Survival of the fastest

5G – A glimpse into the expectations and challenges of next generation mobile networks

5G is seen by the telecoms industry as the key building block of our future mobile digital world and our networked society. Can the technology live up to its expectations?
5G will also enable the massive roll-out of connected sensors and bring about mass-market IoT—think trillions of connected devices. Thanks to higher reliability, flexibility and with a variety of trade-offs between speed, latency and costs, 5G promises to bring to market a range of new services and service improvements as presented in the graphic below.

However, a number of new and existing conditions need to be in place to reap the full benefits of 5G. These technologies, which go from radio to core, are yet to be developed and/or implemented. Among these, availability of the right spectrum bands for 5G deployment will be key. 5G will also be supported by the new generation of radio technologies (e.g. cognitive radio) coupled with new equipment and technologies (e.g. Software Defined Networks) in the Access and Core networks.
Once these are in place, the three main applications of 5G that will most affect our everyday lives are:
1. Enhanced mobile broadband—allowing seamless customer experience from a broadband speed point of view and the rise of new applications on-the-go such as UHD Augmented Reality;
2. Massive Internet of Things—essentially enabling the smart cities of the future;
3. Mission Critical Control—a must in the democratization of applications such as self-driving cars.

Telcos need to gain a clear picture on the monetization potential and return on investment for 5G. Beyond strategy, there are clear operational challenges ahead for the 2020 planned 5G deployment.

5G main use cases

5G ENABLING ASPECTS
- Non exhaustive -

 **SPECTRUM**
- mmWave
- Sub 6GHz bands
- Unlicensed spectr.

 **RADIO**
- 5G New Radio
- Massive MIMO
- Optimized OFDM

 **ACCESS**
- MEC
- C-RAN
- Multi-RAT

 **CORE**
- NFV/SDN & MANO
- New architecture

**Enhanced Mobile Broadband**
- Extreme **DATA RATES**: Multi-gigabits per second, for e.g. UHD virtual reality
- Uniform **USER EXPERIENCE**: At least 100 Mbps everywhere, not impacting QoS/E

**Massive Internet of Things**
- Ultra-**HIGH DENSITY**: 1M devices/Km², for the hyper connected NW vision
- Ultra-**LOW ENERGY**: +10 years of battery life
- Ultra-**LOW BIT RATES**: 10⁶ of bits per sec., for monitoring NW

**Mission Critical Control**
- Deep **COVERAGE**: To reach challenging locations
- Strong **SECURITY**: Critical communications, e.g. government/financial trusted
- Ultra-high **RELIABILITY**: <1 out of 100M packets lost, needed for critical applications
- Ultra-low **LATENCY**: Low as 1 ms, for e.g. autonomous driving and virtual reality

**With great expectations come great challenges**

With new applications will come new business models for Telcos. However, Telcos need to gain a clear picture on the monetization potential and return on investment for 5G. Beyond strategy, there are clear operational challenges ahead for the 2020 planned 5G deployment.

Over the next few years, mobile operators will continue to face increasing margin pressure as data traffic continues its exponential growth, while operators’ revenues grow at single digit pace, if any. As traffic keeps growing, operators must reduce cost-per-bit, as revenues will keep on decoupling from traffic growth. Thus, it is vital for the mobile operators to...
reinvent their business models to address this challenge and exploit service differentiation in order to protect margins. From the perspective of network operators, new business models will emerge with 5G leading to new ways of monetizing the network—building ecosystems for smart cities and IoT being two of the many examples of new models enabled by 5G.

Overall we believe that three types of new business models will be supported by 5G deployment:
- On the consumer side, user differentiation that includes superfast broadband, ultra-high definition video to mobile devices and virtual reality;
- On the corporate side, Network as a Service (NaaS) and information brokering, a byproduct of IoT and analytics.

The first business model, aimed at the consumer, allows operators to take advantage of increased network performance to provide new differentiated services for end users (such as augmented reality.) In the case of NaaS, enabled over network virtualization, the focus is on corporate customers’ needs. Operators can expose their Operations Support Systems (OSS) and allow corporate customers to configure their networks (network slices) in the way that best suits their needs depending on their industry verticals. Information brokering, also aimed at the corporate segment, intends to use the transactional and control data produced by 5G networks to empower new services that benefit from contextual real-time and non-real-time data. Operators can broker critical services information to industry, where events need to be addressed in real time: for instance in the assembly lines of automated factories.

