



Model Based Design in Nokia 5G

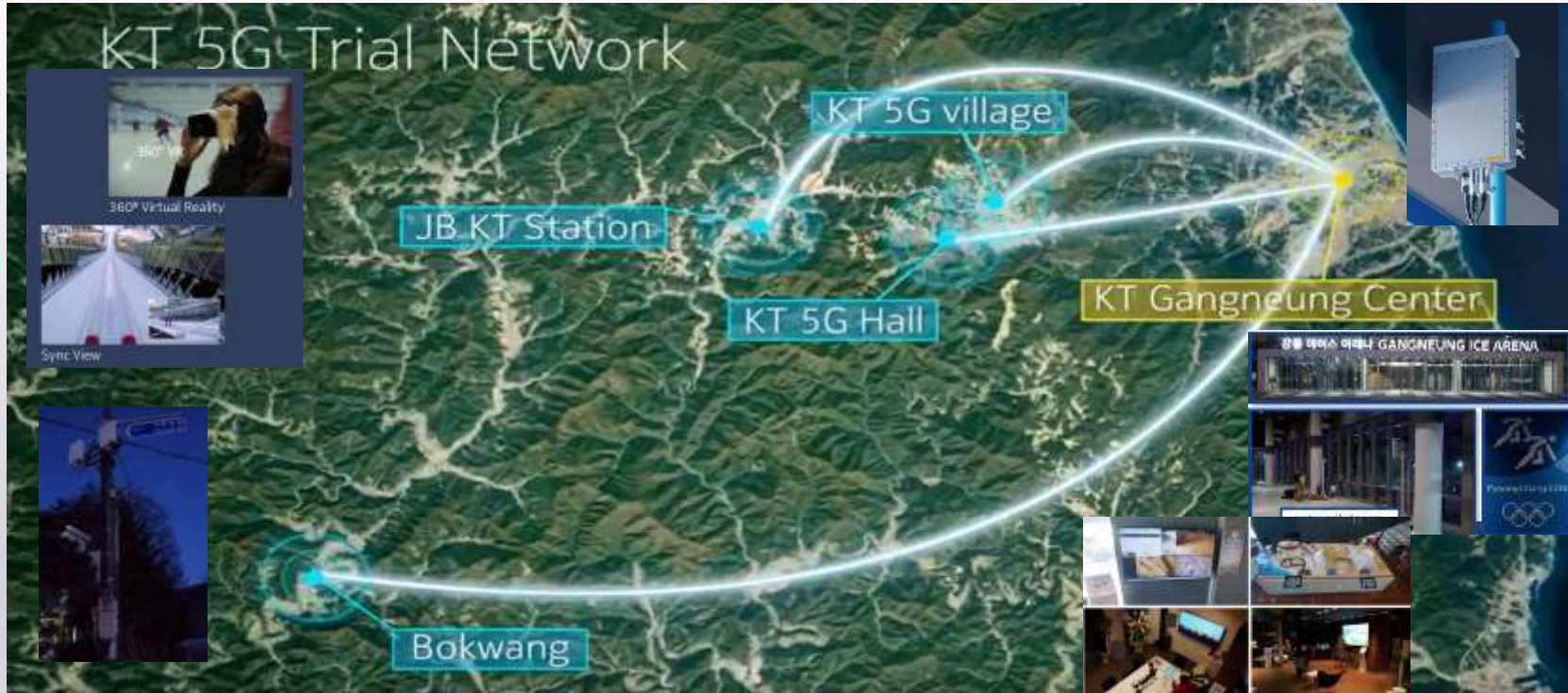
MATLAB EXPO, Helsinki

Sami Repo / Nokia Mobile Networks, Architecture and Technology Foundation

15-05-2018



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

Mobile
Networks

Fixed
Networks

IP / Optical
Networks

Nokia
Software

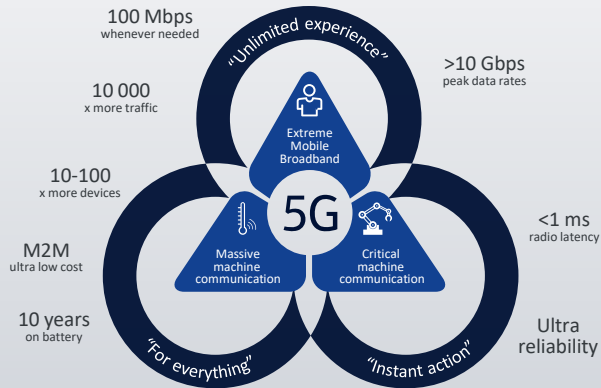
Global
Services

Nokia
Technologies

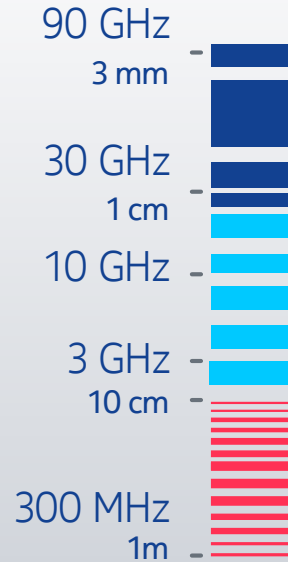
Nokia
Bell Labs



