Five alive!

5G beyond the hype

Few ICT topics are currently hotter than 5G. But what could 5G actually mean for users, operators and other industry players? A critical examination of potential 5G scenarios, use cases and business models is urgently needed – along with a realistic assessment of the complications that may just have 5G's number.

"The road to 5G is in no way hurdle- or risk-free. Considerable obstacles must be overcome if these scenarios are to be fully realized"

ALTHOUGH 5G is an eagerly discussed concept, there is still no industry consensus on what 5G networks will encompass when they are eventually deployed. One view which has gained some acceptance is that whereas 3G and 4G were based around breakthrough technologies such as WCDMA and LTE, 5G will integrate new and existing radio-access technologies.

This combination will include established technologies such as HSPA and LTE – which will continue to evolve while remaining the backbone of operators' radio-access solutions – as well as complementary new technologies. Massive antennas, expanded spectrum – including higher frequencies – and improved base-station coordination will also form a crucial part of the 5G ecosystem [1].

However, the industry discussion so far has mainly concentrated on the theoretical, rather than practical, aspects of 5G. In response, the following text presents five clearly defined 5G scenarios[1] and accompanying use cases, along with broad outlines of how they could translate into possible business models for operators or other ICT players. Crucially, it also highlights some of the considerable obstacles that must be overcome if these scenarios are to be fully realized.

SCENARIO #1: AMAZINGLY FAST

In this first scenario, mobile-broadband users enjoy very high data-rates and instantaneous connectivity. Applications will exhibit "flash" behavior and support instantaneous user access, which is a key requirement for cloud services in particular.

USE CASES: The *virtual reality office* will offer data rates of more than 1 Gbps in 95 percent of office locations and 5 Gbps in 20 percent of office locations (during 99 percent of the busy period). As a result, users of business applications or collaboration tools will have the opportunity to become more efficient and productive.

The *dense urban information society* will respond to the explosive growth of both urban environments and the connectivity demands of city-dwellers. In this use case, the estimated monthly traffic volume handled is about 500 GB per device. This corresponds to about 1,000 times today's average monthly traffic volume per subscriber.

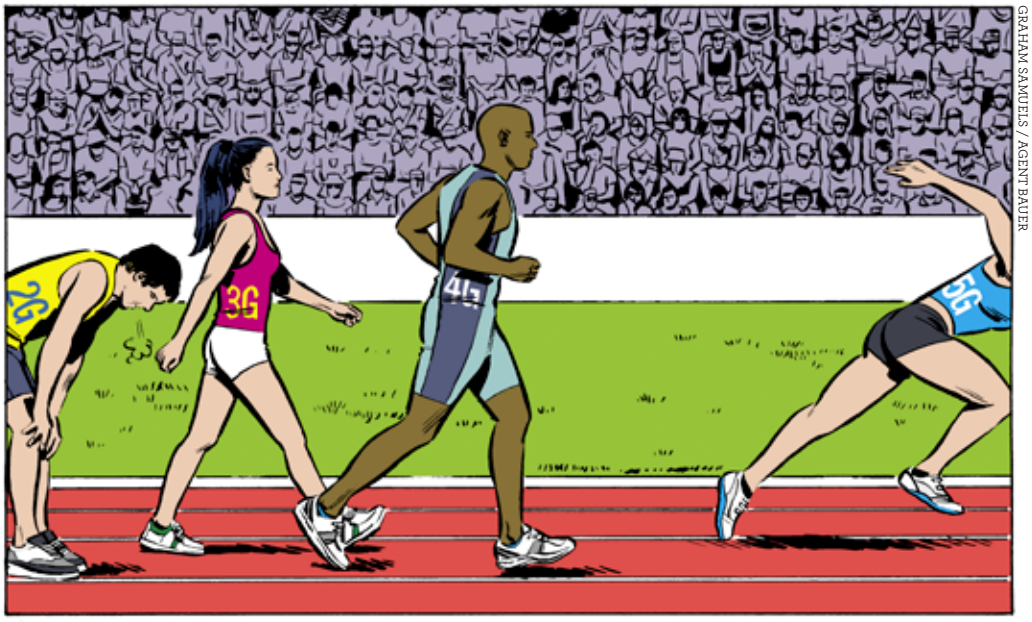
BUSINESS MODELS: This scenario represents an evolution of most operators' current data business models. However, these models may require adaptation to reflect the stronger emphasis on data rates and volumes.

OBSTACLES: Although this scenario lies within the comfort zone of a classical operator, it has implications for the required wide spectrum bands. As a result, operators will need to handle connectivity pushed to the millimeter frequency wave bands. In addition, the transport network connection might become a bottleneck as operators look to expand their networks in a cost-effective manner.

SCENARIO #2: GREAT SERVICE IN A CROWD

This scenario covers mass user connectivity in extremely crowded places such as stadiums, shopping malls, open-air festivals, traffic jams and public transportation. Today, users in these environments regularly suffer from service denials due to network overload.

1) The following 5G scenarios and use cases are user- or device-centric. They can be extended to include service-provider scenarios and use cases.



GRAHAM SAMUELS / AGENT BAUER

"5G scenarios and use cases give a glimpse of what's possible – now it's up to the industry to make them happen"

USE CASES: The *stadium use case* supports traffic volume per subscriber of 9 GB per hour during busy periods, and an experienced user data-rate of between 0.3 and 20 Mbps in a completely filled stadium.

The *festival use case* is based on a lightly populated rural area, with minimal network infrastructure, being visited by 100,000 visitors for an event of limited duration. Here the estimated traffic volume and data-rates per user are about 900 Gbps/km2 and 3.6 GB.

