Self-Organizing Seismic Early Warning Information Network (SOSEWIN): Model-based Prototyping

Joachim Fischer, Frank Kühnlenz – {fischer, kuehnlenz}@informatik.hu-berlin.de

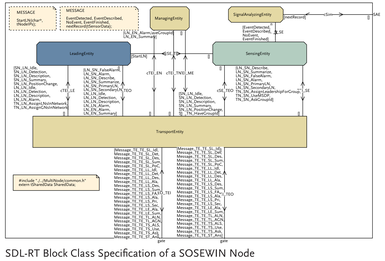
Summary

SOSEWIN is a new approach for Earthquake Early Warning Systems (EEWS) that uses wireless, ad-hoc mesh sensor networks. To develop the prototype of such an infrastructure we follow a model-driven system development paradigm, where models of
- the network in specific geographic regions are coupled with
- alarming algorithms,
- communication protocols and
- earthquake data bases

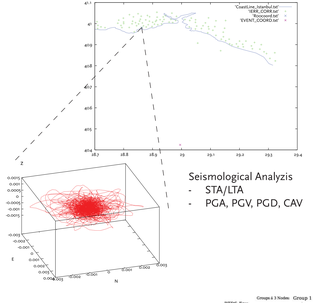
to form the basis for various simulation experiments. The general objective of these studies is to test the functionality of such an EEWS and to optimize it under
- the real-time,
- reliability and
- cost-depended

requirements of potential end-users.

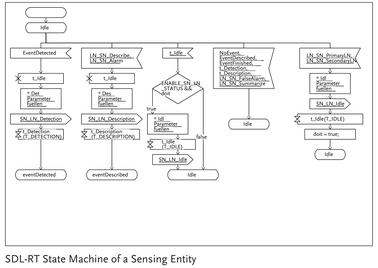
Formal Alarming Protocol Specification in UML/SDL/C++



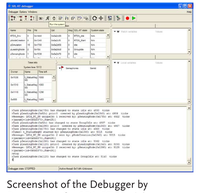
SDL-RT Block Class Specification of a SOSEWIN Node



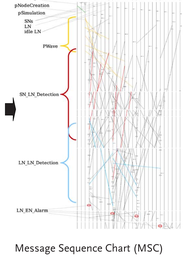
Seismological Analyzis
- STA/LTA
- PGA, PGV, PGD, CAV



SDL-RT State Machine of a Sensing Entity

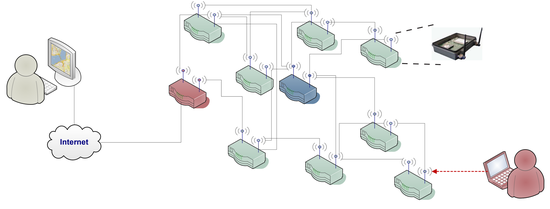


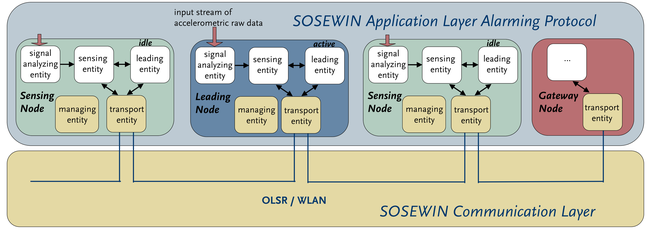
Screenshot of the Debugger by PragmaDev for SDL-RT models

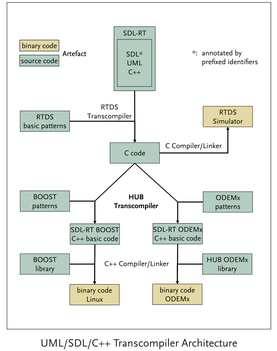


Message Sequence Chart (MSC)

SOSEWIN Architecture







UML/SDL/C++ Transcompiler Architecture

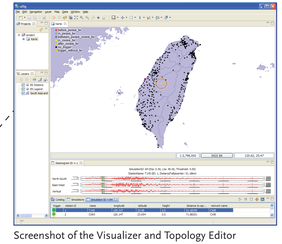
Example of C++-Code for Filtering Acceleration Signals

Model-based Prototyping Infrastructure for EEWS

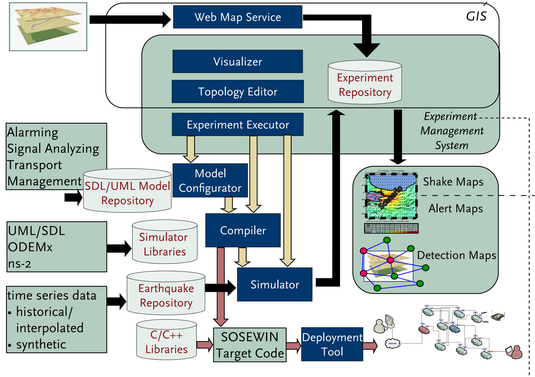
Our prototyping infrastructure was designed for four tasks:
1. model-based development of seismic signal-analyzing algorithms,
2. model-based development of protocol software offering cooperative alarming, and other domain-specific distributed services,
3. configuration, simulation, evaluation, and step-wise improvement of the EEWS models,
4. target code generation of specific software models.

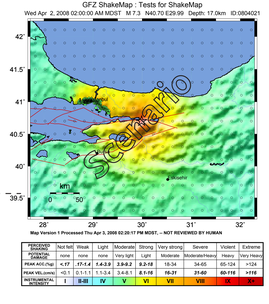
Using this infrastructure, different testbeds can be offered, namely for
- the detection and description of P- and S-waves by (1),
- for the functional correctness of different protocol concepts by (2),
- and for the simulation of complete EEWS models (3).

In addition, our infrastructure will be used for prototyping software components of the target EEWS by (4).

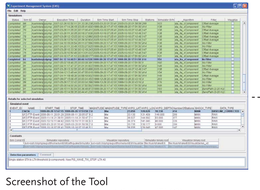


Screenshot of the Visualizer and Topology Editor





PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-.1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



Screenshot of the Tool *Experiment Management System* (EMS)

www.gk-metrik.de

Joachim Fischer (HUB, SAM)
Frank Kühnlenz (HUB, SAM, METRIK, SAFER)
Klaus Ahrens (HUB, SAM)
Ingmar Eveslage (HUB, SAM)
Dorian Weber (HUB, SAM)
Toralf Niebuhr (HUB, SAM)
Ronald Kluth (HUB, SAM)
Adrian Jäkel (HUB, SAM)
Dennis Reinert (HUB, SAM)

Claus Milkereit (GFZ)
Kevin Fleming (GFZ)
Matteo Picozzi (GFZ)
Ingo Veit (GFZ)

Jens-Peter Redlich (HUB, SAR)
Björn Lichtblau (HUB, SAR)
Sebastian Heglmeier (HUB, SAR, METRIK)
Jens Nachtigall (HUB, SAR, GFZ)

www.saferproject.net