

3GPP RAN workshop on 5G, September 2015, Phoenix, AZ, USA.



5G Views and Standardization

RWS-150084

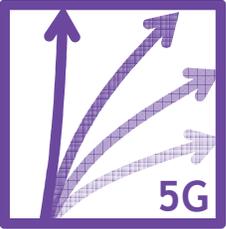
Alcatel-Lucent, Alcatel-Lucent Shanghai Bell

Outline

- What's driving 5G
- 5G Technologies
- Summary

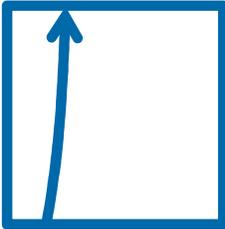
What's driving 5G: For a Unified Ecosystem

5G = unified ecosystem ...



Serving both traditional and potential new applications like drones, real time video surveillance, mobile augmented and virtual reality, IoT...

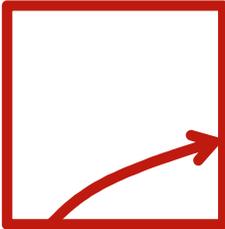
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Ultra-broadband
Offering higher bitrates and supporting extreme traffic densities for the evolution of comms and entertainment



Ultra low latency
Mission critical specialized services and immersive virtual reality



Ultra-narrowband
Efficient sensing and control added to LTE broadband; massive densities of low traffic devices and bearers

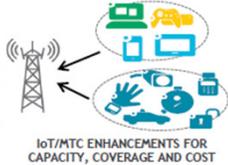
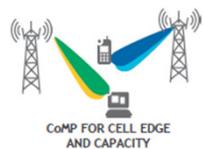


Consistent user experience
Better bits rather than simply more cheap bits to offer a more wireline like experience

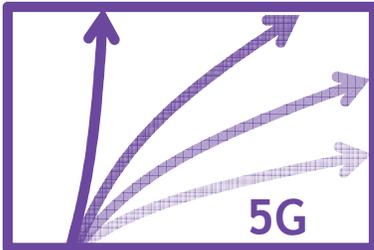
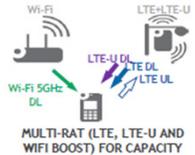
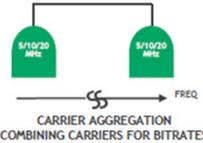
Towards 5G

- LTE Evolution through enhancements to Core Technologies
- Multi-carrier LTE remains in place to carry bulk of wide area broadband traffic
- Dual Connectivity for aggregating LTE with new carriers
- WLAN continues to play a key role to carry local broadband traffic

IMPROVING PERFORMANCE CONSISTENCY AND COVERAGE



INCREASING CAPACITY AND USER BITRATES

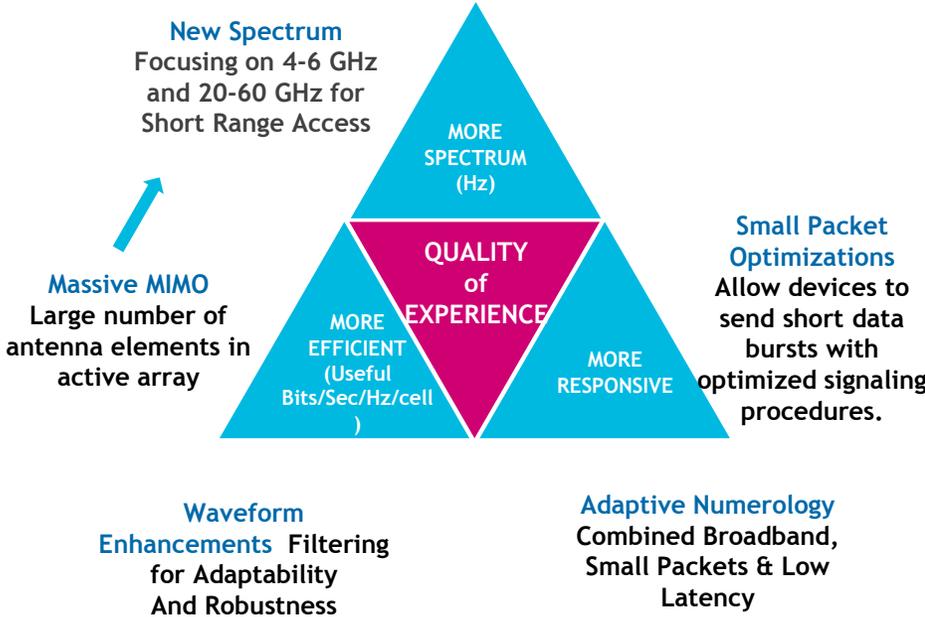


Ultra-broadband continues to grow, concurrently with the rise of new low-latency services, ultra-narrowband M2M traffic and device numbers
 This causes diverging requirements, both technical and economic

