D5.3 A	Benchmark network models - RTE
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Open Cyber-Physical System Model-Driven Certified Development

Executive summary[4]:

Benchmark network models have been generated based on standard IEEE[5] power system test cases. They enable to model simple (14 nodes) to more convoluted (118 nodes) networks in order to assess how individual components are simulated, as well as the computation time scalability when simulating larger networks.

[1] Access classification as per definitions in PCA; PU = Public, CO = Confidential. Access classification per deliverable stated in FPP.
[2] Deliverable type according to FPP, note that all non-report deliverables must be accompanied by a deliverable report.
[3] Due month(s) according to FPP.
[4] It is mandatory to provide an executive summary for each deliverable.
[5] https://www.ieee.org/index.html

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0.2	08/11/2016	Taking feedbacks into account	Draft
1.0	15/11/2016	Taking final feedbacks into account	Released

6 Indicate Main Author(s) with an "X" in this column.
7 Deliverable leader according to FPP, role definition in PCA.
8 Person(s) from contributing partners for the deliverable, expected contributing partners stated in FPP.
9 Typically person(s) with appropriate expertise to assess deliverable structure and quality.
10 Status = "Draft", "In Review", "Released".

CONTENTS

ABBREVIATIONS

List of abbreviations/acronyms used in document:

Abbreviation	Definition
DC	Direct Current
IEEE	Institute of Electrical and Electronics Engineers
iPSL	iTesla Power System Library

1 INTRODUCTION

In order to ensure an efficient and secure power supply for all electricity consumers, electricity utilities, transmission system operators, industrial companies and research entities conduct many power system simulations. These simulations range from individual components validation to large scale, system-wide security assessments.
With the increase of power electronics and DC components, legacy power simulation tools need large updates in order to deliver fast, reliable results. In order to assess whether OpenModelica could be used as a power-system simulation tool, some realistic IEEE test cases were generated in Modelica format. These standard test cases will allow comparing results obtained with OpenModelica with already existing results in the literature (or legacy tools).
The small test cases will allow to quickly validate the behaviour of individual components, while larger test cases will enable to assess how well OpenModelica computation time scales when dealing with larger setups.

2 IPSL LIBRARY

The test cases rely on the iTesla Power System Library for individual components modelling. iPSL[1] was mainly developed by RTE, AIA, KTH and DTU during the iTesla European (FP7) project[11], in order to provide an open Modelica library for power-system studies.

3 TEST CASES

The IEEE test cases are standard power-system test cases inspired from the American electric power system in the 1960s.
These test cases are publicly available in static CIM (CGMES) format. The CIM to Modelica conversion is based on an experimental conversion workflow first developed during the iTesla European project: a load-flow was first performed on these setups, then the static models were mapped with iPSL models. Various parameters' sets were used in order to describe diverse generators behaviours.

3.1 IEEE 14

The 14 nodes network has only five generators and eleven loads. It can quickly and easily be implemented in various data formats[12].

3.2 IEEE 30

The 30 nodes network allows studying more convoluted behaviours, while keeping computation times within a few minutes[13].

[11] http://www.itesla-project.eu/
[12] http://icseg.iti.illinois.edu/ieee-14-bus-system/
[13] http://icseg.iti.illinois.edu/ieee-30-bus-system/

3.3 IEEE 57

The 57 nodes network[14] already gives an insight as to how well OpenModelica handles larger models, both for the compilation and simulation processes.

3.4 IEEE 118

The largest IEEE test case provided here gathers 118 nodes and 54 generators[15], and includes more voltage control devices.

4 REALISTIC SYSTEM-WIDE TEST CASES

When the aforementioned test cases lead to satisfactory results while computation times remain low, much larger test cases may be generated, up to tens of thousands of nodes (realistic pan-European power system studies would require over 10 000 nodes with detailed, non-linear models and many discrete events).

14 http://icseg.iti.illinois.edu/ieee-57-bus-system/
15 http://icseg.iti.illinois.edu/ieee-118-bus-system/

REFERENCES

[1] L. Vanfretti, T. Rabuzin, M. Baudette, and M. Murad, iTesla Power Systems Library (iPSL): A Modelica library for phasor time-domain simulations, SoftwareX, Available online 18 May 2016, ISSN 2352-7110, DOI: 10.1016/j.softx.2016.05.001.