

# 5G: the future Internet

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# Overview

- 5G definition
- requirements
- key radio technology components
- architecture proposal
- ultra low-cost networks for very low ARPU areas
- conclusion

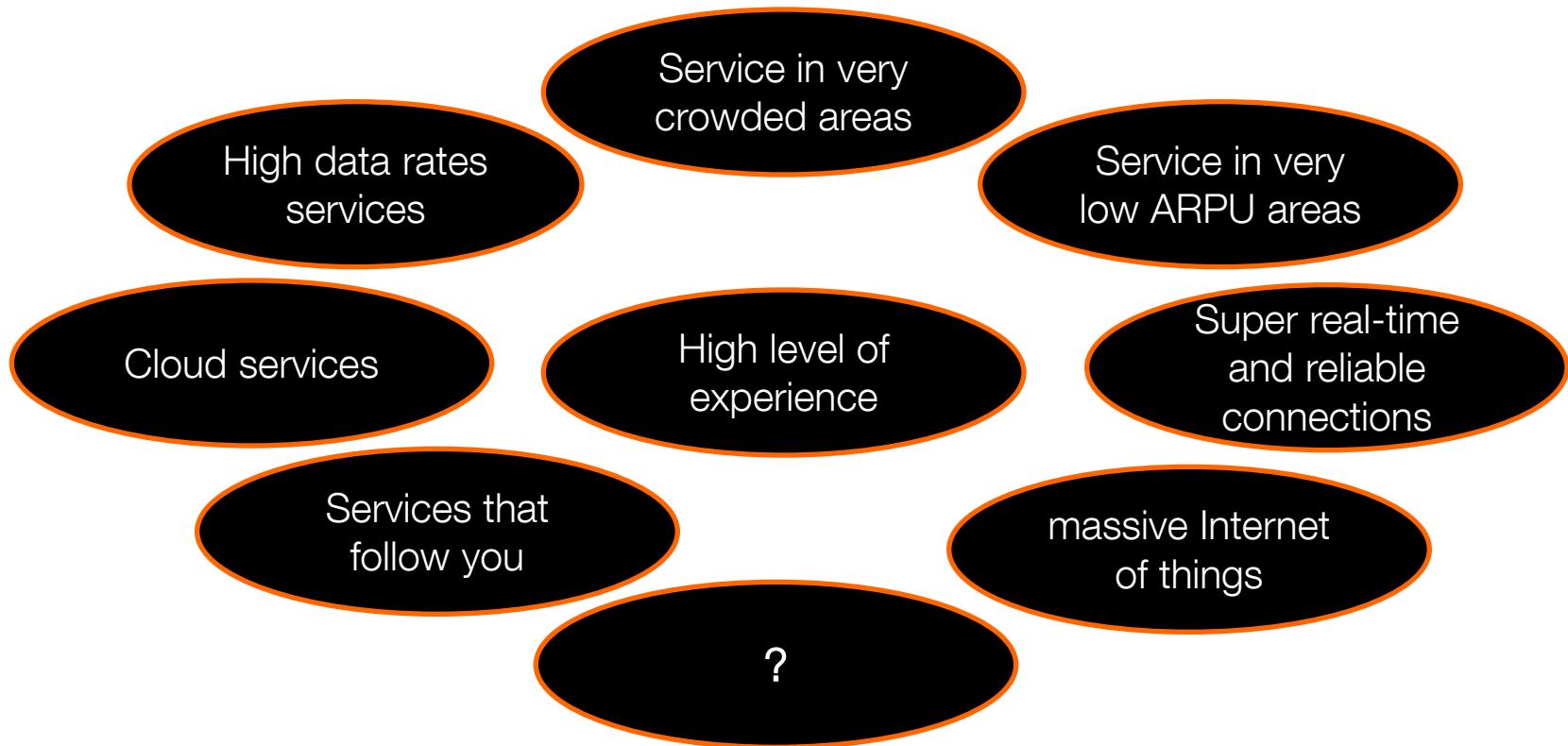
# Orange 5G Vision

# 5G Definition

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

- In our view, 5G is the future Internet, including
  - Radio Access Networks
    - 3GPP RAN(s)
    - non-3GPP RAN(s), e.g. High Efficiency WLAN / IEEE 802.11ax
  - a convergent core network (CN) between fixed access and radio access(es) (3GPP and non-3GPP)
  - 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

