INTRODUCTION

Simple telecommunication process could be modelled in different and simple ways. Example could be simple text defining the basic steps. But the business processes for the service provisioning are a set of simple and complex processes for the realisation of service connection, disconnection or change. Very often it is a combination of several processes. Furthermore, the most telecommunication operators use the system support, which may include several interconnecting systems, for the management of the service realisation and maintenance. It can be CRM (Customer Relationship Management) system, workflow system, systems for activation of network elements, inventory system and other OSS (Operations Support Systems) systems [1]. The task of the workflow system is to operate with other systems to realize the service activation, deactivation or change. Obviously, simple definition of the business process in that system environment is not enough and even impossible. Moreover, sometimes a model in the form of a diagram is not sufficient to describe the business process accurately and efficiently, let alone a textual description.

A model for the specification of the business processes which are supported by BSS (Business Support Systems) and OSS systems has to be capable to describe and specify all the business processes needed for the provisioning of telecommunication services. The model has to ensure a combination of the activities needed for the realization of one or more telecommunication services or processes. Furthermore, the model has to enable easy changes and upgrading of the existing business processes and easy introduction of the new business processes. It enables fast and efficient introduction of the new products and services on the telecommunication market.

II. MODEL DEFINITION

A model should contain the elements which are capable to describe all situations in the business process supported by the system support. These elements [2], [1] are:

A. Start and end nodes

Start node represents start and end of the business process or the subprocess. There are two different types of the end nodes: the first one represents end of the business process or the subprocess and the second one represents end of the process branch.

B. Manual task

It is an action which the actor of the process has to do during the business process.

C. Outgoing and incoming signals

It is the communication between the systems which participate in the business process.

D. Subprocess

It is part of the business process which denotes certain entirety in the process with similar actions or action which are repeated several times in the process or in different processes.

E. Decision node

It is a decision which part of the business process will be executed. It could be OR or XOR node. It is the execution of the business rule incorporated in the business process.

F. Split node

It is parallel execution of different actions during the business process.

G. Join node

It represents joining of two or more branches of the business process. Among others, different branches can be a result of the execution of a decision or split node.

H. Time control

It is notation of the place in the process where the execution is stopped for a certain time. It is execution of the business rule where the process has to wait for defined condition.

I. Process interruption

It is place where the process can be interrupted from the CRM system or on the basis of the answer from the inventory system when there is no technical feasibility for service activation.

III. A TOOL FOR THE MODELLING

A software tool for designing such model has to be a tool which enables a graphical representation over the diagrams. The languages which are often used for the business process modelling are different variants of nonstandard diagrams, BPMN (Business Process Modelling Notation), EPC (Event-driven Process Chains) and UML (Unified Modelling Language) activity diagram. Nonstandard diagrams are very imprecise and insufficient for modelling the telecommunication processes which are supported by the systems. BPMN and EPC are the graphical languages with the syntax which allows very efficient modelling of the business processes. But, these languages are primarily intended for the business analysts and they give the view on the business processes adapted to the business side. On the other hand, UML activity diagram has appropriate syntax too, but the structure of the language is appropriate for the modelling of the business processes intended for the development of the software solutions like the system support in the telecommunications [3].

Syntax of UML2 activity diagram is shown in Fig. 1 [2], [4]. The elements of UML2 activity diagrams can be mapped to a defined model as follows [2]:

- Initial and final node to Start and end nodes
- CallOperationAction node to Manual task
- SendSignal Action and AcceptEvent Action to Outgoing and incoming signals
- CallBehaviourAction node to Subprocess
- Decision node to Decision node
- Fork node to Split node
- Merge and Join node to Join node
- TimeEvent node to Time control

The process interruption can be described by the combination of previous defined elements.

In the syntax of UML2 activity diagram, there is no OR decision node. In a less formal model it could be solved by the notes where decision node is OR decision node, or in a more formal model, OR decision node can be constructed by the combination of XOR decision and fork nodes. Such construction of OR nodes with more branches becomes too complicated.

Element InterruptibleActivityRegion in the syntax of UML2 activity node can be useful for the modelling of the situation where two parallel branches are waiting for the execution and the execution of one will lead to “closure” of the other.

UML2 is a standard language with a wide range of usage and possibilities. One possibility is the simulation of the system’s dynamic behaviour. In the examples [4] and [5], system’s behaviour simulation was presented. This solution was adapted and implemented for the simulation of the behaviour of the system support used in telecommunication [2], [6].

