

Combining TTCN-3 and Petri Nets for Validation and Test

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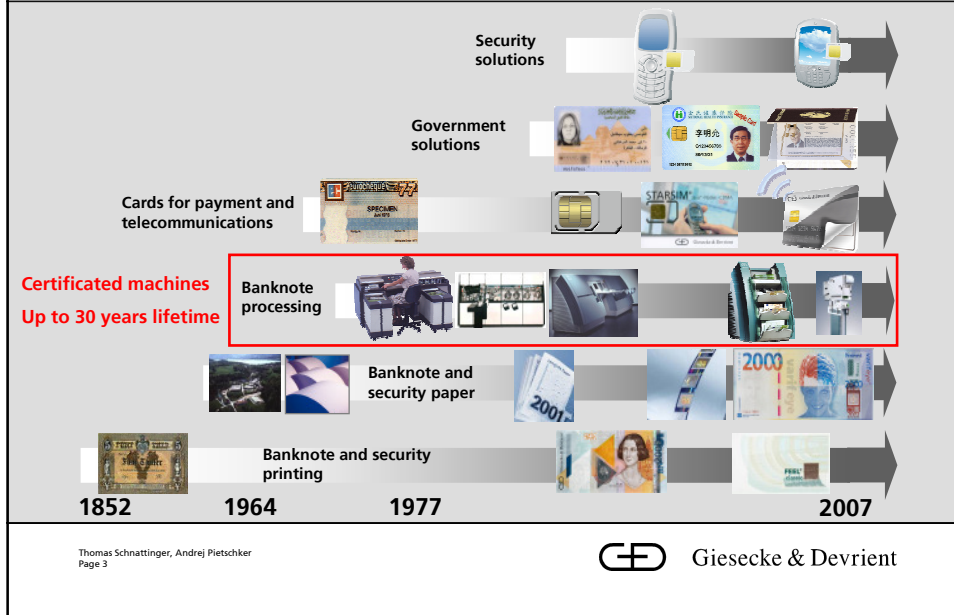
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Creating Confidence.

Agenda

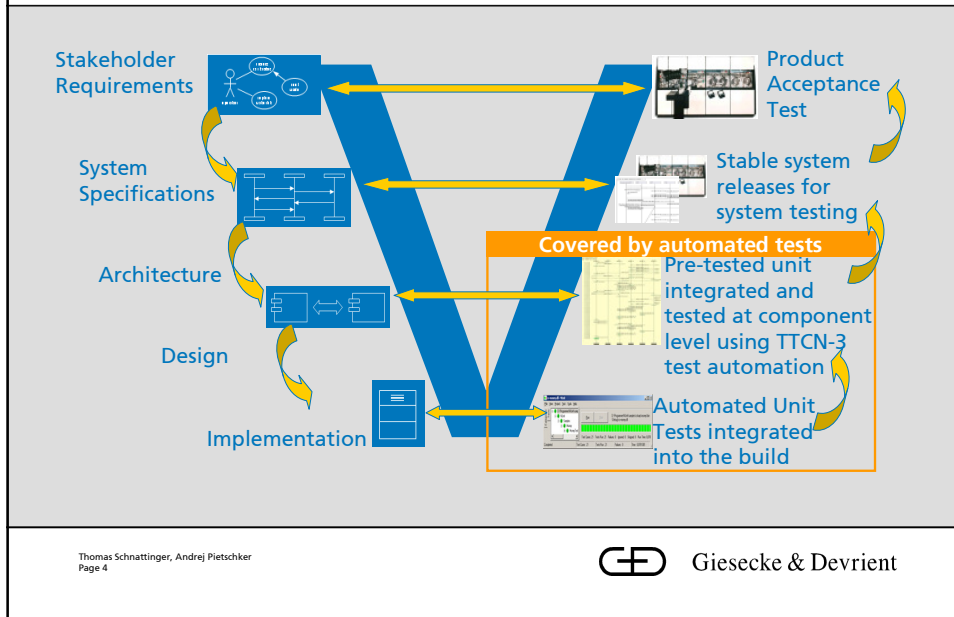
- Automated testing in the software development process
- Motivation for system specifications with formal methods
- Excursion: Basics of Coloured Petri Nets (CPNs)
- A Coloured Petri Net model for BN processing and jam recovery
- A Coloured Petri Net model as System Under Test (SUT)
- Conclusions



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Automated SW-Testing – Where do we Stand?