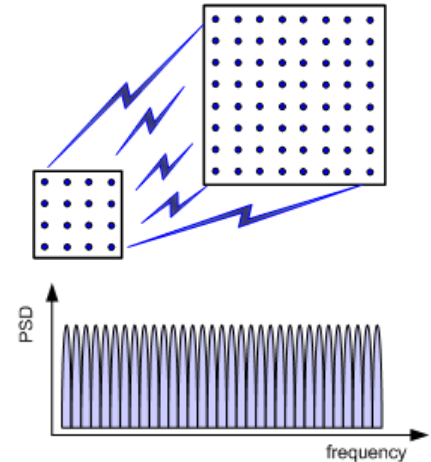
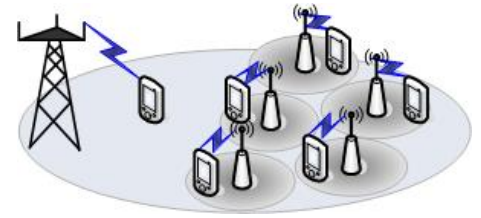
- Impact on RF design, form factor, energy?

## New waveforms

- Benefits against 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)

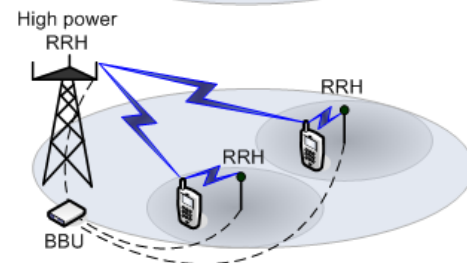
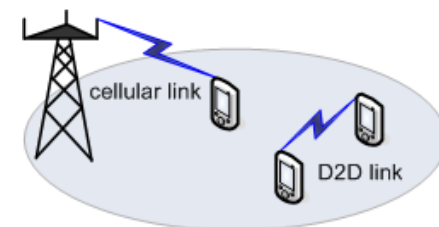
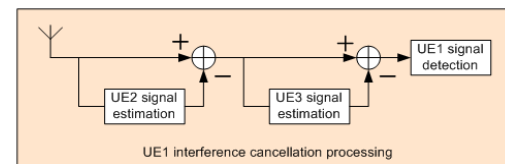
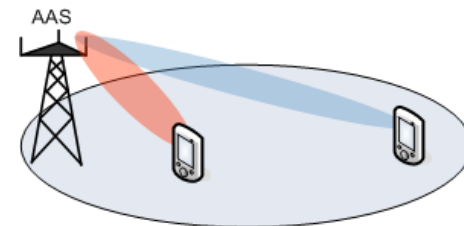
- Coverage extension, local communications offload