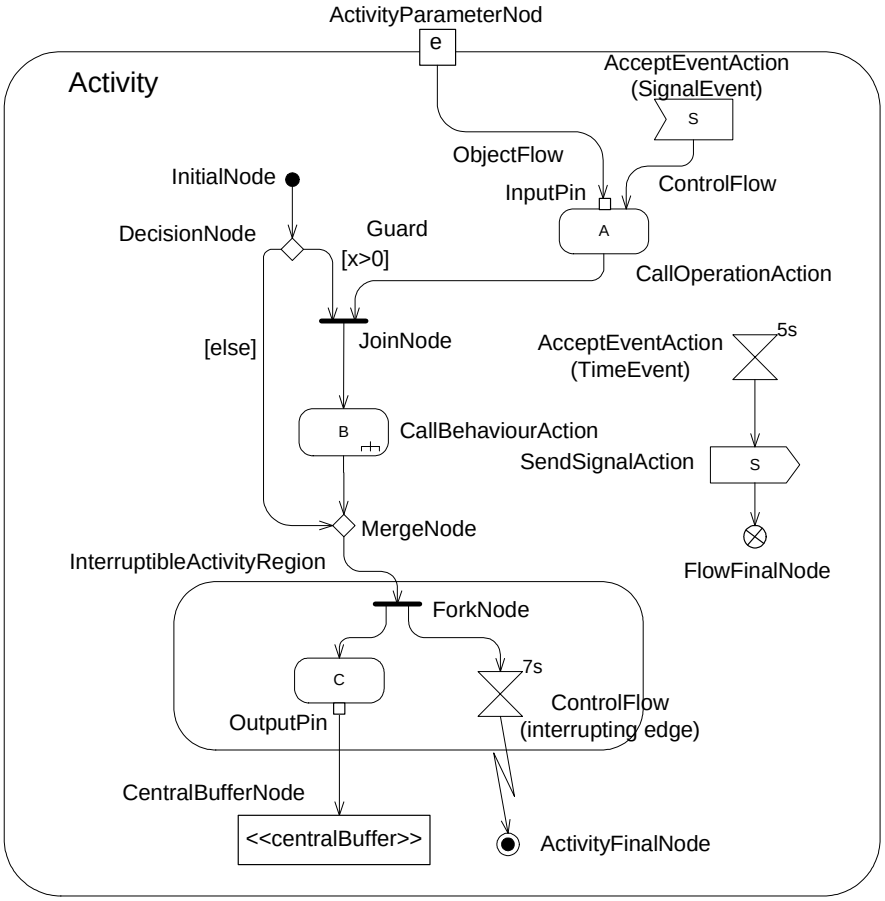


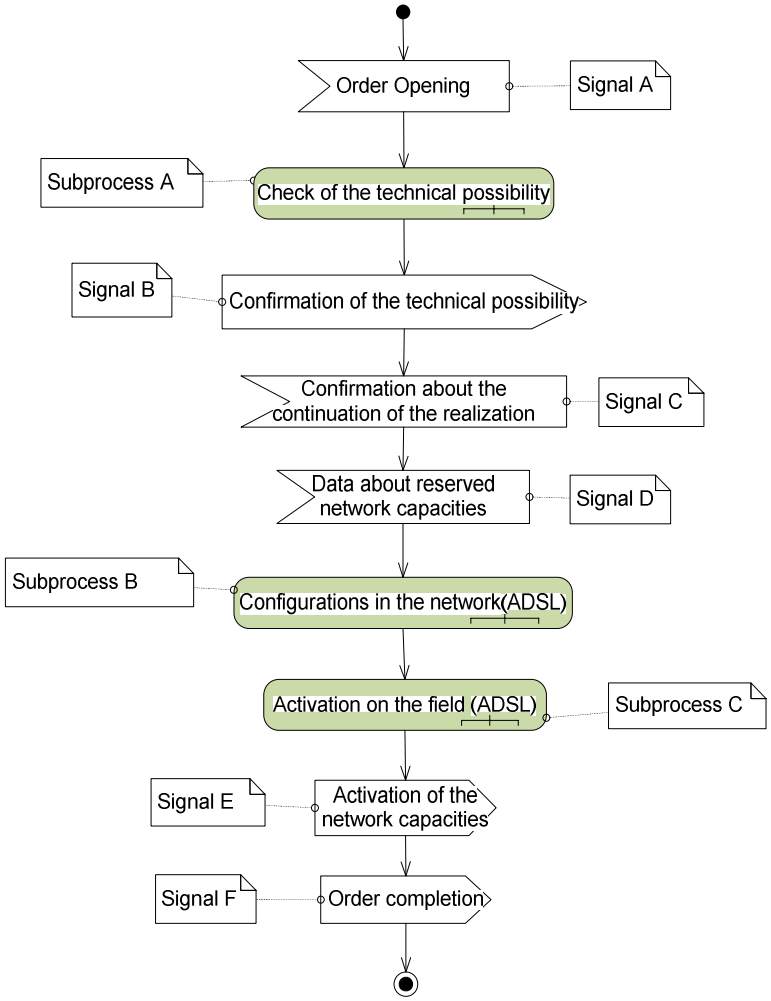
Fig. 1 A syntax of UML 2 activity diagram

