Committed to Europe

5G – a mobile revolution of the future

The term “5G" describes a range of technical advances designed for mobile networks so they can carry more data traffic than at present, at great speeds, with very high reliability while connecting myriads of devices.
The extra capacity is needed for two reasons. The first is our growing expectation that we should be able to do all the things we normally do on home or office computers while we are out and about. This requires vastly more connections to the cloud and, when these are added to the growing demand for HD-quality video streaming, eventually even 4G systems will struggle to cope.

At the same time, emerging services and technologies within the “Internet of things” – self-driving cars and aerial delivery drones for example - will place huge demands on networks and so function much better with a more capable infrastructure. Other cutting-edge activities will also benefit, such as “smart-city” services, e-health and farming. What all these uses have in common is the need to connect very large constellations of varied mobile devices – but with levels of cost-effectiveness, reliability, efficiency and security that are currently beyond the means of the available mobile networks.

Industry and Policy Support

Providing this leap forward in service will mainly be a task for industry, advancing through individual innovation and joint work on new technical standards. Nevertheless, 5G also poses a challenge to Europe: how to support the 5G revolution so as to regain the industrial lead conferred by the highly successful GSM standard in the late 1980s?

The GSM standard paved the way for European leadership in mobile communication technology for many years. In practice, the standard was first proposed by CEPT (a body in charge of telecoms policy involving 48 countries across Europe). Its recommendations were considered and developed at the political level within the EU and Member States, into a series of agreements to pursue a common standard for the first digital replacements of the original analogue mobile telephony networks. Eventually supervision of the GSM standard was passed to ETSI (a European standardization organization).

To re-create a similarly winning formula, many telecom policy areas will need careful review. Policy makers will also need to consider how European operators and device manufacturers can keep pace with overseas companies – many of whom benefit from large, well-integrated home markets.
Significantly, 5G will also mark the rapid expansion of the Internet from being an information and entertainment service into the carriage and delivery of vital services upon which EU citizens will come to rely for their convenience and safety. Thus the role of network management must expand - and regulation comes to reflect this new reality.

Ubiquity, reliability, speed

There are many possible uses for 5G but Orange is looking closely at a number of areas where 5G enhancements can make a real difference in the near future. Among these are smart automotive applications, smart cities, e-farming, e-health and Industry 4.0.

Automotive: 5G could assist in three areas: driving assistance, safety & navigation and remote sensing. As the prospect of self-driving cars draws closer, the way they move around each other must be managed so as to enable basic procedures like overtaking and co-operation at junctions. New possibilities like “platooning”, where cars form convoys on shared journeys, will ease congestion and reduce journey times.
Using self-driving cars will also become safer as they sense their surroundings, share information about hazards and alert emergency services to accidents. Finally, local authorities and highway managers will benefit from real-time information about traffic flows and use it to run traffic lights and other control technologies.

Smart Cities: the idea of smart cities defies simple definitions but mainly involves getting better use and value out of local services by adding electronic communication, interactivity and intelligence. Possibilities include: smart passenger tickets for combined transport systems, parking and traffic management and intelligent street lighting that saves power by responding to need.

Smart farming: there are many ways that 5G could help farmers. For example: networks of sensors could map the need for irrigation, pest control or fertiliser. This would allow farmers to match the use of resources to the needs of growing crops, with a clear benefit to the environment. Techniques similar to those used for traffic control will eventually guide self-driving farm machinery and enable the better location and management of livestock.

E-health: the number of patients using wearable monitors for various conditions is likely to increase – especially among the elderly. Although the data needs of these devices are rarely high, the *coverage* of signals needs to become much more pervasive. 5G could help by providing total geographic coverage - improved where needed by much larger cells for low-density areas and by allowing massive, fast, data-flows with a guaranteed level of service. Such features will be needed in particular by specialists using ultra-high-definition datalinks to perform diagnoses and even, one day, treatments or surgery with remotely-operated equipment. The use of immersive or 3D visual interfaces, only possible with 5G, will allow procedures to take place safely and make better use of consultant time.

Industry 4.0: European industry will undergo a digital transformation. 5G will enable and be fully part of this process. It will allow companies to improve their productivity, their competitiveness and to offer optimized and more personalised services to their customers. For example, smart grids or tracking system used in a warehouse will allow companies to manage their logistics, inventory management or undertake repairs if needed.

Finally, 5G deployment should also allow to better taking up the challenge of connectivity in sub-urban and rural areas. In the next part we will explain the 5G infrastructure and required policy changes.

5G, basic characteristics and policy challenges

In the first part, we reviewed some uses and applications of 5G. In this part, we will describe how to make 5G a reality.
What all the various 5G proposals need is a vastly more capable network infrastructure. To achieve this, the networks must be ubiquitous - and capable of handling whatever data loads arise. What follows are some of the policy adjustments needed to assist these developments.

Spectrum needs

As cars can go faster on wider roads, the higher capacity and data rates envisaged for 5G call for much wider spectrum bandwidths. The spectrum "blocks" allocated will also need to be contiguous and larger, especially in the higher spectrum bands. All radio signals have limits to the amount of data they can carry and these are set both by the transmission technology used and the attributes of radio frequency itself. Thus higher overall levels of signal traffic need more "room" in terms of spectrum.

Moreover, generally speaking, the higher the frequency, the easier it is to find spectrum potentially available for communication purposes. So, wide amounts of spectrum should be identified not only in traditional telecom bands but also in the higher ranges, the so-called "millimetre waves", which are not yet used for mobile communication.