## Centralized architecture

- Cloud RAN and slow-coordination central controllers

## Inter-Radio Access Technologies interworking

- Especially between LTE and WiFi



# Architecture proposal

## 1<sup>st</sup> level requirements

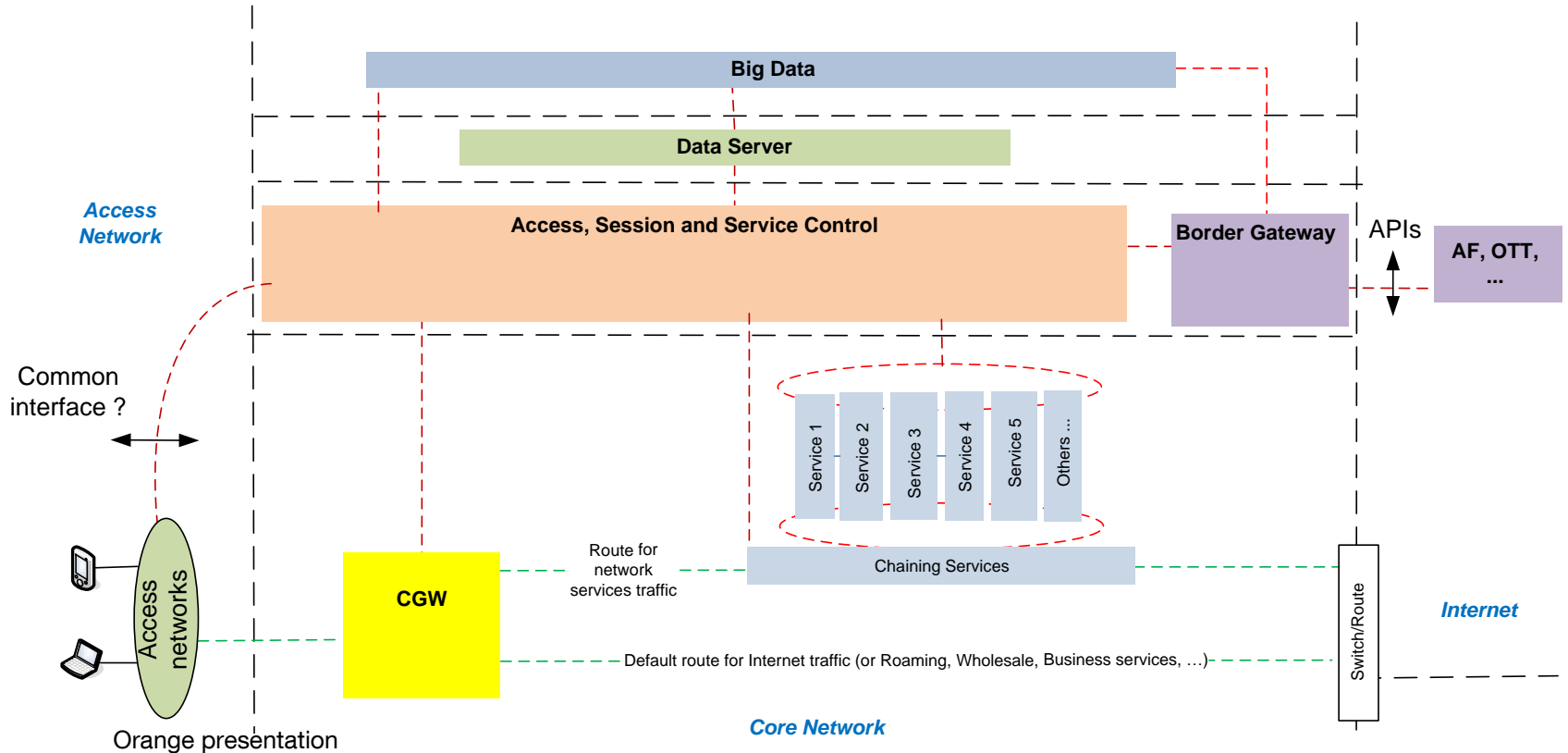
- Network adapted to (new) services
- Decrease cost
- Improve user experience
- Support traffic growth

## 2<sup>nd</sup> level requirements

- Facilitate Big Data-based services
- Adapted to IoT and M2M
- Multi-tenant facilities
- Flexible and simple network
  - Convergence
  - Less network nodes
  - Simple and rapid service deployment
- Better network resilience
- Improving: latency, throughput, QoS, HO delay
- High connectivity transparency across multiple access technologies
- High network capacity / scalable network
- Control plane / Data plane separation

