



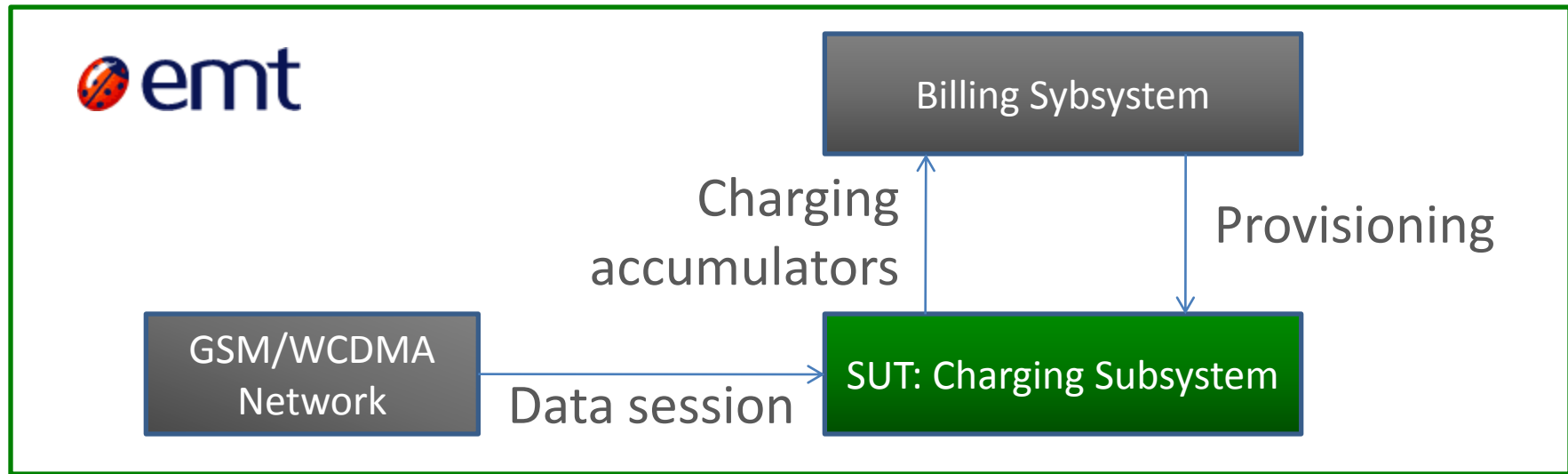
Model-based TTCN-3 testing of a mobile operator charging subsystem

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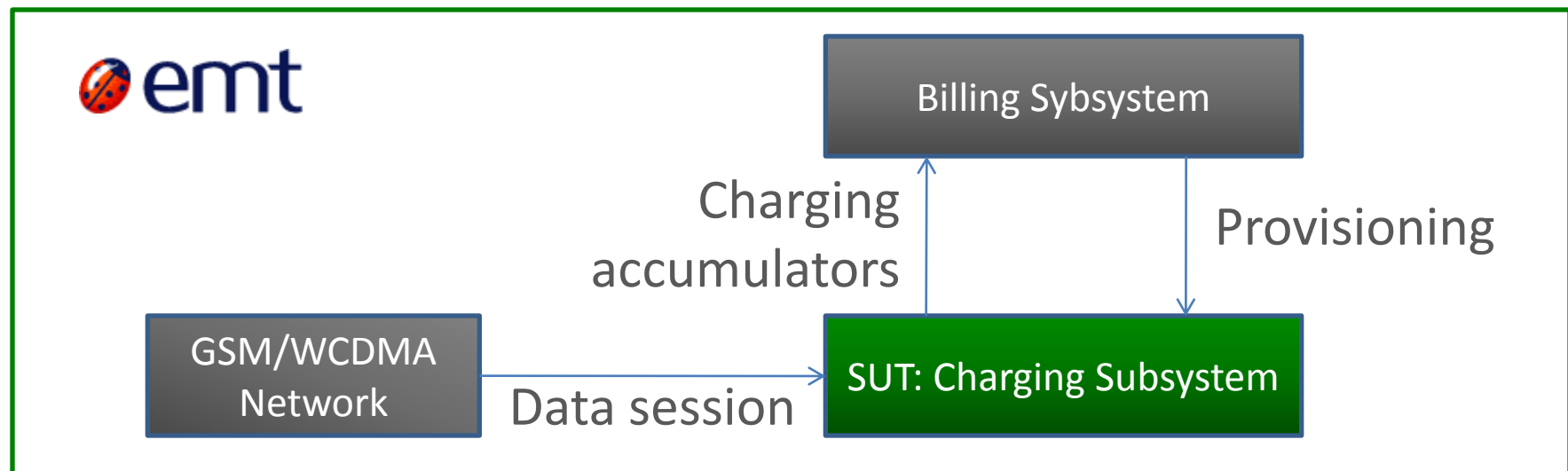
System Under Test

