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5G: WHAT IS IT FOR?

THE NEXT GENERATION OF TECHNOLOGY WILL ENABLE NEW APPLICATIONS, BRINGING EVEN GREATER BENEFIT TO SOCIETY

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ABSTRACT

Since the very first mobile phone call was made over 40 years ago, the technologies that first enabled people to talk to each other over a wireless connection have undergone several generations of evolution with a massive increase in performance.

Sometime around 2020, the next generation of standards, performance levels, equipment and devices will become commercially available under the label of 5G. But what will people use this new generation of technology for? How will we benefit from 5G technology? What will be different about it? And how will 5G be an integral part of industry transformation to make it a fundamental enabler of the Networked Society?

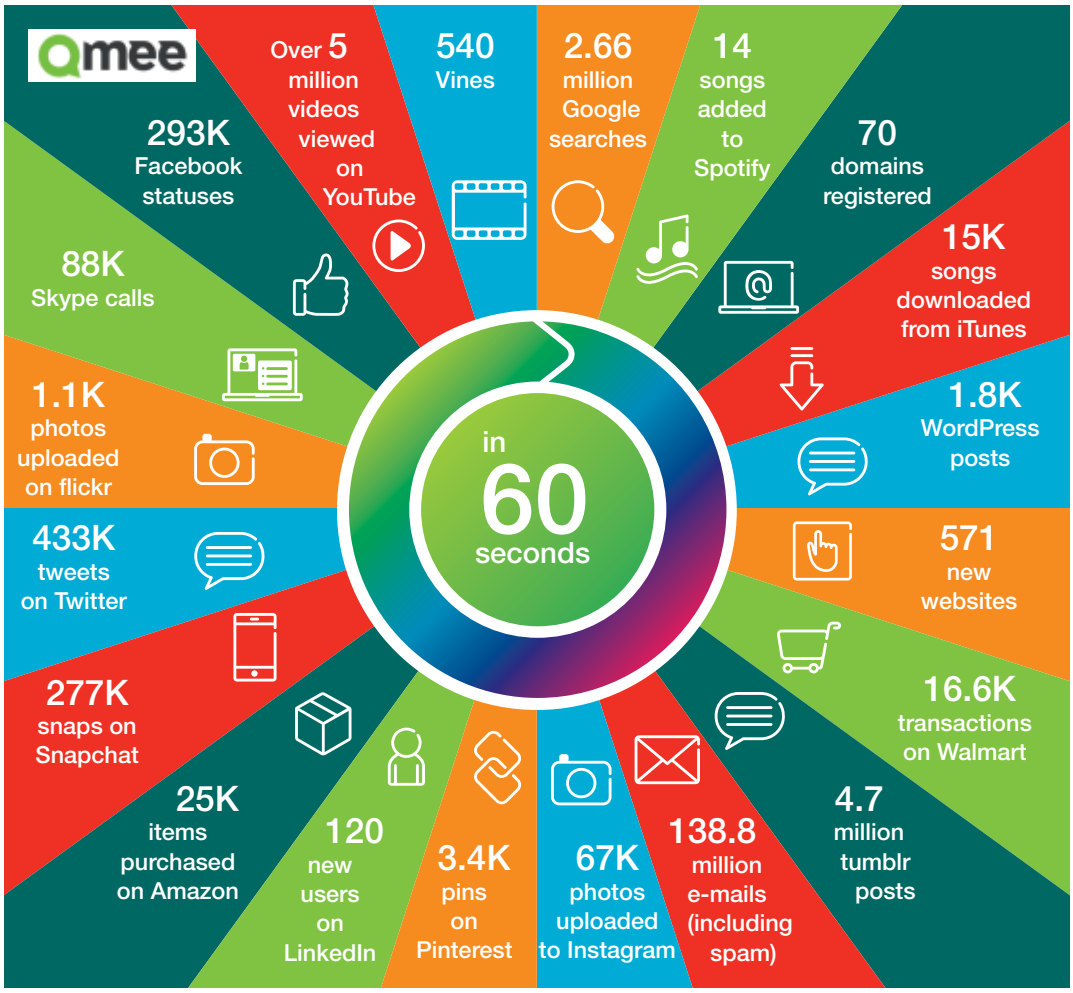
WHERE ARE WE?

