Software shift-left by utilizing Model-based design and MathWorks code generation tools

MATLAB EXPO, Helsinki
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Architecture and Specification
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Facts and figures

€130bn
Invested in R&D since 2000

€22.2bn
Net sales in 2021

4,000
Patent families declared as essential to 5G

~130
Countries of operation

155+
Years in business

Nobel prizes

~9
Application area: DFE
Digital Front End

- Algoritmically complex
- Very large design
- High number of configuration parameters
- Needs to support many use cases
What is shift-left?
It is everything

https://devopedia.org/shift-left
SoC design process

Agile waterfall

- Window of opportunity
- Modelling hardware + software
- Hardware
- SW modelling
- Software
- Pre-silicon verification
- Milestone N
- RTL Freeze
- Milestone N+1
- [fixed time]
- Tape-out
- Engineering sample
Modeling Phases
Model-based Design in Nokia 5G

System Analysis and exploration

- Use cases / Scenarios -> Collection -> Creation

High Abstraction
- Functional models

Medium Abstraction
- SW/functional model + API models
- HW functional model

Low Abstraction
- SW reference model + API functions
- HW abstraction + other layers

Development Phase

- HW reference model
- Complete API functions
- HW abstraction + other layers
- HW implementation
- SoC implementation (ASIC / FPGA / etc)

Supplemented by Rapid Prototyping / Existing HW -> FPGA / HW Prototyping / Existing HW

Code generation!

Time

Amount of effort

Productization
Tools of the trade
MathWorks code generation tools

- MATLAB Coder
- Simulink Coder
- Embedded Coder
- Stateflow
Code customization

- Interface customization
- Code generation template customization
- External code integration
- Code replacement
Code testing and debugging

- Code readiness analysis
- MEX file testing
- Software-in-the-Loop Execution
- Processor-in-the-Loop Execution
- Run MATLAB unit tests on the generated code
- Add run-time checking for generated code
- Generate Code Generation Report with Traceability
Key takeaways

- New workflow, new mindset
- Well timed resourcing and training
- Technical support
- Minimize external dependencies to the model
- Minimize defect fix turnaround time
- Coordinate
- Re-use and Improve
The outcome – A success story

1. Considerable software shift-left
   • In time for the "window of opportunity"
   • Approx. 6-12 months direct impact

2. Improved collaboration

3. Improved communication

4. Increased re-use

5. Increased quality

6. Executable specification