IV. THE PRINCIPLES OF THE TELECOMMUNICATION BUSINESS PROCESSES MODELLING

The implementation and use of the telecommunication service require the business processes. The purpose of these processes is to ensure the service provisioning, maintenance and co-existence with the complex telecommunication environment. Using system support for the business processes management requires well-defined processes. Central place in the coordination of needed activities for the service provisioning and maintenance has the workflow system over defined business processes. There are many simple and complex processes and it is very important to design these processes in an optimal and efficient way. The key to achieve this is modelling which can ensure that all needed processes are involved and that the development and changes in the processes can be done easily and optimally.

In this work, modelling of the telecommunication business process through the scenarios was proposed [1], [7]. A scenario can be a simple process like a voice service connection or a complex process which includes disconnection of the existing services, a number portability to the another operator and a rental of the cooper pair to the another operator. A model of the scenario includes basic interactions between the systems which are part of the system support and the subprocesses which represent the activities related to the certain service and have to be executed in the certain period of time. A scenario represents the highest level of the process approximation with the basic subprocesses in the process – modules [7]. In this way, a model of the scenario could be easily mapped in the model of the enterprise provisioning process. The scenarios are useful in a testing and validation of the processes specification [8].

As shown in Fig.2, a model of the simple process is used for the specification of the business process managed by the workflow system.



Signal A – Order opening initiated by the CRM system. Customer's data, products (VoIP, Internet access and/or IPTV) and corresponding subproducts and attributes are sent

Subprocess A – A check of the technical possibility. Check and reservation of the network elements in the Inventory System is automatic. In the case of the error check and reservation in Inventory System is manual. Inventory system sends an answer about technical possibility (exist, not exist or some changes are needed)

Signal B – A confirmation to the CRM that the technical possibility exist

Signal C – A confirmation from the CRM that the realization can start

Signal D – A data about reserved network capacities from the Inventory System

Subprocess B – A reconfiguration in the ACS (Auto Configuration System - System for automatic configuration of CPE (Customer Premises Equipment)) and DSLAM (Digital Subscriber Line Access Multiplexer). If VoIP (Voice over IP) connection was ordered, Exchanges (IN (International Exchange), LE (Local PSTN Exchange) and IMS (IP Multimedia Core Network Subsystem)) configurations are needed. IMS port remains blocked

Subprocess C – An activation of the services on the field (MDF and customer's premises). A technician has to go to the customer because it is the first connection on the customer's premises. A selfinstalation is not allowed.

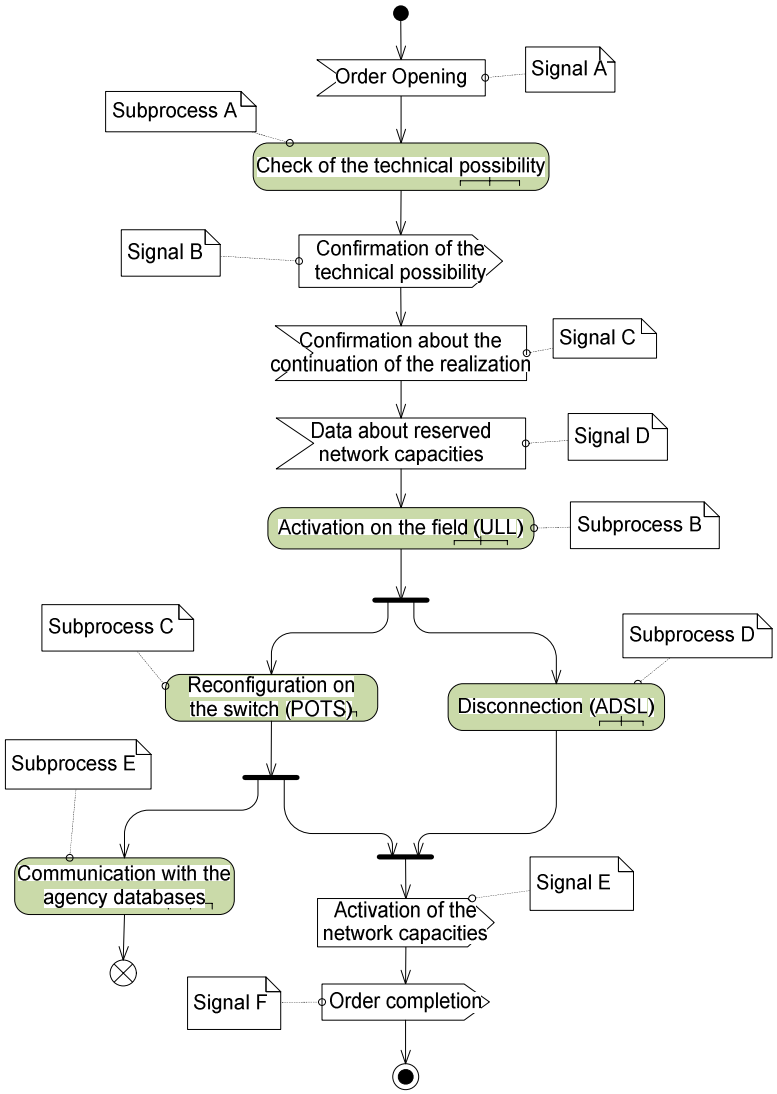
Signal E – A confirmation that the activation of the network capacities in the Inventory System can be done

