Model Based Design in Nokia 5G

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Sami Repo / Nokia Mobile Networks, Architecture and Technology Foundation
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5G and Model Based Design are reality

Unleashing the potential of 5G – in Korea - @YouTube
Nokia goal to create the technology to connect the world
5G challenges

100 Mbps whenever needed

>10 Gbps peak data rates

10,000x more traffic

<1 ms radio latency

10-100x more devices

Ultra low cost

10 years on battery

M2M

Unlimited experience

Critical machine communication

Extremely Mobile Broadband

Massive machine communication

For everything

“Instant action”

90 GHz

3 mm

30 GHz

1 cm

10 GHz

10 cm

3 GHz

10 cm

300 MHz

1 m

Does everything!

Works everywhere!

Ready in no time!

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The new spectrum

- **5G radio** is the most **flexible** way to benefit from all available spectrum options, including licensed, shared access and unlicensed, FDD and TDD bands, narrowband and wideband allocations.
## 5G challenges

### Massive MIMO and Beamforming

### Value and applications

### 5G Deployment scenarios

#### The realities of massive MIMO

| Practical at high bands >1.7...3 GHz | Antenna size becomes smaller as operating frequency increases |
| Works better in TDD than in FDD | TDD can use reciprocal channel with Release 9 (TM8) devices since uplink and downlink use the same frequency. In FDD, mMIMO UL capacity gain is the same as in TDD. FDD provides excellent coverage as there is no time based multiplexing. With slow adaptation and Rel10 (TM9) / Rel13/14 (TM10) UEs DL can work well as well |
| Works better in 5G than in LTE | Beamforming is integral part of 5G from Day 1 |
| Capacity & coverage solution | Beamforming is a capacity solution in LTE however can also improve coverage |
| Active antenna | Beamforming requires use of active antennas. Integration of radio helps increase efficiency and realize compact site solutions |
Model Based Design?
How to start to answer to 5G challenges?

➢ Many simulation & modeling environments!

➢ We want to:
  • Analyze & explore a system/design per use cases
  • Understand and dimension performance and capacity
  • Have common language for communication and automation
  • Reduce risk, Increase quality and visibility to the making
  • Model elaboration as well as Continuous test and verification
  • Enable Knowledge capture & management
One key area – Radio and Digital Front End
Modeling Phases

Take away: Flexibility, Visibility and Capability to react through entire Design Flow

System Analysis and exploration

- Use cases / Scenarios
  - Collection
  - Creation

- High Abstraction
  - Functional models
  - SW functional model + API models
  - HW functional model

- Medium Abstraction
  - SW functional model + API models
  - HW Abstraction + other layers
  - HW reference model

- Low Abstraction
  - SW reference model + API functions
  - HW Abstraction + other layers
  - HW reference model
  - SoC implementation (ASIC / FPGA / etc)

Development Phase

- Functional SW
- 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

Grid / Cloud use + Automation
Version control + Releasing / Project
Productization

User training + Community / Documentation

Time

Amount

Intro
Challenge
MBD
Example
Summary

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ReefShark – Concentrated power for RF and baseband processing

Pushing the limits with in-house silicon innovation.

Compute optimized for all layers of the network edge
- RFIC and transceiver: massive MIMO Adaptive Antenna solution
- Digital Front End for LTE and 5G radio systems supporting massive MIMO
- Baseband Processor supporting 5G numerologies and processing needs

AI capabilities embedded within radio and baseband processing.
Thoughts of Model Based Design

VISION where and how to enable MBD is a key element

- **Challenges** seen in pushing vision forward
  - Buy-in: Old habits sit tight.
  - Ramp-up: Train people and explain the flow -> And repeat.
  - Templates: How to work, and preferably map to work flow -> And repeat.
  - Common methods: E.g. instruments on measuring for example radio performance criteria -> And repeat.
  - Common information sharing: Wiki-type useful, and e.g. internal libraries -> And repeat.
  - Constant keep-up and update of the vision: Need to blow to the embers -> You know it, repeat...

Mastering Model Based Design has brought **benefits** in our **5G development**

1. Visibility and Understanding of options
2. getting Faster to execution.
3. Quality improvements and better control of implications