5G Technologies

A New RAT for 5G, providing:

- Adaptability
- Efficient support for massive numbers of small packets
- High frequency operation >6 GHz
- User-centric Radio Access for Forward Compatibility



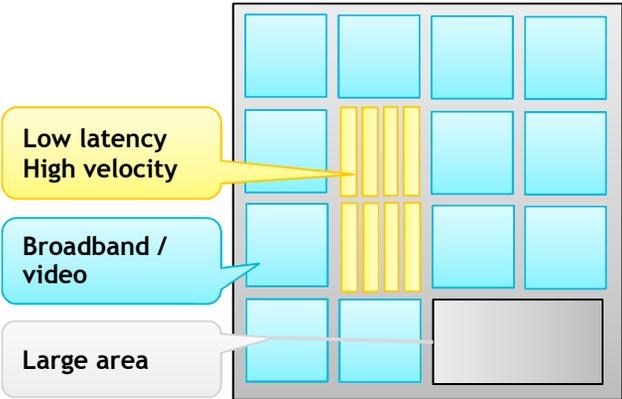
Adaptive and multi-service

Per-user optimization for different Dopplers and latency requirements

Robust Waveform: Enabler for flexibility

Flexible Frame Structure: Variable TTI and PRB size to enable low latency services

Numerology scalable to 100 MHz bandwidth carriers



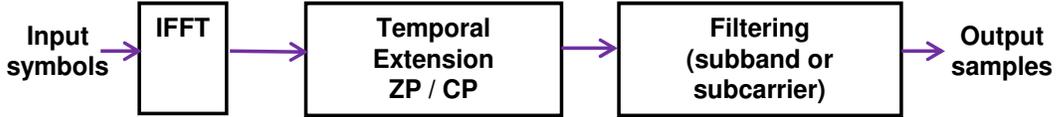
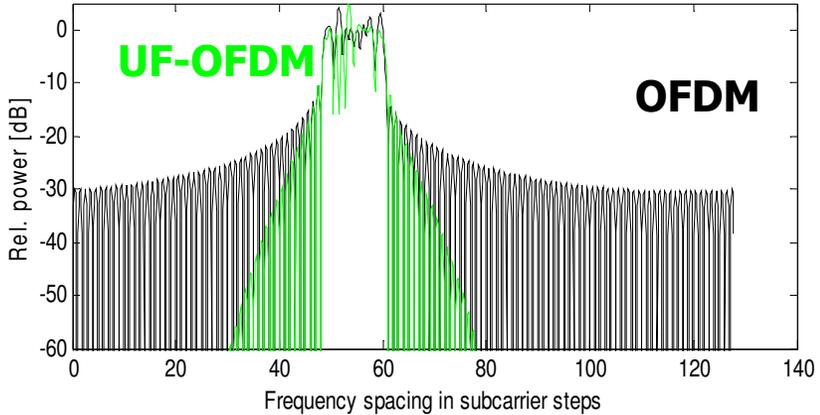
Parameter	LTE	Requirements for 5G
Sub-carrier	15 kHz	3.75 - 120 kHz
TTI	1 ms	0.125 - 4 ms
Max BW	20 MHz	~1 GHz

Robust Waveform by Enhanced Filtering

Filtering of the OFDM/SC-FDMA waveform for Improved Spectral Properties

Sub-band filtering: Complexity similar to CP-OFDM

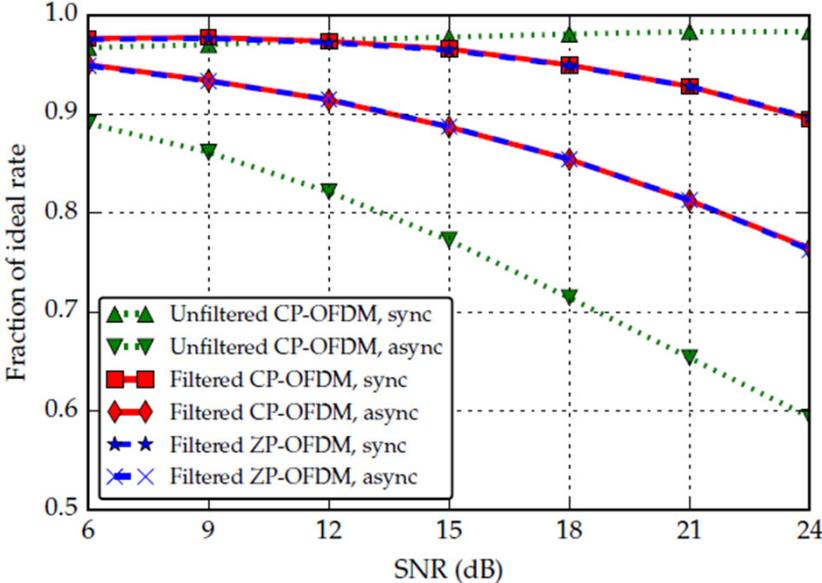
Enhanced filtering enables Per-user numerology as well as asynchronous tx