Signal F – A confirmation to the CRM that the realization according to the order is finished. A time of the realization is sent

Fig. 2 Connection of the services over the ADSL access

A model consists of three subprocesses: the first subprocess presents check of the technical possibility which is prerequisite for the realization of the user's request; the second models part of the process when needed configurations of the network elements have to be done before the action in the access network; these actions are modelled through the third subprocess. Important parts of the model are notes because they contain a short description about the model elements, like the signals or subprocesses, and it gives a clearer description of the scenario.

A model of the complex process is shown in Fig. 3. The model specifies process for rental of the local loop to another operator, number portability to another operator, disconnection of the voice service and disconnection of the broadband service.



Signal A – Order opening initiated by the CRM system. Customer's data, products (ULL (Unbandling local loop), Number portability, Voice, Internet access and/or IPTV) and corresponding subproducts and attributes are sent

Subprocess A – A check of the technical possibility. Check and reservation of the network elements in the Inventory System is automatic. In the case of the error check and reservation in Inventory System is manual. Inventory system sends an answer about technical possibility (exist, not exist or some changes are needed)

Signal B – A confirmation to the CRM that the technical possibility exist

Signal C – A confirmation from the CRM that the realization can start

Signal D – A data about reserved network capacities (for ULL) and existing network capacities (for services which are disconnected) from the Inventory System

Subprocess B – A wiring on the MDF (Main Distribution Frame). A local loop was prepared for another operator

Subprocess C – A port reconfiguration on the local PSTN switch. All incoming call in PSTN network will be redirect to another operator via IN switch

Subprocess D – A reconfiguration in DSLAM, IMS and ACS

Subprocess F – A confirmation that the telephone number was prepared for another operator