- ▶ Customer: Estonian mobile operator EMT (www.emt.ee)
- ▶ SUT: postpaid data charging subsystem in EMT
- ▶ CS: provided by Ericsson (www.ericsson.com)
- ▶ CS is customized using EMT business rules



CS core functionality

- ▶ Subscribers are provisioned by billing subsystem
- ▶ Provisioning the charging rules to the subscribers
- ▶ According to the data sessions the subscriber account is credited by CS



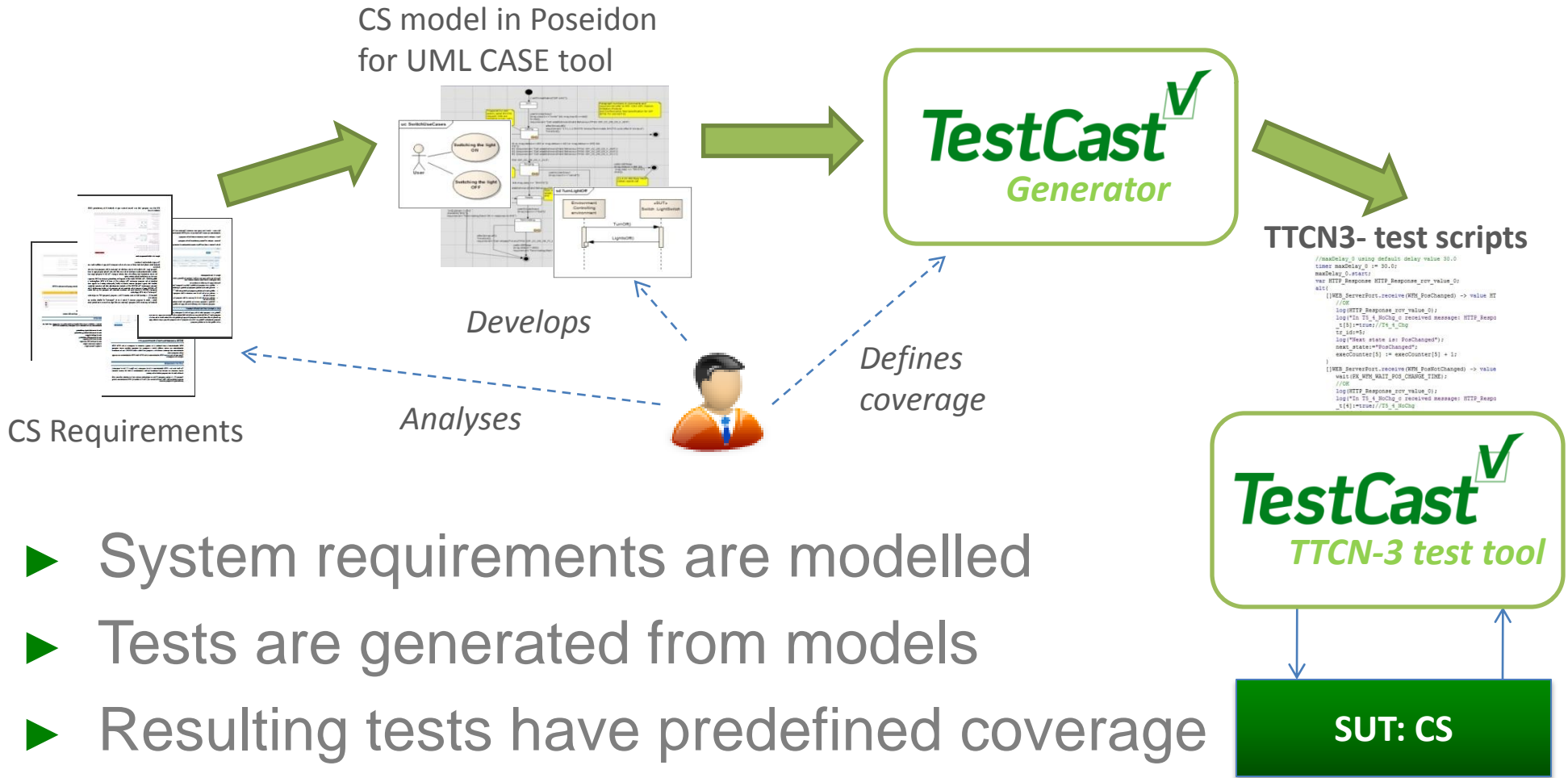
CS testing bottlenecks

- ▶ Ericsson upgrades CS software from time to time
- ▶ Customer introduces new subscription packages or changes existing ones from time to time
- ▶ Manual testing is time-consuming and error-prone
- ▶ Time for testing the updates is usually very short

Customer's hopes from MBT

- ▶ Shorten the regression testing time.
- ▶ Increase the test coverage
- ▶ Avoiding risks caused by the human factor in executing huge amount of boring tests manually
- ▶ Reducing the amount of manual tests significantly