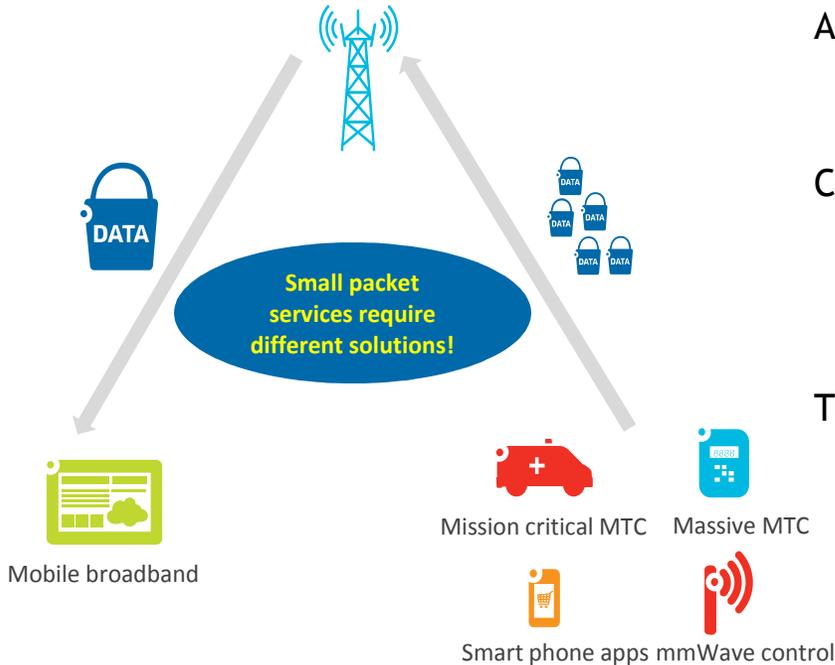
Filtered waveform: Robustness to time-frequency misalignment

Sub-band filtering with Dolph-Chebyshev Window. Filter impulse response equals the cyclic prefix duration

Filtering mitigates the rate loss on unfiltered CP-OFDM in the presence of asynchronous time and frequency alignment



Small Packet Optimizations



Aim for an efficient transmission scheme for sporadic small packet (~ 1000 bits) transmission in UL

Classical use case is MTC, but increasingly also many smart phone apps and control signalling to support data transmission

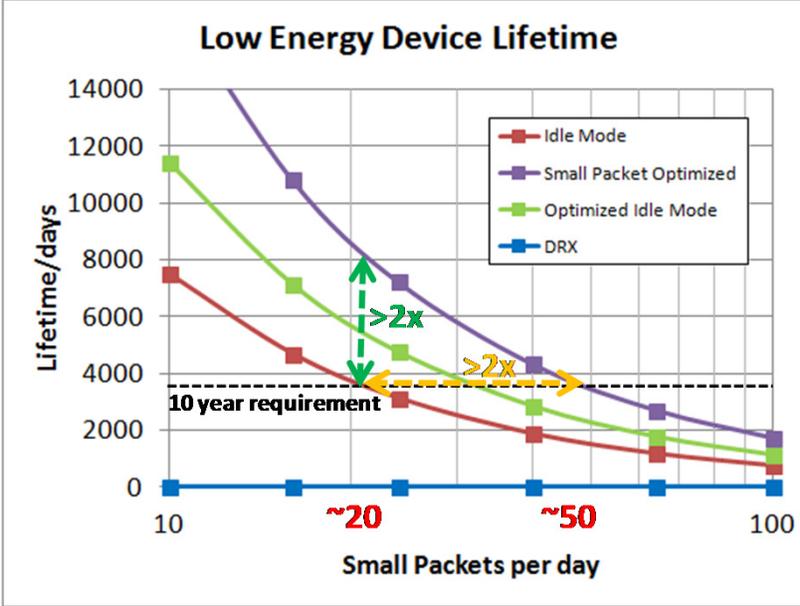
The solution should be:

