

5G: the Orange vision

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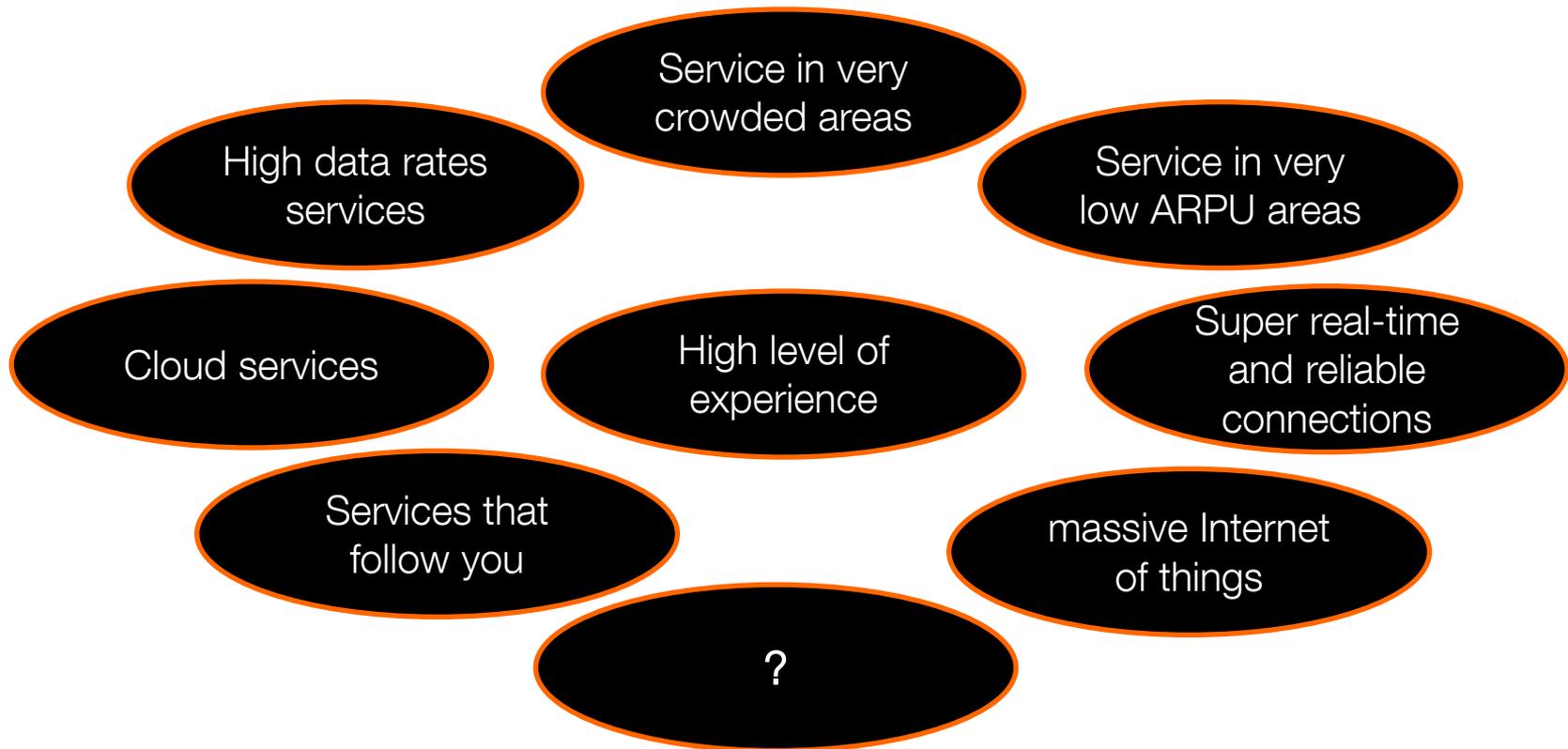
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5G Definition

5G is the technology we will deploy and operate in the 2020-2030 decade

- In our view, 5G is the future Internet as a whole, including
 - Radio Access Networks
 - 3GPP RAN(s)
 - non-3GPP RAN(s), e.g. High Efficiency WLAN
 - a convergent core network (CN) between fixed access and radio access(es) (3GPP and non-3GPP)
 - 5G CN standardization should involve 3GPP but also fixed access SDOs, e.g. Broadband Forum
 - inter-domain networks (transport, etc.)

Services vision



A wide diversity of services, calling for a flexible and future-proof infrastructure

Overview of Orange's key 5G Requirements

Network

- LOW POWER CONSUMPTION
- COST EFFICIENCY
- FLEXIBILITY FOR FUTURE EVOLUTIONS
- fixed-mobile convergence
- integration of 3GPP and non 3GPP RATs
- resilience and robustness
- higher capacity
- higher spectrum efficiency
- ease of deployment & operation
- control of EMF exposure levels
- support for high down to very low bit-rates
- spectrum agility

User experience

- homogenous experience over the coverage area, from static to high-speed-trains velocity, from outdoor to deep indoor
- higher typical throughput per user/ application
- E2E latency of a few ms
- connectivity transparency
- experience optimisation on a per customer basis

Enablers for new business

- Internet of Things
- vehicles connectivity (moving networks, V2V)
- options for ultra low cost networks

Key radio technology components

Potential disruptions

Ultra-dense small cells networks

- Sites acquisition, backhaul & energy, network mngmt?