BUSINESS MODEL: This scenario creates an opening for cloud services, further consolidating the convergence between the IT and telecom sectors. Cloud service providers (currently dominated by IT and data-communication players) might see a niche market to provide cloud-based services on top of operator networks.

OBSTACLES: The main technical challenge of this scenario is providing accessibility to a large crowd at a sustainable network cost. For operators, increased activity from over-the-top cloud service providers can also impact already-challenged margins.

SCENARIO #3: BEST EXPERIENCE FOLLOWS YOU

This scenario involves high data-rate coverage provided for users on the move, such as in cars or trains. Users will have the impression that network infrastructure is following them, rather than disappearing in certain areas.

USE CASE: The typical use case for this scenario is the provision of high data-rate services such as video streaming and file downloads in *blind spots*, that is, locations with consistently bad coverage. The data-rate requirements are at least 100 Mbps in downlink and 20 Mbps in uplink, while maintaining end-to-end latencies below 100 milliseconds (ms). For any blind spot, availability must be as high as 95 percent.

BUSINESS MODEL: This scenario might trigger automotive manufacturers to reconsider the communication services business models for their products and prompt them to become actors in the telecom sector. For instance, there may be value for automotive players to own spectrum and provide services directly to the mobile user, either with or without operator collaboration. Similarly, the satellite or aviation industries (including both airplanes and possibly drones) can offer similar services for mobile devices.

OBSTACLES: The technical challenge for this scenario is providing robust and reliable connectivity solutions, as well as the ability to efficiently manage mobility with low battery consumption of user terminals and at a low cost.

SCENARIO #4: SUPER REAL-TIME AND RELIABLE CONNECTIONS

This scenario deals with new applications that have very strict latency and reliability requirements. In today's communication systems, these two factors are approached from a human-centric perspective and are unable to support machine-to-machine (M2M) communication with real-time constraints.

USE CASES: *Traffic efficiency and safety* is a typical application for super real-time and reliable connections. Traffic flows and accidents can be managed by cooperative intelligent traffic systems that exchange information with less than 5ms end-to-end latency.

Smart grid networks require reliable information transfer between power grid substations within the range of a few milliseconds. They need real-time monitoring and alerting functionalities and the capacity to respond immediately to altered system conditions. Messages, which will have expected payload sizes of up to about 1500 bytes, should be transferred with five-nines reliability within about 8ms delay on the application layer.

BUSINESS MODEL: Operators can leverage their network experience and position themselves as credible transformation partners in vertical industries such as transport and utilities. This unique expertise should balance the danger of wireless communications becoming a commodity. On the other hand, industrial players can also expand into the telecom sector and sell services both to mobile operators and directly to consumers.

OBSTACLES: The challenge is to create a sustainable mass market that supports profitable products. From a technical perspective, it is also unclear if reliable and delay-intolerant networks are compatible with a sustainable cost and energy model.

SCENARIO #5: UBIQUITOUS THINGS COMMUNICATING

This scenario focuses on efficiently connecting and managing a very large number of things, ranging from low-complexity devices such as sensors and actuators to more advanced devices such as medical equipment. The resulting requirements vary widely in terms of payload size, transmission frequency, complexity, energy consumption and latency, and cannot be fully met by today's cellular networks.

USE CASES: *Massive deployment of sensors and actuators* is a typical application in which small sensors and actuators are used to optimize monitoring, alerting or actuating. Portable objects may be equipped with tiny tags for the purpose of tracking their location. Manufacturing, transport and agriculture are some of the domains that can benefit from these deployments.

A second use case is *emergency communications*. In this use case, basic communications can be provided in places where mobile or wireless network infrastructure is limited or unavailable as a result of a natural disaster.

BUSINESS MODEL: This scenario is the most fragmented, since it addresses a number of industries with different production cycles, legislation, interests and competition rules. Vertical or sector-specific solutions present fewer difficulties than creating a horizontal business model based on end-to-end communication solutions across sectors.

On the other hand, the scenario is an ideal opportunity for small to medium-size companies to enter the market with simple products that use a cheap transceiver without an attached SIM card, thereby avoiding competition with dominant chipset vendors. The possibilities for players in every industry to exploit the data created by billions of things communicating are also attractive.

CHALLENGE: The major technical challenge is to secure network coverage for such a mass of devices. Another challenge is to build the end-to-end regulatory framework and standards necessary for globally functional products.

FIVE ALIVE!

Current and previous mobile systems have not completely addressed the first three scenarios due to market and technological barriers. The fourth and fifth scenarios can be considered as new, and therefore differentiate 5G even more fully from previous generations.

Some use cases can be mapped to several scenarios. For example, the *emergency communications* use case requires the same high reliability and mobility as the use cases in the *super real-time and reliable connections* and *best experience follows you* scenarios.

It should also be clear from the above that the road to 5G is in no way hurdle- or risk-free. In particular, there exists a real risk of fragmentation, with each industry or sector attempting to create proprietary solutions instead of working towards a common standard.

The expansion of 5G will also be impacted by unpredictable user- and technology-related factors. User factors include the impact of advertising, user tastes and created societal needs. Technology factors, meanwhile, go beyond purely scientific considerations to include questions of gaining or retaining market share and protecting or re-establishing political equilibrium.

But although the road to 5G may be long, the results should make it worthwhile. The scenarios and use cases described above have given a glimpse of what's possible – now it's up to the industry to make them happen. ●

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FURTHER READING

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