Looking Ahead to 5G

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INTRODUCTION

The continuing growth in demand from subscribers for better mobile broadband experiences is encouraging the industry to look ahead at how future 5G networks can be readied to meet extreme capacity and performance demands. Nokia, along with other industry partners, believes that communications beyond 2020 will involve a combination of existing and evolving systems, like LTE-Advanced and WiFi, coupled with new, revolutionary technologies designed to meet new requirements, such as virtually zero latency to support tactile Internet, machine control or augmented reality. 5G will be the set of technical components and systems needed to handle these requirements and overcome the limits of current systems.

This plenary session presentation provides an overview of the 5G vision and discusses the requirements, challenges and opportunities that exist for new technological solutions.

THREE DEVELOPMENT PILLARS OF 5G

Unlike 2G, 3G and 4G, it is unlikely that 5G will be a single new Radio Access Technology (RAT) nor will it replace macro cells. It will be a combination of existing RATs in both licensed and unlicensed bands, plus one or more novel RATs optimized for specific deployments, scenarios and use cases. In particular, Nokia has identified the need for a new RAT for ultra-dense deployments, with the aim of providing a virtual zero latency gigabit experience.

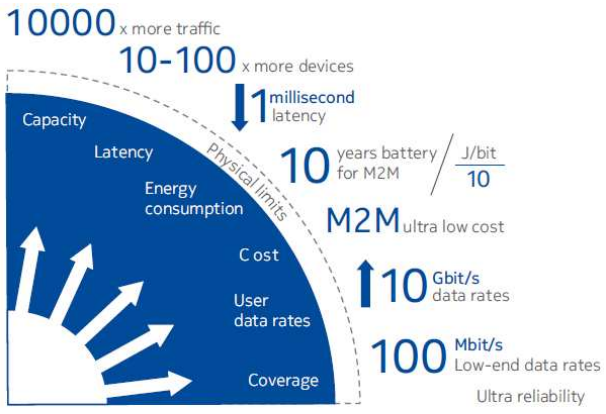

Figure 1. Existing technologies will not provide the capabilities to meet market demands beyond 2020.

Nokia is already undertaking extensive research to map out the scope of 5G and has a clear vision of the three key pillars that will make this future network a reality.

More spectrum must be pressed into service

More radio spectrum for mobile networks is vital to meet the increased capacity and coverage demand. New spectrum will need to be allocated and put into use quickly

Networks will become much denser with many more cells

The second pillar of 5G will be to use many more base stations, deployed in a heterogeneous network (HetNet), combining macro sites with smaller base stations and using a range of radio technologies.

Raising the overall performance of networks

The third major goal will be to get the best possible network performance by evolving existing radio access technologies and building new 5G wireless access technologies.

RADIO CHALLENGES & OPPORTUNITIES

Unlocking Spectrum Assets

All available spectrum, from ~400MHz to ~100GHz, will need to be leveraged to provide the capacity desired to meet 5G requirements. Likewise, the system bandwidth will vary from aggregated 20MHz LTE channels to new air interfaces supporting up to 2GHz BW. Radios for these new high frequency bands will benefit from the performance of various advanced semiconductors, such as SiGe and GaN, with significant gain in these bands.

System gain at very high frequency bands will need to be supported by use of larger scale antenna arrays. Highly integrated phased arrays offer compact solutions for this problem. SiGe arrays in mmWave bands and hybrid solutions using different device types in lower bands coupled with advanced packaging solutions offer industry opportunities.

Cell Densification

Densely populated base station networks bring the base station closer to the user to achieve a better user experience; i.e. use of small cells. A major small cell challenge is access to useable sites. Designing radios to be small, unobtrusive and low power improves their successful deployment and are supported by use of highly integrated and energy efficient radio elements as well as by advanced packaging and thermal management techniques.