High frequency bands (e.g. 6 – 100 GHz)

- which band(s)? and BWs?, need new channel models

Massive MIMO

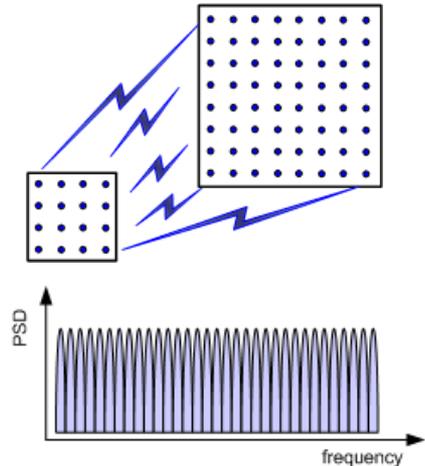
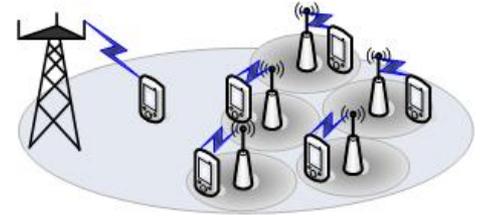
- Impact on RF design, form factor, energy?

New waveforms

- Need to demonstrate the benefits vs. OFDM

Full duplex: Tx and Rx on the same resources

- Feasibility, domain of application? longer term...



Native integration of 4G concepts

MIMO evolutions

- Active antennas / 3D MIMO

Interference mitigation techniques

- Interference coordination, advanced receivers

Device-to-Device (D2D)

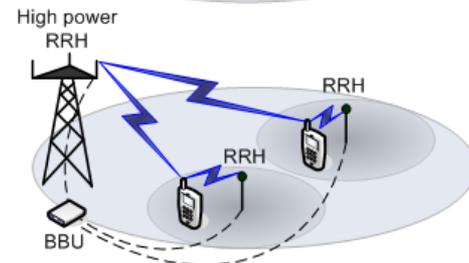
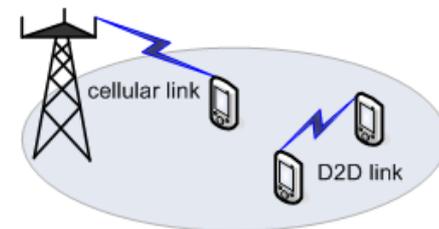
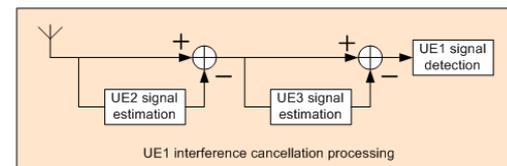
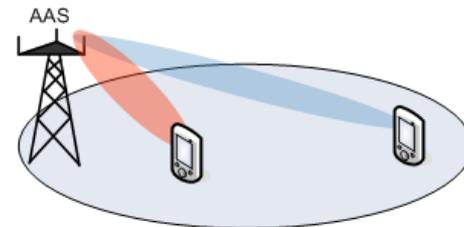
- Coverage extension, local communications offload

Centralized architecture

- Cloud RAN and slow-coordination central controllers

Inter-Radio Access Technologies interworking

- Especially between LTE and WiFi



System design considerations

On a new air interface

- A new 5G RAT will be needed for frequency bands > 6 GHz
- for bands < 6 GHz, 2 alternatives are possible for the 5G RAT
 - a new RAT
 - a backward compatible evolution of LTE
 - legacy LTE devices can share a carrier with 5G devices
- A new RAT will open full flexibility and disruptive solutions for maximum performance and energy efficiency
 - we do not see big drawbacks with non backward compatibility

If significant gains in performance and/or energy efficiency are confirmed, our preference will be to define a new air interface below 6 GHz

it will have to be designed simultaneously for bands > 6 GHz and < 6 GHz

More on a new air interface

- forward compatibility: a new air interface should support adding new modes in the future without disturbing the initial 5G devices
 - e.g. via “blank subframes”, as proposed at the end of LTE Rel-8 standardization
- a new 5G air interface should preferably support simultaneous multi-services on the same carrier (e.g. MBB, MTC, various degrees of latency and reliability), provided performance is not too compromised

LTE+5G interworking

- when 5G will be deployed, a significant amount of spectrum will be already allocated to 4G, so that the 5G spectrum may be in lower amounts
- if restricted to standalone operation, 5G would deliver a reduced user experience than 4G

If a new non backward compatible 5G RAT is introduced below 6 GHz, it is mandatory that bandwidth aggregation is possible between this new RAT and LTE to offer appropriate 5G user experience at initial network roll-out

Ultra-low cost networks for very low ARPU areas

Motivation

- Today 2 to 3 billions of inhabitants on Earth still do not have access to Internet
 - in many areas, the reason is the cost to deploy and operate networks and acquire terminals
- Bringing connectivity to such areas in an economically sustainable way requires
 - ultra-low cost network infrastructures
 - ultra low-cost devices
 - ultra-low cost operation and maintenance

Typical Services

Basics: voice, wireless Internet access with DSL-like data rates

Targeted environments

Rural and suburban areas in very low ARPU regions

5G needs to offer options and possibilities for ultra-low cost deployments for very low ARPU areas

Conclusion

Conclusion

- 5G will need to provide significant enhancements in
 - User experience
 - Network performance and operation
 - Enablers for new services
- Consistent user experience, Network energy & cost efficiency and flexibility for future evolutions are top requirements for Orange in 5G
- A new air interface below 6 GHz will maximize the gains in terms of performance and/or energy efficiency (gains are to be confirmed)
- We support 5G to offer options for ultra-low cost networks, in order to enable Internet connectivity to today's unconnected populations

thanks

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