However, sending radio waves from one point to another – propagation - becomes more of a challenge as the frequency rises: high-frequency signals lose power more rapidly as they travel in the air, are sensitive to smaller obstacles like tree leaves or even rain and find it harder to penetrate walls.
The good news is that antennas are also to become smaller as the frequency increases and technology develops. This allows the use of new antenna designs employing many antenna elements in the same space. These new antennas, using a form of signal processing called "beamforming", can direct a signal just to a given user - instead of broadcasting it in all directions as happens today. This compensates for some of the propagation losses in the higher frequencies. Beamforming can also boost the network capacity by serving many users at the same time, each with a specific beam. This feature will make 5G a greener technology as this greater antenna directionality will mean less wasted power.

New network architecture and "network slicing"

The demands placed on 5G will likely require networks to become denser in some areas, using extra transmitters with much smaller range – so-called "micro" and "pico" cells - in crowded streets, airports, stadiums or shopping malls. The prospect of thousands of users and machines communicating, people browsing the Internet, watching or uploading online videos at the same time and in the same location will put a strain even on improved networks. 5G will not completely replace existing radio access technologies (like 4G, Wi-Fi or Low Power Wide Area). Firstly they will have to be maintained to sustain the service to their subscribers in the 5G ramp up period. Secondly, some are expected to remain in use in the long run to handle specific usages or because of their widespread market adoption, complementing the 5G new radio in order to serve the future needs. 5G should integrate these technologies and their evolutions by having them managed by the 5G core network, enabling an optimised user experience across different access technologies, and maximising the network operation efficiency.

This brings us to some other important features of 5G. In order to run critical services the networks will, for reasons of practicality and in some cases safety, need to offer *guaranteed service levels*. For this to be possible, some activities on 5G will need to be run as distinct services within the cloud, with "virtual walls" separating a particular set of data processing and communications from other activities. This is known as 'network slicing' and the viability of some activities will depend on it.

When decision-making has to be subject to little or no physical delay ("latency"), some computing power may need to move out to closer to users themselves. Moving or flying objects, in particular, have to make decisions so fast that the slightest delay or interruption to communications could have serious consequences. Finally, in the case of remote medical diagnosis and treatment, the data transmission capabilities of a connection between patient and doctor will need to be very high indeed and without a risk of failure. In all such cases, networks need to be enabled to offer service guarantees without legal or regulatory obstacles.

When will 5G happen?

At the present time, industry is working through standards bodies to produce common 5G specifications. An initial release, known as Phase 1, is planned mid-2018. This will enable the launch of 5G commercial networks from 2020, offering a first set of 5G capabilities for "extreme" mobile broadband, ultra-reliability and low latency, for human and machine communications. In the meantime, experiments are underway to test the technology

components, which will be followed by large-scale trials in the 2018-2020 period. Phase 1 will be followed with subsequent specification releases, increasing support for more 5G technologies and use-cases, in response to customer demand.

5G and policy

Policy, especially at EU level, might make a real difference and following a wide consultation, the EU Commission put forward a highly ambitious proposal "5G for Europe: an action plan" on 14 September 2016.
Among various measures, they intend to:

- Align 5G deployment across all EU Member States, for network introduction by 2020.
- Coordinate the availability of the new spectrum bands at the next World Radio Communication Conference.
- Promote early deployment in major urban areas and along major transport paths.
- Facilitate the implementation of an industry-led venture fund.

Orange welcomes these initiatives while recognising that they are very big projects to realise in a so short period of time. Orange also believes that in order to speed up 5G networks rollout, the following policy changes should also be advanced.

Investment & Regulation:

In the main, 5G applications will emerge on the basis of viable business cases and the infrastructure needed for these will in turn encourage and enable the development of new uses. The main responsibility for infrastructure investment remains with network operators.

However, at present, the telecoms industry is still regulated by an almost 20 year old framework, which is no longer fit for purpose. As a consequence, the funds needed for investment are not being generated and spending, in terms of investment-per-customer, has lagged behind both the US and other parts of the world for some time. The major developments in the market, like the rise of internet-based services or the need for investment in the next-generation fibre networks, require swift legal changes.

Orange and the telecoms industry welcome the proposed revision of telecommunications regulatory framework. We hope the European Electronic Communications Code (EECC) will incentivise infrastructure investment on one hand and boost operators' investment capability on the other. At the same time an overarching goal is to significantly *simplify* the rules and to reduce sector-specific, "ex-ante" regulation.

The spectrum market

5G will require more, affordable, spectrum allocation, with more harmonisation across the EU: most Telcos have a "footprint" extending across more than one Member State. The arrival of 5G calls for a more dynamic regulatory environment by allowing access to additional spectrum resources. While Orange welcomes recent agreements by RSPG (Radio Spectrum Policy Group) and CEPT (Conférence européenne des administrations des postes et des télécommunications) to identify 5G pioneer bands, we believe it is important for Europe to issue a schedule for making all these bands available by 2020, in order for its citizens to fully benefit from the advantages offered by 5G.

However, availability is not the only issue. Existing frequency ranges are allocated across the continent in widely varying forms. There are differences in licence and ownership arrangements and the auction designs used to release spectrum in some Member States can be excessively expensive. Thus, further work toward harmonising the licence conditions, durations and facilitating a transparent secondary market would go a long way to create the more efficient spectrum market that 5G depends on.

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