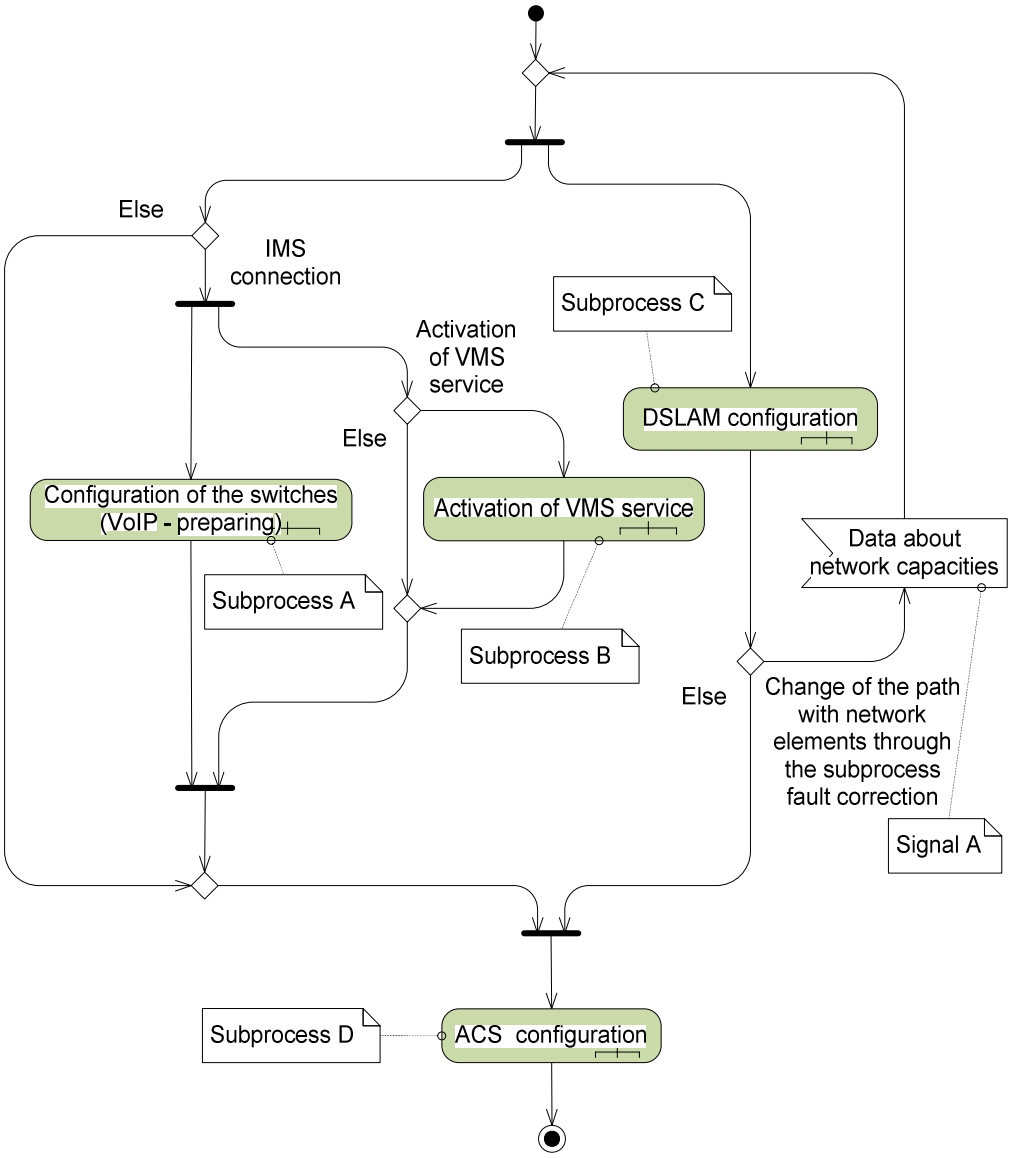
Signal E – A confirmation that the activation and deactivation of the network capacities in the Inventory System can be done

Signal F – A confirmation to the CRM that the realization according to the order is finished. A time of the realization is sent

Fig. 3 Connection of the services over the ADSL access

Every subprocess contains the actions which belong to different processes coupled together in the one complex process. A model defines a business rules and a timeline of the subprocess execution. First, a local loop has to be prepared for another operator by MDF wiring. Then, the network elements can be disconnected. After the port disconnection on the local switch and redirection of the calls to the IN switch, it is possible to send a confirmation to the agency databases that the voice number is ported to another operator.

A module (subprocess) which represents needed configurations of the network elements and systems for the preparing of the ADSL access before the actions on the access network is shown in Fig. 4. This is the lower level of the process approximation and the process is modelled here with more details. As shown in the model of scenario, the notes are important parts of the modelling, too.



Subprocess A – If VoIP (Voice over IP) connection was ordered, Exchanges (IN (International Exchange), LE (Local PSTN Exchange) and IMS (IP Multimedia Core Network Subsystem)) configurations are needed. IMS port remains blocked

Subprocess B – If VMS service was ordered, needed configuration will be executed

Subprocess C – Automatic configuration of DSLAM port. Manual task will be created in the case of the error