# 5G functional Architecture

Preliminary view subject to refinements



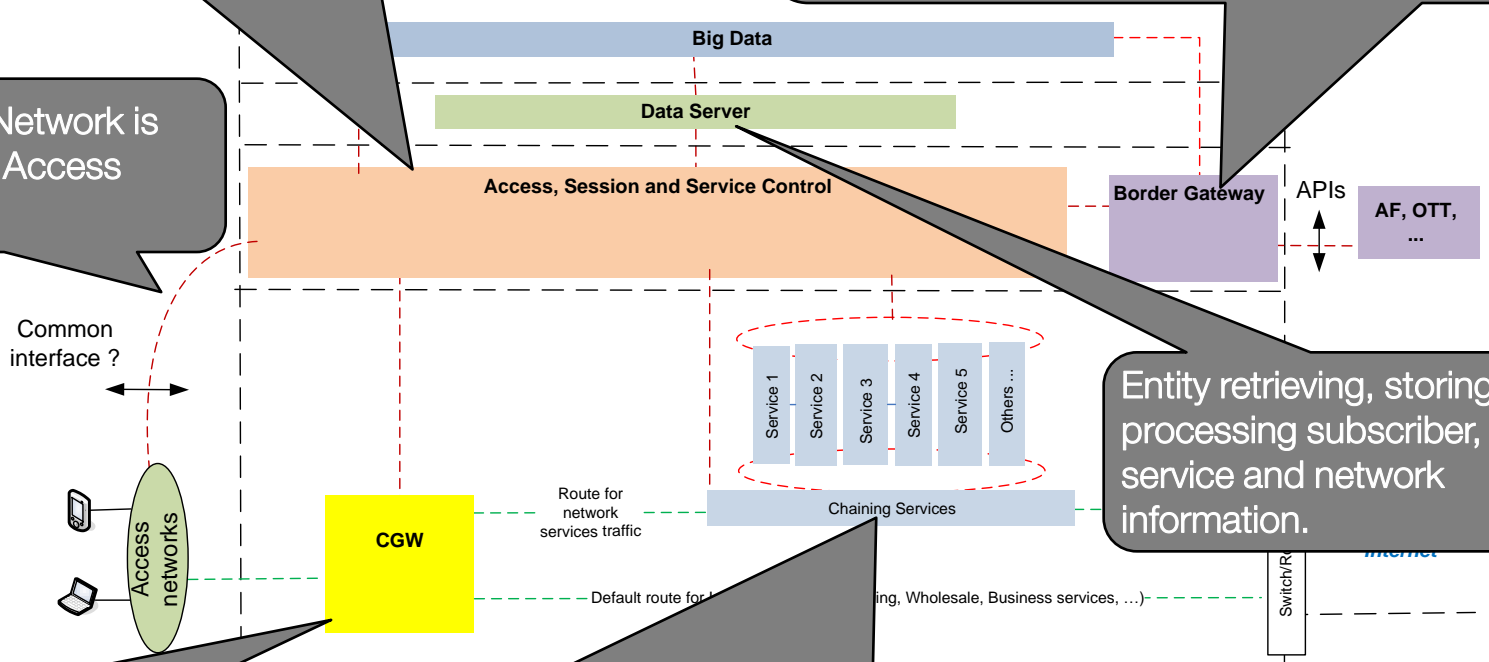
# Architecture

view subject to

Control plane managing access, session, mobility procedures. Controls CGW and handles dynamic service enabler chaining control. Interacts with Border gateway for 3<sup>rd</sup> party service control.

Enables 3<sup>rd</sup> parties to interact with operator network, retrieve information, request QoS for a given user/service etc. Performs authentication, accounting and protocol adaptation functions.

Interface to Core Network is independent from Access Technology.



Entity retrieving, storing and processing subscriber, service and network information.

Anchor point for all type of user and connectivity (fixed, mobile, WLAN); Routing and forwarding

Operator service enablers: functions that can be invoked flexibly depending on user profile and service requirements. Chaining Services invokes service enablers as requested.

# Ultra low-cost networks

# 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

# Ultra-low cost networks for very low ARPU areas

- Designing the technology from the start with application to ultra-low cost networks in mind will maximize the cost reduction possibilities
- Potential solutions
  - Extended macro coverage solutions
  - Simplified architecture and networks
  - Relaxation of network constraints (availability, performance...)
  - Low cost network operations
  - Adapted IPR framework, simplified RF design
  - Self healing / optimizing / configuration
  - Low cost backhaul solutions



# Conclusion

# Conclusion

- 5G will be the future Internet: new radio accesses and a convergent core network supporting both radio (3GPP, WLAN) and fixed accesses
- Consistent user experience, Network energy & cost efficiency and flexibility for future evolutions are top requirements for Orange in 5G
- We supports 5G to offer options for ultra-low cost networks, in order to enable Internet connectivity to today's unconnected populations
- Orange actively participate in the joint initiatives to shape 5G (e.g. NGMN, 5G PPP, 3GPP)

thanks

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