Automated SW-Testing – Potential Extensions

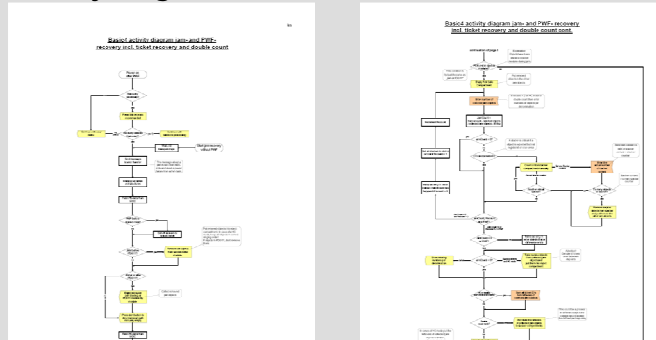
Test-cases should be applied as early as possible

Test-cases should be available and verified as early as possible

We need an *executable model* as a System Under Test (SUT) to apply and verify the test cases *already in the first phases* of the development process

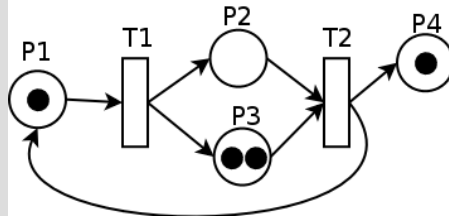
System Specifications – Our Current Approach

How do we currently tackle these issues in the specifications?
“Activity diagrams”:



We need formal, *executable* high-level descriptions for the specifications, e. g. Petri Nets

Excursion: Coloured Petri Nets (CPNs)




Coloured Petri Net =
Petri Net +
elaborated type system +
arbitrary data manipulation

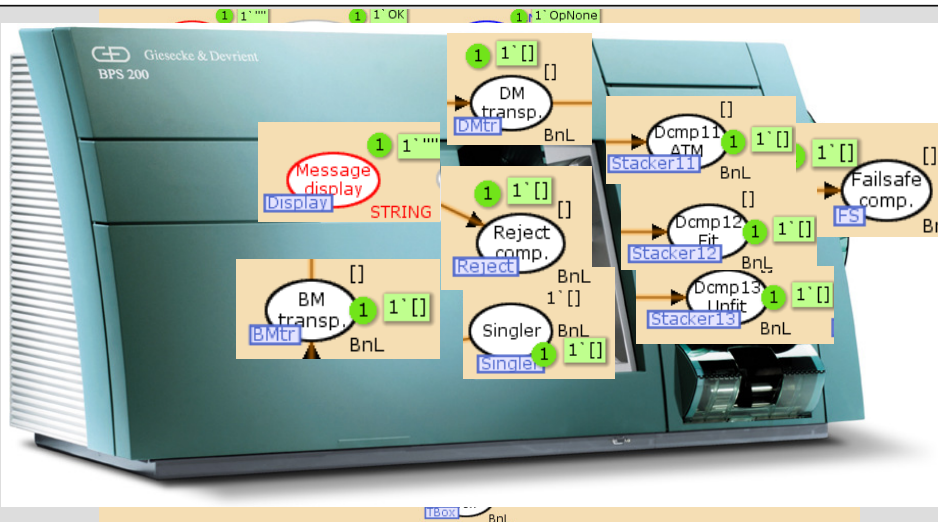
Some benefits of Coloured Petri Nets

- graphical oriented language with a well-defined semantics for design, specification, simulation and verification of systems
- hierarchical descriptions (subnets)
- description of states and actions (data manipulation)
- formal analysis methods
- tool support → [CPN Tools](#)