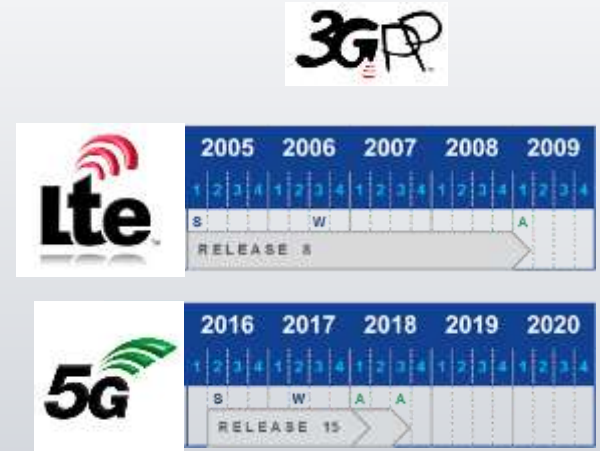
5G challenges



Does everything!



Works everywhere!

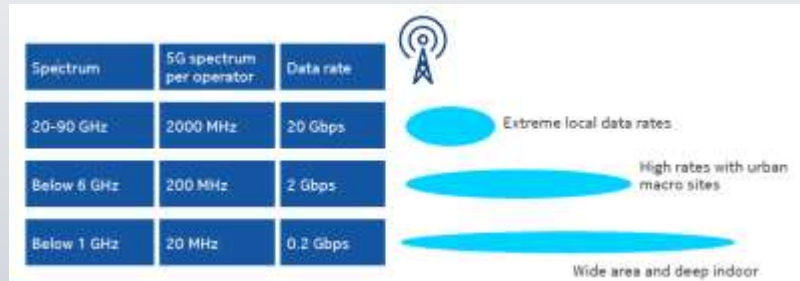


Ready in no time!

5G challenges

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.



Subcarrier spacing [kHz]	15	30	60	120
Spectrum	<6 GHz	<6 GHz	<6, >20	>20 GHz
Max bandwidth [MHz]	50	100	200	400
Symbol duration [us]	66.7	33.3	16.7	8.33
Nominal cyclic prefix [us]	4.7	2.3	1.2	0.59
Scheduling interval [ms]	0.5	0.25	0.125	0.125