However, many strategic and operational challenges lay ahead that need to be overcome on the road to a full and optimal 5G deployment. In many ways, 5G is posing transformational questions to Telcos on the rise of new business models, the need to operate in a more efficient and mission critical way and, of course, the adaptability of the operators to new technological challenges. In addition, to start the journey, the current lack of 5G standardization creates a risk for Telcos in divergent technology deployment that will in turn lead to higher costs and compatibility concerns.
Challenges that need to be addressed for 5G deployment

**Standards**
As operators begin 5G activities ahead of standardization, identifying use cases and moving faster than standards work, there is an increasing risk of divergence in 5G deployments.

**“Killer use cases”**
There is a need to definitely answer to the question of where is the intersection between economics and long-term infrastructure for the 5G 2020 deployment.

**Spectrum**
Decisions are yet to be made on spectrum availability for 5G. New bands below 6GHz and above 24GHz are still yet to be defined, and judgments on spectrum refarming are yet to be made.

**IPv6 & Massive IoT**
The needed IPv6 adoption to support the massive IoT will have to be guaranteed by operators in their networks, if one wants to take advantage of the full spectrum of 5G possibilities.

**Security**
With the IT-driven 5G architecture, and its non-telco protocols more susceptible to hack, the critical services on top of the network will demand extra attention to security.

**Transformation**
From an operator point of view, transform its current OSS and BSS platforms into a convergent MANO solution across its overall network operations; will be a major challenge to be solved prior to full 5G adoption.

Thus, to prepare for 5G, mobile operators need to make objective decisions on when and how to make the required network investments, and need to take into consideration the operational changes that are required to evolve to a 5G environment. The key steps of this evolution are shown in the graph below.

Overall business transformation process

1. **Prepare for 5G**
   - **PLAN**
     - BUILD SOLID BUSINESS CASE(s)
     - Define 5G strategy and envisioned use cases
     - Techno-economic models to validate business cases
     - 5G spectrum assessment for optimal use
     - Select the right strategy/journey path to 5G

2. **Deploy 5G**
   - **DESIGN & BUILD**
     - PLAN 5G NETWORK AND OPERATION
     - In-depth view of tech choices and impacts
     - Optimal radio evolution for selected journey
     - New processes and new tools
     - DEPLOY AN IOT OFFER
     - IMPLEMENT 5G NEW RADIO
     - VIRTUALIZE & ORCHESTRATE WITH NFV/SDN
     - MIGRATE CORE TO A FULL-SCALE CLOUD
     - DEPLOY 5G NETWORK & OPERATIONS

3. **Operationalize 5G**
   - BUSINESS TRANSFORMATION PROCESS
     - Due to 5G “softwarization” of telco network (e.g. NFV, SDN, slicing, etc.) common organizational areas will need better interaction with each other to solve day-to-day problems, such as IT and Engineering; thus the need for a structural redesign

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Smoothing the transition from 4G to 5G

Transition technologies such as LTE - Advance Pro (4.5G) will bridge the transition from 4G to 5G networks, allowing operators to maximize the value of their current networks.

Mobile Telcos continue to build out their LTE networks with a push to upgrade to LTE-A and are also looking to advance to 5G. However, prior to the 5G rollout a mid-step will take place, more specifically LTE-Advance Pro or 4.5G. 4.5G will be backward compatible with prior LTE releases, increasing 4G capabilities with multi-gigabit per second bitrates and even lower latencies.

4.5G will begin providing the capabilities to support new 5G use cases, allowing to adjust network architectures ahead of time for 5G deployment. In addition, 5G networks will need a network architecture that meets certain requirements, such as adaptation to different service types, network slicing and backhaul requirements for lower end-to-end latency and ultra-high bandwidth. This will be enabled by parallel developments on Network Function Virtualization (NFV) and Software-Defined Networking (SDN).

As of today, 5G is still in its technical requirements definition, with inputs provided from different standardization organizations, prior to its expected release in 2020. The following diagram shows the predicted roadmap for 5G.
Conclusion
Telcos will continue to experience double digit growth—estimated at a 23 percent compound annual growth rate (CAGR) up to 2020—in data traffic, meaning that they need to keeping investing in new infrastructure and expansion to attend the market demand. Additionally, competition from OTTs are eroding revenues that are not growing at the same pace as their capital expenditure (CAPEX). Thus, it has become a survival imperative for operators to rethink their business and operating models. Service providers are aiming to reinvent themselves into agile digital players looking for new sources of revenues, developing innovative value added services, reducing time to market and cutting their cost to serve. A successful transition to 5G becomes therefore one of the cornerstones of this transformation.

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