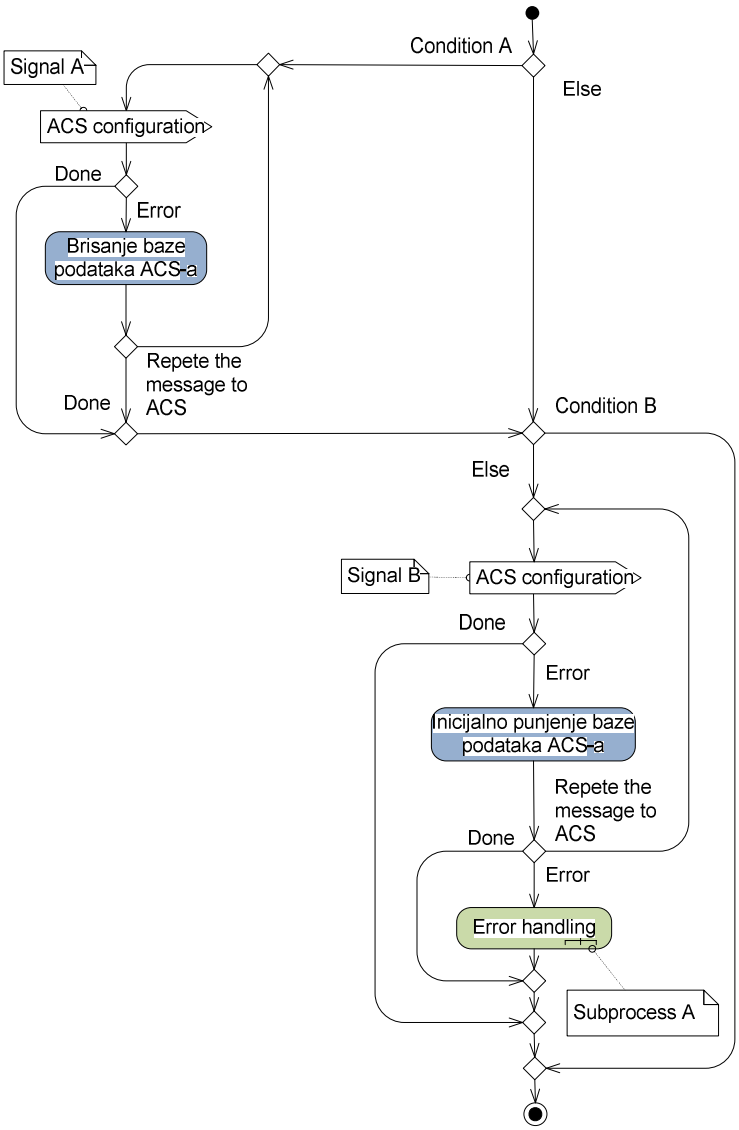
Subprocess D – An automatic configuration of the ACS system

Signal A – New data about network capacities will be obtained from the inventory system

Fig. 4 A subprocess "Configurations in the network (ADSL)"

In this module, there are the decision nodes before some subprocesses because a module can be used in more scenarios. In some scenarios where this module is executed, this subprocesses are used in some nodes. For example, in the case of the connection of the service for Internet access, it is not necessary to start a subprocess "Configuration of the switches (VoIP – preparation)". In another scenario, if the services for Internet access and VoIP service were ordered, a subprocess "Configuration of the switches (VoIP – preparation)" should be executed. A subprocess "DSLAM configuration" should be executed in every scenario where this module was used. It is very important to use these modules in an optimal way because the conditions in the decision nodes can be very complex.

Next subprocess shown in Fig. 5 is the lowest level of the process approximation.



Condition A – Access disconnection **or** Service disconnection **or** ADSL relocation **or** FTTH relocation **or** ADSL->FTTH migration **or** VoIP->MSAN migration **or** VoIP->POTS migration **or** ADSL->BSA migration

Condition B – (Access disconnection **and not** relocation **and not** ADSL->FTTH migration) **or** VoIP->MSAN migration **or** VoIP->POTS migration **or** ADSL->BSA migration

Signal A – Automatic ACS reconfiguration

Signal B – Automatic ACS configuration

Subprocess A – A procedure for the intervention on the network or OSS/BSS systems in the case of the error during the provisioning process. This procedure can be used in any provisioning process.

Fig. 5 A subprocess "ACS configuration"