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

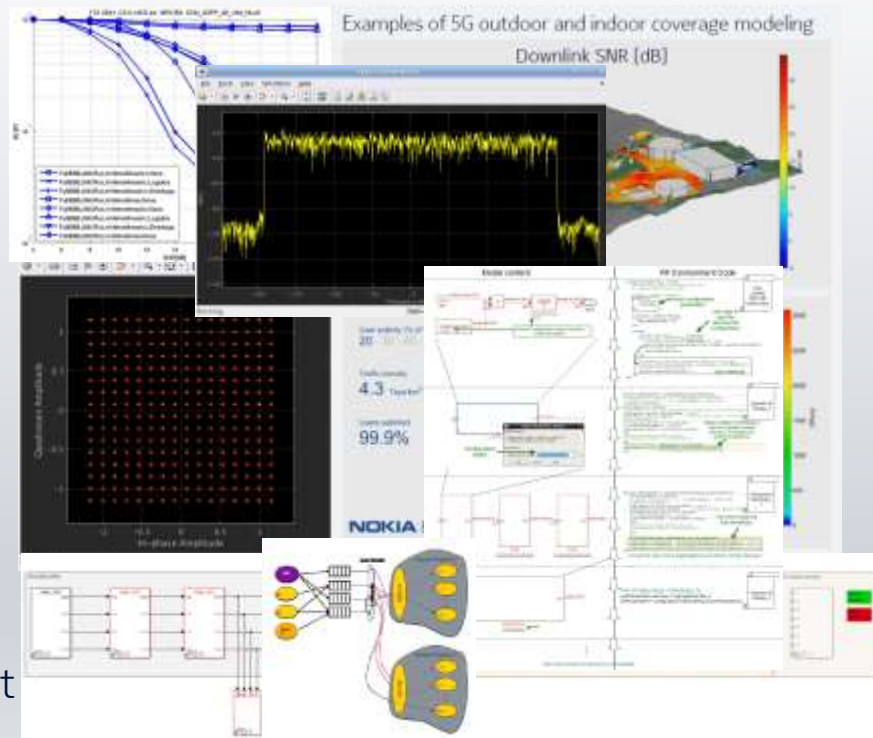
Beamforming requires use of active antennas. Integration of radio helps increase efficiency and realize compact site solutions

Model Based Design?

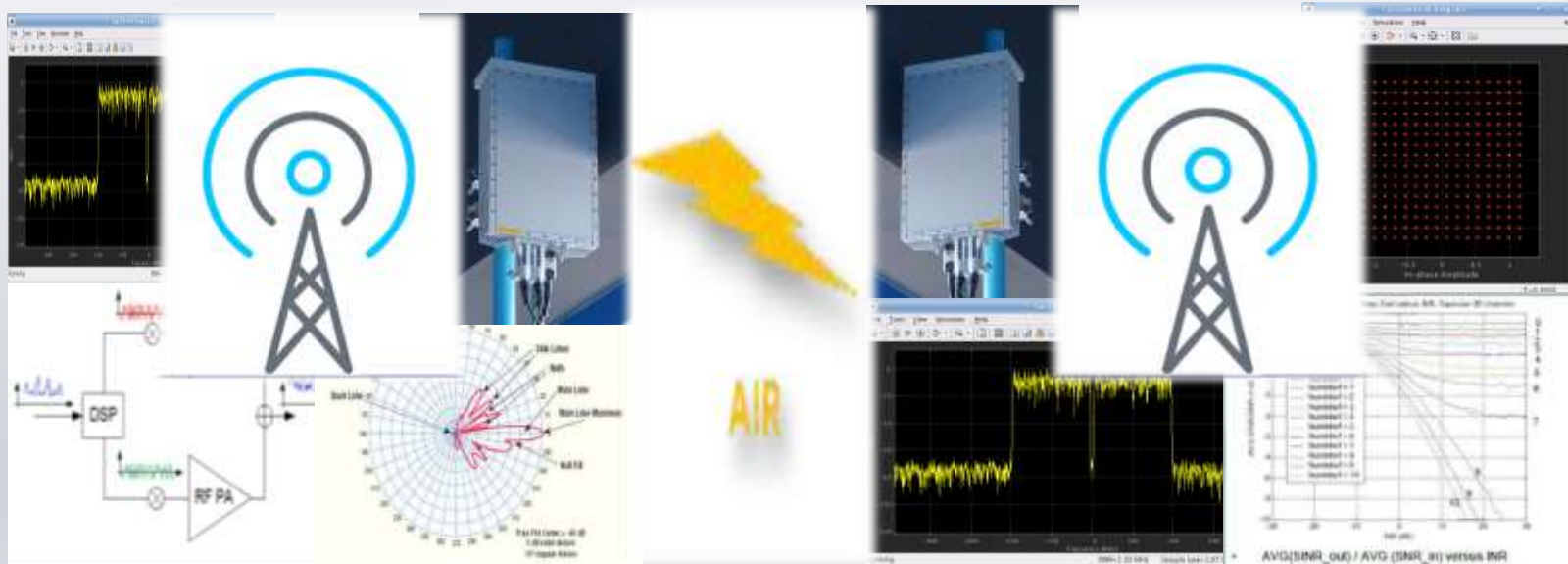


How to start to answer to 5G challenges?

