Bluetooth modelling, validation and test suite generation

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Real-time aspects in protocol modelling, simulation and validation are very important today. Modern systems in the wireless world, like Bluetooth [1], have very hard time constraints, so demands on the specification languages, simulation and validation tools used in protocol technology are high. The main goal of my work was to specify a complete system to simulate and validate the Bluetooth baseband protocol layer and to generate TTCN test suite [2] automatically.

Bluetooth was modelled in SDL [3] for validation and testing purposes [4]. The protocol model is not simple: there are many states and variables used to specify the baseband protocol layer. Therefore the state space to be generated during validation is very large, so it is not easy (or even impossible) to fully validate this SDL model. That is why the Exhaustive state space exploration algorithm was not applicable on this model and so the Bit-state algorithm was used to validate the SDL system. As a result of validation it can be said that serious problem was not found. The validation procedure was helpful to complete the right SDL model because some design failures were detected and only some model specific problems were occurred.

The Telelogic Validator tool (Autolink) [5] were used for TTCN test suite generation combining with SDL Observer processes. The starting point of the generation was the SDL specification and the goal was to get a TTCN test suite in an automated way. The quality of the generated test suite was good but the test cases had to be completed manually since there were no guard timers generated to protect the tester against deadlocks during testing. However it is very positive that naming of constraints could be controlled with configuration of the generator tool and concurrent TTCN was also supported in the Validator.

The plan for the future is to continue this work by modelling more (up to 8) Bluetooth nodes communicating with each other. To describe this system an extra process has to be defined for modelling the radio channel. This solution makes it also possible to simulate the losing of data frames and the channel delay.

References

[1] Specification of the Bluetooth System (Core), Specification Volume 1, 2001

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[3] ITU-T Recommendation Z.100 - Specification and Description Language, 1996

[4] R. L. Probert, A. W. Williams: Fast Functional Test Generation Using an SDL Model, Testing of Communicating Systems, Budapest, Hungary, 1999

[5] M. Schmitt, A. Ek, B. Koch, J. Grabowski, D. Hogrefe: Autolink - Putting SDL-based test generation into practice, Testing of Communicating Systems, Tomsk, Russia, 1998