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Page 7

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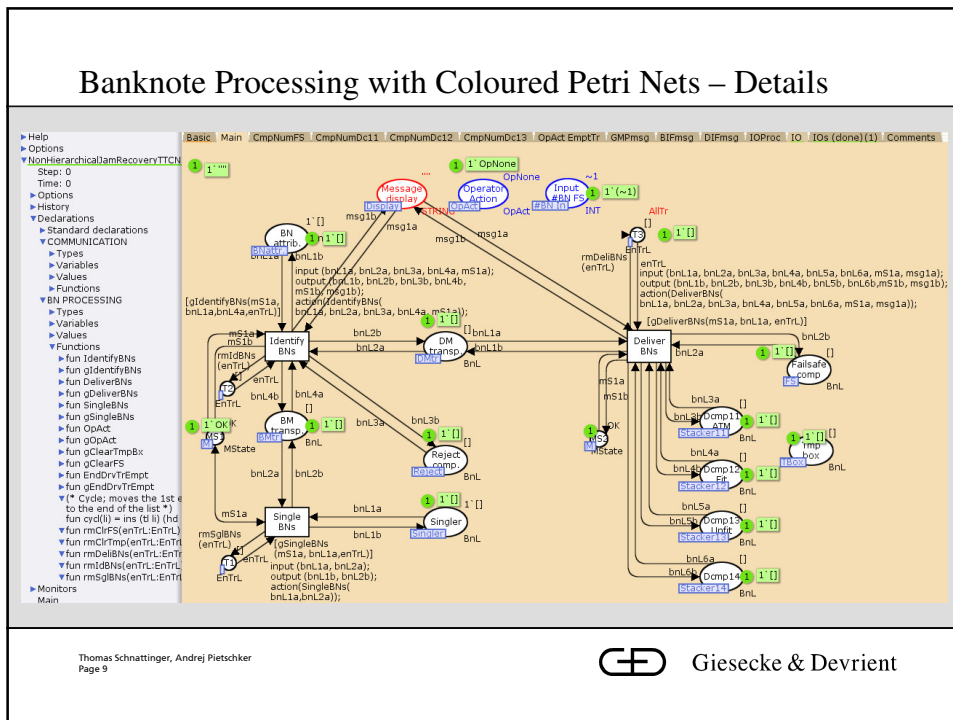
Banknote Processing with Coloured Petri Nets



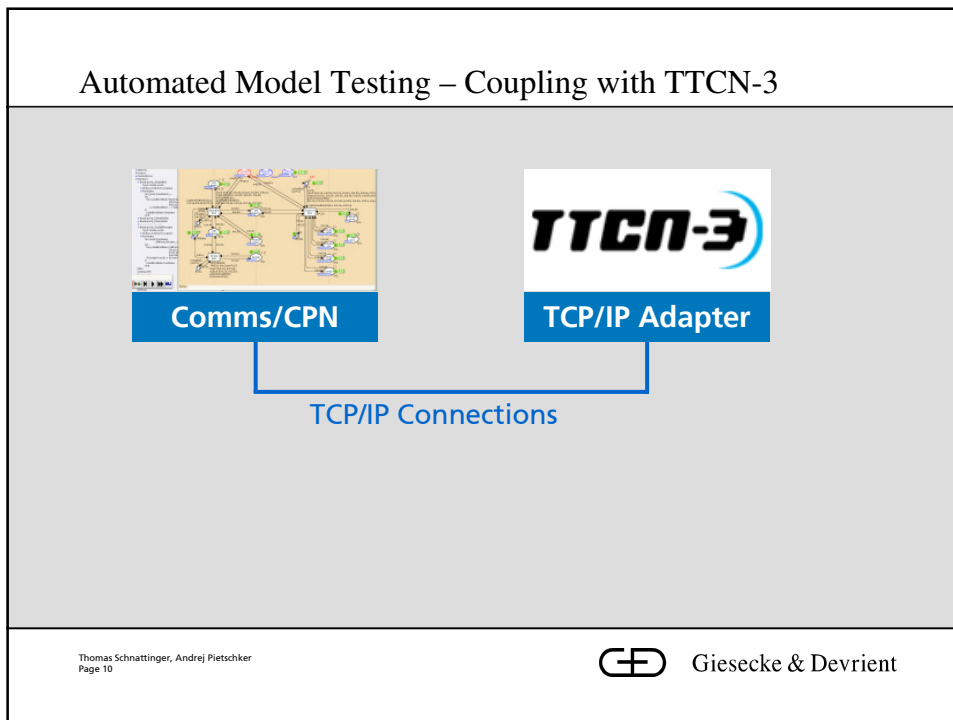
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Banknote Processing with Coloured Petri Nets – Details