- Spectrally efficient when taking all overheads into account
- Low latency
- Energy efficient

Energy Consumption optimization for small packets

Different UE Power Saving States:

- Discontinuous Reception (DRX): UE monitors the network in short intervals. Maximal sleep cycle 2.56 s
- LTE Idle Mode: UE needs to monitor cells, is out of sync and doesn't have a security context.
- Optimized LTE Idle Mode ('R13'): Same as in Idle mode but allows the UE to maintain UE context in Idle mode.
- Small Packet Optimized: Double the LTE Idle Mode lifetime
 - Number of packets per day with 10-year battery lifetime increased from ~20 to ~50



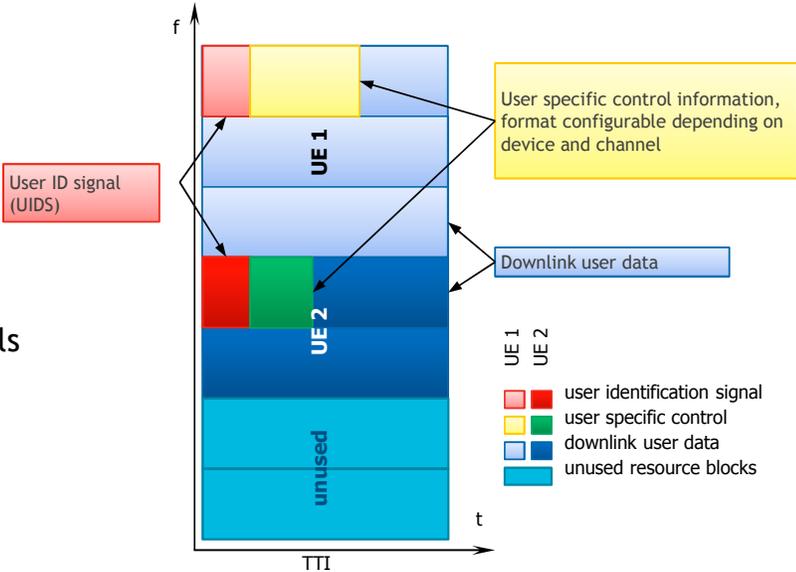
User-centric Radio Access for 5G

- Motivation

- Allow conflicting design targets to be fulfilled within a single carrier
- Coexistence and forward compatibility

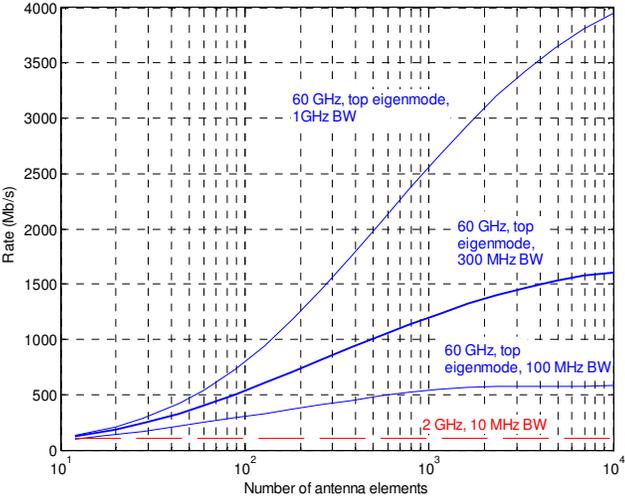
- Building blocks

- User-specific physical layer channels and signals only
- No must-be-present signals
- Initial Access Channel



High bands to add massive capacity

- 20-60 GHz, “mm-wave” bands
 - Provides massive capacity for well placed users in dense urban areas
 - Enormous blocks of spectrum available for short range outdoor or indoor access
- Using Massive MIMO as an enabling technology to achieve high spectral efficiency through multi-user transmission
 - Radiated energy efficiency over 4G
- “Low” and “high” band 5G combined by carrier aggregation
 - Low Band Carrier assistance



1 GHz BW at mm waves brings 10× capacity of a reference low-band LTE link: using ~128 joint elements (e.g. 32 AP × 4 UE)

Summary of Our views on 5G

- 5G supports enhanced mobile broadband and also large numbers of small packets efficiently
- 5G provides a multi-service performance consistency through an adaptive air interface that enables asynchronous transmission and optimization for small packets
- Diverse and diverging requirements call for a New RAT that is user-centric and forward compatible
- 5G will follow a path of continuing evolution
- 4G/LTE evolution continues well after '5G' launch

Thank You