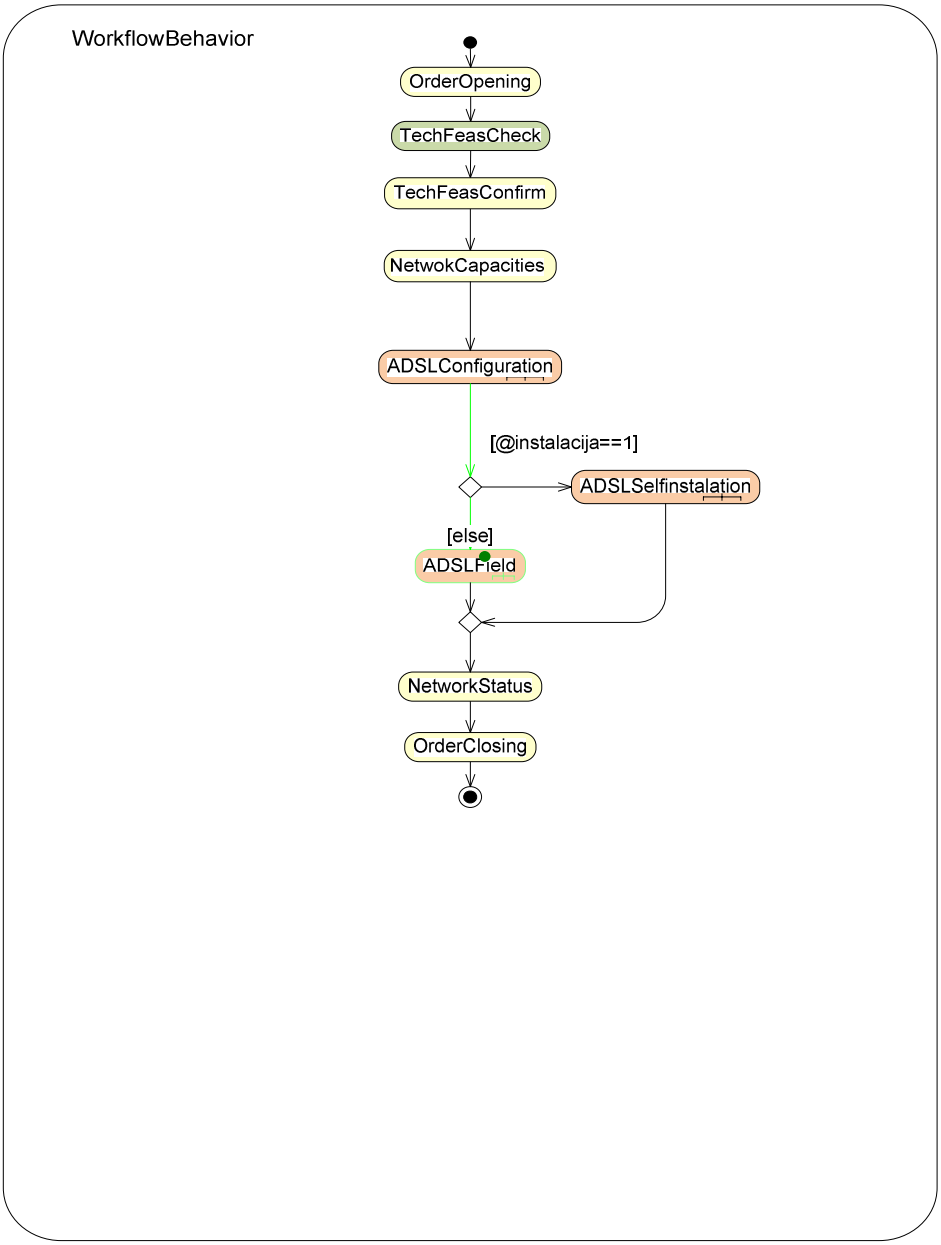
This is a simple subprocess with two signals and two actions (manual tasks). The manual tasks are marked blue to better distinguish themselves from the subprocesses. The tasks have original names on the Croatian language. This subprocess is used in more modules and in different scenarios. Therefore the conditions in the decision nodes are more complex than those in module (subprocess) "Configuration in the network (ADSL)". The decision nodes in the subprocess are one of the most sensitive parts in such modelling and the precision is very important here.

V. A BUSINESS PROCESS SIMULATION

As mentioned previously, the use of UML2 language gives possibility of the simulation of the system's dynamic behaviour. Adapting solution "ActiveCharts" makes it possible to simulate the business processes for the service provisioning through the model described in the previous chapters [6]. A solution "ActiveCharts" uses UML2 Activity diagram and ASM formal

method to formalize UML2 activity diagram and to get such semantics that simulation through the diagram is possible. Finally, a solution uses regular C# code to define the actions in the activity nodes [4].

It is possible to simulate the behaviour of the workflow system according to the scenarios. One example is shown in Fig. 6. This is connection of the services over the ADSL access. Final service activation can be made by the customer (selfinstalation) or by the technician.