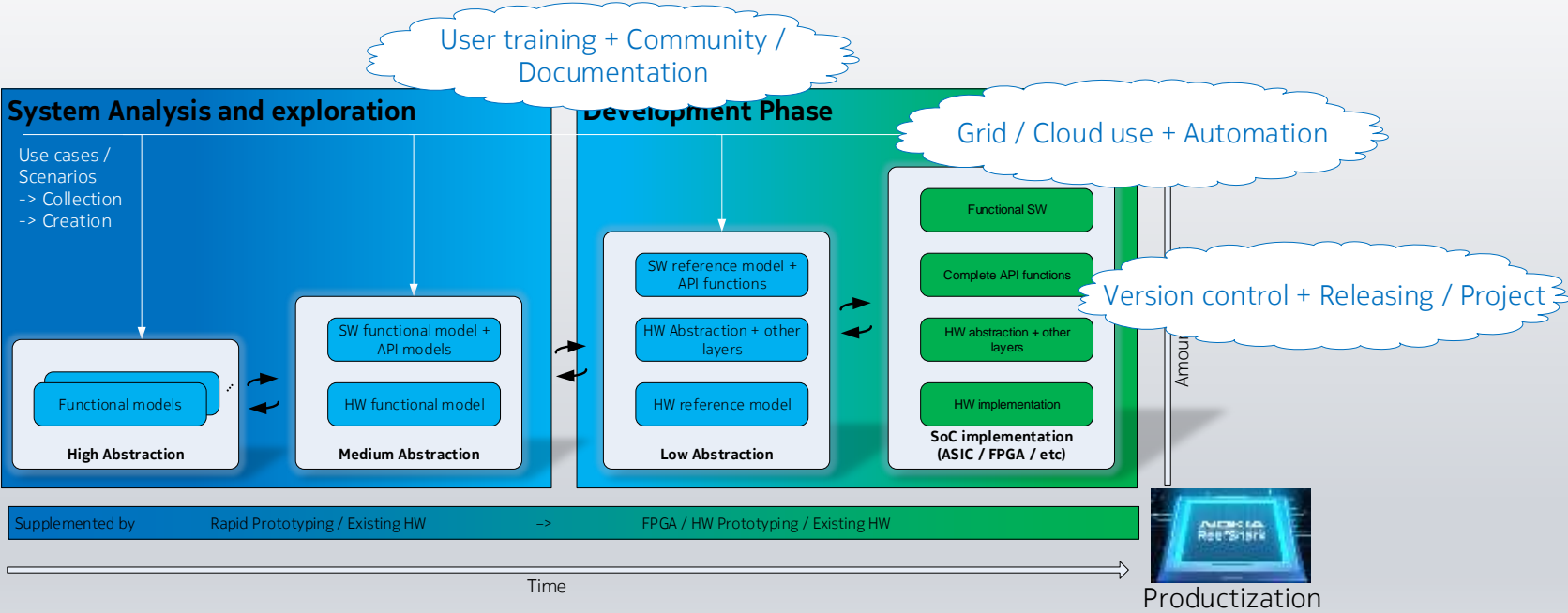
- Many simulation & modeling environments!
- We want to:
 - **Analyze & explore** a system/design per use cases
 - **Understand** and dimension performance and capacity
 - Have **common language** for communication and automation
 - **Reduce risk, Increase quality** and **visibility** to the making
 - **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

ReefShark – Concentrated power for RF and baseband processing

Pushing the limits with in-house silicon innovation.

AI capabilities embedded within radio and baseband processing

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



[Nokia Reefshark -video](#)

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



Public

NOKIA