MBT workflow used

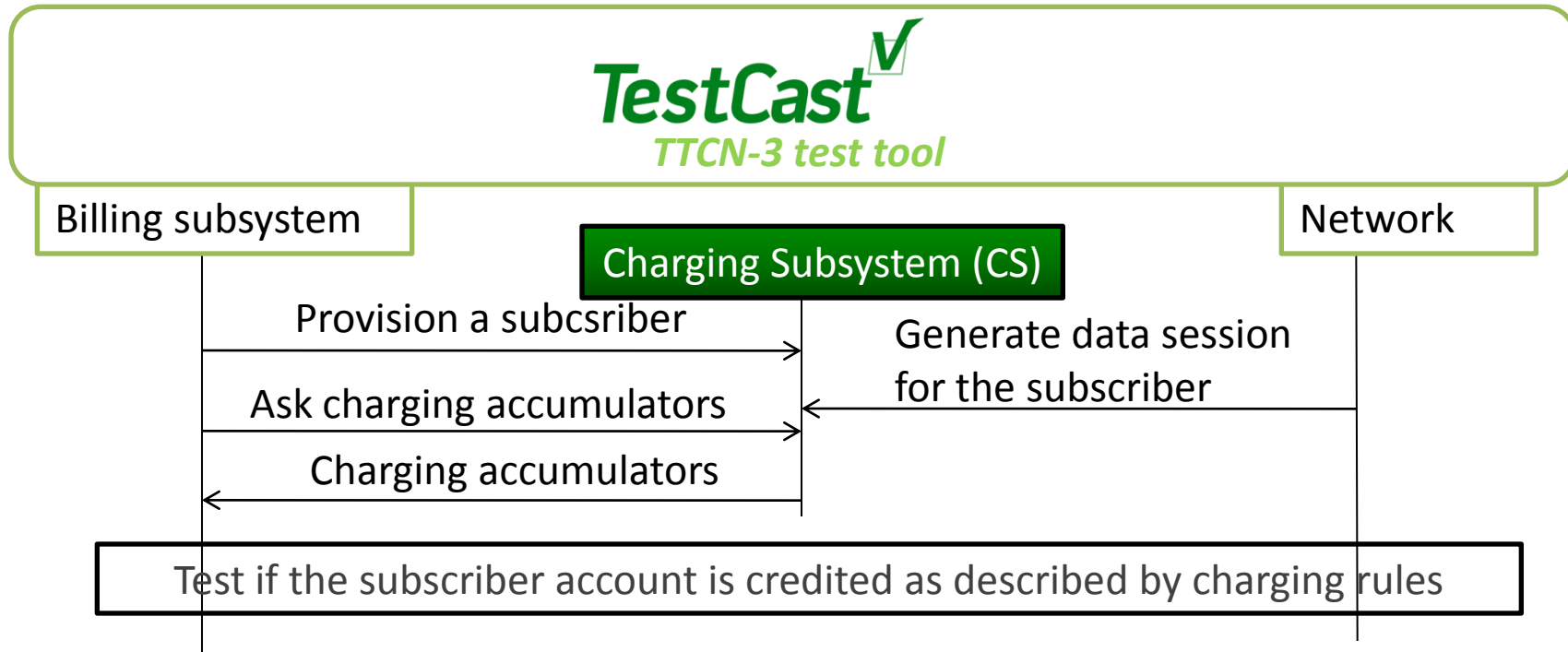
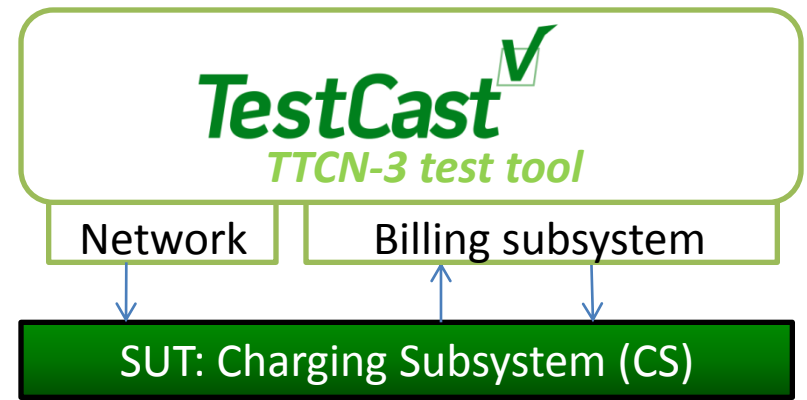


- ▶ System requirements are modelled
- ▶ Tests are generated from models
- ▶ Resulting tests have predefined coverage

CS features under test

- ▶ Subscribers provisioning
- ▶ Changing subscription profiles
- ▶ Changing month and day
- ▶ Bonus data amount usage
- ▶ Free data amount usage
- ▶ Priced data usage within HPLMN limit
- ▶ Priced data usage in the case of unlimited HPLMN
- ▶ Data usage if HPLMN limit is exceeded

Main test scenario



CS model

- ▶ State machine models the behavior of CS
- ▶ Only few model states (forBonus, forFree, noCharge, Priced, LimitExceeded)
- ▶ 16 context variables
 - ▶ Properties of subscriber profiles
 - ▶ CS accumulators for different purposes
- ▶ 106 transitions
 - ▶ Express CS and environment transactions
 - ▶ Used for modelling the charging rules

