Extending Telecom Service Design Activities for Early Verification

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Scope and Objective

Our research is in the Telecom Service (TS) Specification activity
  • It specifies how the service can be achieved (implemented)
  • The entry point of the specification activity is the requirements

We aim to propose methods and tools to assist the different stakeholders that are involved in the TS specification activity
Agenda

- Context
- Problems
- Approach & Methodology
- Contributions
- Related work
- Conclusion and Future work
Context: Telecom Service Characteristics

- Telecom Services are used by a large number of users → Quality to be improved

- TSs are composed of several applications that interact with each other → TS design is complex

- TS design contains software and hardware elements → Different domains and abstraction levels
■ TS term is “the offering of telecommunications for a fee directly to the public or classes of users as to be effectively available directly regardless of the facilities used” [FCC 96, term 51]

■ ArchiMate is a language that decomposes the TS architecture in terms of viewpoints and domains. This is helpful to describe the TS architecture
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Problems

- RQ1: How to detect the TS design errors and flaws earlier before the implementation phase?
- RQ2: How to correct the design and improve the qualities accordingly?
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Approach

- Relying on Model Driven Engineering (MDE) and Model Driven Analysis [Moreno, 2008], we propose to verify the TS design earlier than implementation activity. MDE helps to manage complexity
  - Our approach is based on tool chain: design and verification tools
  - We use simulators, other tools can be used such as model checkers
- We rely on ArchiMate to propose Early Verification Language
- Eclipse contains EMF and several model transformation languages

“Softgoals, Design, tools, and Measurements” Meta-Model (respects ArchiMate language)
Methodology

- RQ1: How to detect the TS design errors and flaws earlier before the implementation phase?
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■ Contributions

■ Related work

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Contributions: Linking between Design and Verification Activities

- We propose a Linking Meta-Model (LMM) that is used to generate tools which support the different early verification activities
  - We define the abstract syntax of the Domain Specific Early Verification Language (DSEVL)
  - This language provides a transversal alignment between measurements and ArchiMate layers
Contributions 2: Linking TS models to Simulators and Tool Selection method

- We have mapped the TS design to different network simulators (OPNET and NS-3)
- We have proposed a method to select the proper tool (simulator) according to the measurement it supports
Example: Obtaining data from Business & Technology layers of ArchiMate

Video Conference example (implemented using ArchiMate), the code is generated using XPAND/Eclipse

```java
public String getName() {
    return name;
}
public void setName(String newName) {
    this.name = newName;
}
public void exitConference() {
}
public void enterConference() {
    Clientpartiofconferencesystem clientpartiofconferencesystem = new Clientpartiofconferencesystem();
    clientpartiofconferencesystem.joinConference();
    this.startStop();
    this.getName();
}
```

```c++
void f_RegistrationTime_64274c95 (Time oldval, Time newval){
    std::cout << "Traced" << oldval << "to" << newval << std::endl;
    std::cout << "Traced:";
    Simulator::Now()<<std::endl;
    NS_LOG_INFO ("The probe RegistrationTime_64274c95 is set from the value " << oldval << " to the value " << newval);
}
void f_DevQueueDrop_64274c93 (uint64_t oldval, uint64_t newval){
    std::cout << "Traced" << oldval << "to" << newval << std::endl;
    NS_LOG_INFO ("The probe DevQueueDrop_64274c93 is set from the value " << oldval << " to the value " << newval);
}
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## Related work

<table>
<thead>
<tr>
<th>Approach/Aspect</th>
<th>Managing Complexity</th>
<th>Considering Different Stakeholders</th>
<th>Using Simulation</th>
<th>Measurement Analysis Activity</th>
<th>Consider Hardware Elements</th>
<th>Ability to use multiple tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Context modeling and a context aware framework</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
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<tr>
<td>2. A set of integrated tools for behavioral modeling and analysis of embedded systems</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
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<tr>
<td>3. A tool-chain for performance analysis of coordination models</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
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<td>+</td>
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<tr>
<td>4. A model-driven software environment for modeling, simulation and analysis</td>
<td>+</td>
<td>?</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>5. Our Approach</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>- (FW)</td>
<td>+</td>
<td>+</td>
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</tbody>
</table>

> **Our approach considers the hardware elements as part of the verification process, thanks to the simulation technical space and ArchiMate language definitions**

1. Achilleos et al., 2010 and Achilleos et al., 2008
2. Ivanov et al., 2010
3. Arbab et al., 2009
4. Touraille et al., 2011
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Conclusion

- **RQ1**: How to detect the TS design errors and flaws earlier before the implementation phase?
- **RQ2**: How to correct the design and improve the qualities accordingly?

<table>
<thead>
<tr>
<th>Aspect/Achievement</th>
<th>LMM</th>
<th>Tool Selection</th>
<th>Map Design to Simulation (C.G)</th>
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<tbody>
<tr>
<td><strong>RQ1</strong></td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><strong>RQ2</strong></td>
<td>+ (by extension)</td>
<td>-</td>
<td>+ (to obtain measurements)</td>
</tr>
<tr>
<td>Managing Design Complexity</td>
<td>+ (ArchiMate)</td>
<td>-</td>
<td>+ (Model To Text)</td>
</tr>
<tr>
<td>Cost Reduction</td>
<td>+ (Reusability)</td>
<td>+ (Automation)</td>
<td>+ (Automation)</td>
</tr>
<tr>
<td>Time to Implementation</td>
<td>+ (Reusability)</td>
<td>+ (Automation)</td>
<td>+ (Automation)</td>
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<tr>
<td>Preparing for Validation of the Approach</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Reduce Code Implementation Errors and Time</td>
<td>+</td>
<td>-</td>
<td>+</td>
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- Our results contributes positively to the RQ1
- The LMM links between activities, as it is always used by the model transformations, LMM contributes positively to RQ2
Limitations

- **Time to implement a Model Transformation is considerable:**
  - Implementing the code generation templates

- **Considering different technical spaces, and domains during the mapping activity needs domain experience and accuracy**
Future work

- We intend to:
  - Continue to investigate the rest of the research questions according to the methodology that we proposed;
    - The measurement analysis activity using analytical theory;
    - The correction decision activity in the feedback loop;
  - Define the concrete syntax of the early verification language that we propose “DSEVML”. This helps the TS designer in describing the properties of the system with measurement associations using models;
  - Investigate the usage of other types of tools for verification
  - Experiment our approach and proposed tools with an operator.
Thank you

Thank you for your attention

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Publications

- Alloush, I.; Kermarrec, Y. & Rouvrais, S. A Transversal Alignment between Measurements and Enterprise Architecture for Early Verification of Telecom Service Design, EUNICE 2013. [Accepted]
- Alloush, I.; Kermarrec, Y. & Rouvrais, S. An Automated Tool Selection Method based on Model Transformation: OPNET and NS-3 Case Study, IEEE-SCS, (Spects 2013) [Accepted]
- Alloush, I.; Kermarrec, Y. & Rouvrais, S. A generalized model transformation approach to link design models to network simulators: NS-3 case study (SimuTech2013) [Accepted]