Automated Model Testing – Coupling with TTCN-3



Coupling of CPN with TTCN-3 – Demonstration

The screenshot displays the TTCN-3 development environment. On the left, a tree view shows the project structure, including 'CPN_Library' and 'TestCases'. The main window shows the execution of a test case, with a table of parameters and a log of test steps.

Parameter	Value	Default
ARC_P3ES	7	7
PROVINCE_RESERVE_CAN_P3ES	false	false
CAN_TIMEOUT_P3ES	10.000s	10.000s
STOP_AFTER_UNEXPECTED_MESSAGE	true	true
TESTCASE_TIMER_VALUE	0.0	0.0
reserve_jail	false	false
download_jif	false	false
download_of	false	false
download_of	5.0	5.0
KEEP_ALARM_TIME	0.2	0.0
CPN_SimTime	1	5
res_jif_P3ES	4	4

The log shows a sequence of test steps, including 'send_GIP_P3ES_MID_P3ES_G3_TIP' and 'receive' actions, with timestamps ranging from 13:40:02.147 to 13:40:02.199.

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Automated System Release Testing – Coupling with TTCN-3



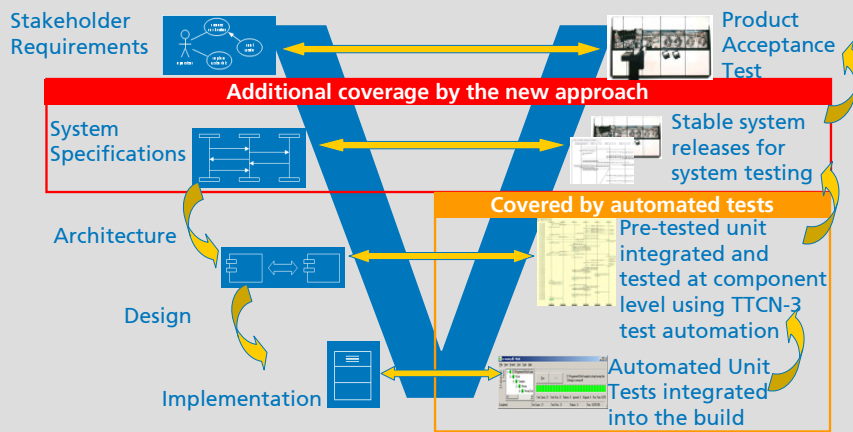
CAN bus

The new approach allows for testing specifications and system releases with the same test-cases


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Automated SW-Testing – The New Picture



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Outlook

Model extensions

- Inclusion of timing/performance aspects in the CPN model
- Refinement to the level of single CAN messages

Tool extensions

- CPN model support for SW-architecture decisions
- Test case generation from the model
- Code generation from the CPN model

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Page 14

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Conclusions

CPN require more effort during specifications, but

- CPN Tools facilitates *explicit, unambiguous* and *complete* descriptions and thus *better specifications*
- The *visual representation* allows an abstract view, focused on the core elements
- The specifications can be used in automatic and interactive simulations
- Coupling with TTCN-3 allows to use the specifications as a *System Under Test (SUT)* in automated testing
- Test cases can be validated as soon as the specifications are available