Tests generation and execution

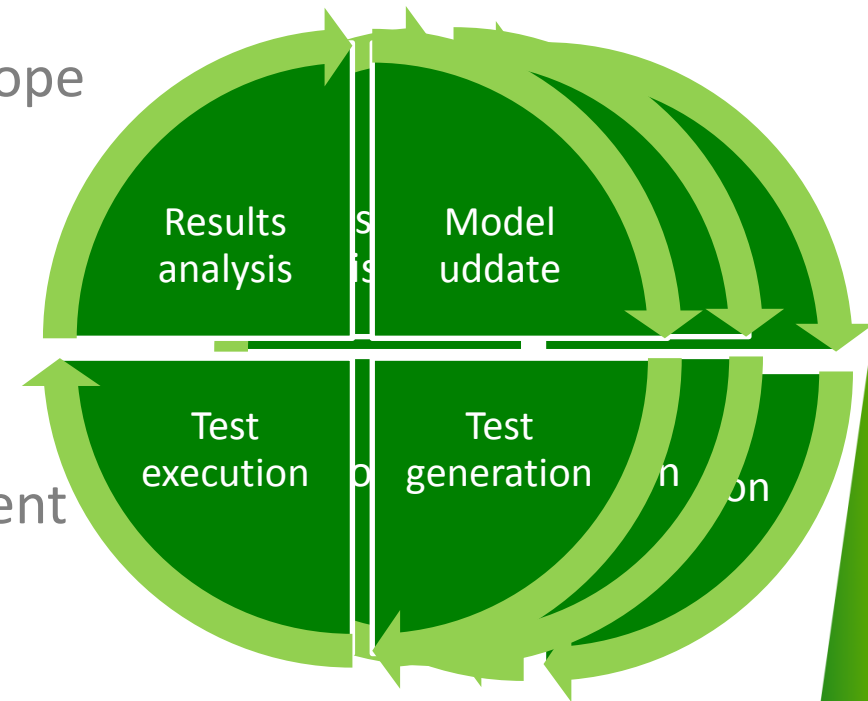
Coverage	Generation time	Test length (transitions)	Amount of TTCN-3 (LOC)	Execution time
All transitions	2 min	213	9 213	5 min
All transition pairs	57 min	1 672	22 765	24 min
All transition triples	18 h 49 min	12 807	89 191	5 h

Detected errors

- ▶ Note: CS was quite well manually tested before the MBT started
- ▶ In total 15 new errors were detected
- ▶ Detected charging errors could spoil the reputation of the operator

Project process, time spent

- ▶ Beginning (94 h, 31%)
 - ▶ Introduction to problem domain
 - ▶ Setting up test environment
 - ▶ Executing 1st generated test case
- ▶ Incremental development to cover the scope (142 h, 47%)
 - ▶ Model updates
 - ▶ Test generation
 - ▶ Test execution
 - ▶ Analysing results
- ▶ Refactoring and test generation for different subscription profiles (32 h, 11%)
- ▶ Creating of documentation (32 h, 11%)



Manual testers feedback

- ▶ Adoption of MBT seems too complex
- ▶ It's hard to understand which requirements are tested by generated tests. They don't trust the generated tests.
- ▶ It seems that results analysis will take more time than performing all tests manually

What we learned from manual testers feedback?

- ▶ Manual testers don't have needed skills for MBT
 - ▶ Formalizing the requirements
 - ▶ Abstract thinking
- ▶ Manual testers may be afraid of losing job?
- ▶ Model structural coverage criteria are hard to understand and map to requirements coverage

Test automation specialists feedback

- ▶ Higher test coverage than manually scripted
- ▶ The tests building productivity increases significantly
- ▶ Long generated test cases detected otherwise hard to find errors
- ▶ Significant tests maintenance costs decrease is foreseen
- ▶ Requirements traceability and results analysis is the key issue that should be improved in MBT

Conclusions

- ▶ Manual to MBT → reduces test quality decrease caused by human factor
- ▶ All transition test coverage tests allow quickly (5min) verify in regression test the past functionality
- ▶ MBT revealed significant amount of errors that were not disclosed in manual tests
- ▶ At the end of project the testing staff was convinced that CS is ready for taking into real use
- ▶ MBT is the technology that EMT will start to use

Thank you!

More information:

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