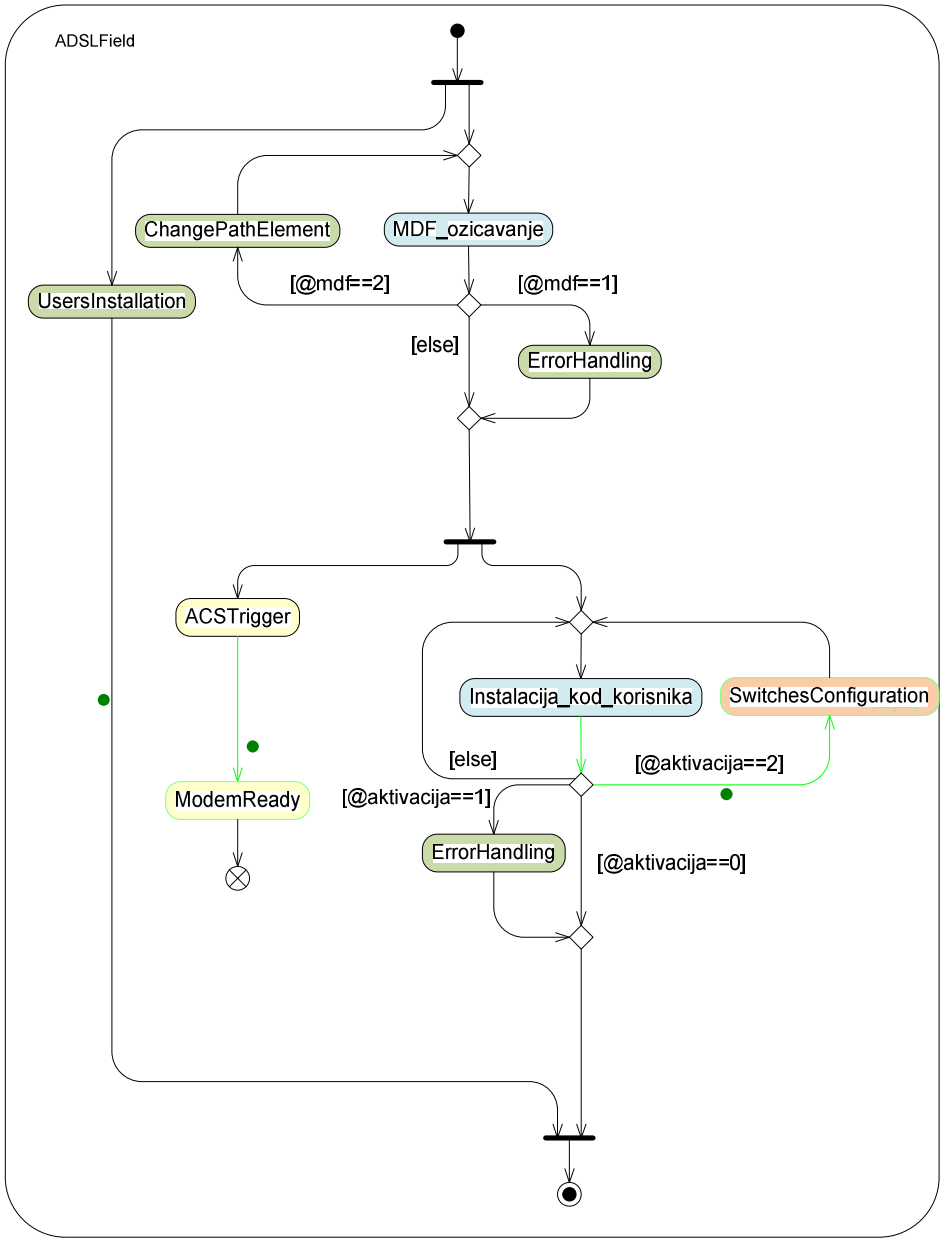


Condition **@instalation==1** – selfinstalation was chosen

Fig. 6 The simulation of the ADSL connection process

In this example, through the input parameters for the simulation, the service activation by the technician is selected. Because it is the simulation of the workflow system's behavior rather than the simulation of the other system's behavior, the signals were modeled like the action nodes. To differentiate these action nodes from the other action nodes they are marked with different color.

A simulation of the process through the subprocess "ADSLField" is shown in Fig. 7. One input parameter of the simulation will lead to an option of the switches configuration from the field task (action node) for technician. During the simulation, it is possible to change result of the field task. Some of the action nodes can have predefined value to simulate result of the field task or signal.



Condition **@mdf==1** – Error (a procedure for solving error has to start)

Condition **@mdf==2** – Element change (a procedure for change some of the network element (e.g. port on DSLAM) has to start)

Condition **@aktivacija==0** – Done (a task was done successfully)

Condition **@aktivacija==1** – Error (the procedure for solving error has to start)

Condition **@aktivacija==2** – IMS configuration (a final configuration on the switches has to start)

Fig. 7 The simulation of the process modelled by a subprocess "ADSLField"

VI. CONCLUSIONS

Modelling of the processes for telecommunication service provisioning is a complex task. There are many simple and complex business processes which are supported by OSS systems. To ensure quality support, optimal business processes are needed, which is hard to achieve without optimal modelling.

In this work, one possible way of the modelling of such complex environment like the system support for the provisioning of the telecommunication services is proposed based on the scenarios. The model is divided on several levels of the process approximation, with the highest level giving a global picture about the process and the lower levels on the details important for the specification and development of the system support. Such a structural way of the modelling gives a clearer picture of the processes and is more understandable for all sides involved in the process design and development.

Additional possibility of the model is the process simulation. It further enhances the expressive power of the model. To achieve full application of the simulation in the phase of the system support specification, it is necessary to enable the development and application of simulation in a simple and practical way.

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