The Networked Society is taking shape. New applications brought together through connectivity are being put into operation every day. Children in remote regions attend schools that are wirelessly connected to the internet. Remote monitoring techniques are being used to combat illegal logging and deforestation, trash cans are telling us when they need to be emptied, and machines operating in hazardous environments are being remote-controlled from a safe distance.

These are just some of the applications that connectivity and evolved ICT technologies have already enabled. But it is not just business that is being transformed; people are becoming increasingly dependent on the millions of applications that cellular networks deliver to their smartphones and other mobile devices. Today, for example, more than 5 million videos are viewed on YouTube, and 67,000 images are uploaded to Instagram every minute.

The way people do things is changing: we are moving away from consuming content in groups to a more individual experience (TV has shifted from the living room to the second screen, for example); connectivity is providing the means and smart devices are providing the interface. We are doing more with less: by enabling systems to track, monitor and interact with things, connectivity allows us to use the Earth's resources wisely – to share them, reuse them, and even dispose of them in a sustainable manner.

Figure 1: What we do over the network today in one minute



Source: Qmee

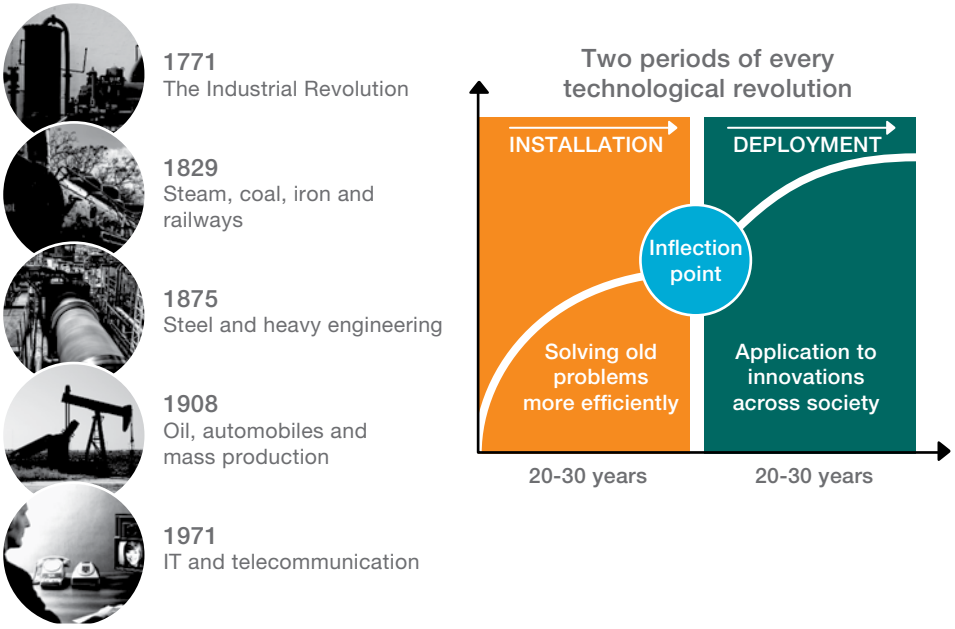
WHAT BROUGHT US HERE?

Carlota Perez is a lecturer and international consultant, specialized in the social and economic impact of technical change and in the historically changing conditions for growth, development and competitiveness. Her theory on technological revolution, which is illustrated in Figure 2, asserts that global change is brought about in two phases.

The first phase, which lasts from two to three decades, is the installation phase. During this time, the infrastructure for new technology is established. In the second phase, deployment (which also lasts for 20 to 30 years), the technology is used, but not for the purpose for which it was originally designed.

Today, we are at the inflection point between the two phases of the ICT revolution. During installation, the players of the telecom industry built mobile telephone networks, which have evolved over time. Today, people, business and society are using those

Figure 2: Inflection point



Source: Professor Carlota Perez
University of Cambridge

networks – originally designed to carry voice from one handheld device to another – to carry massive amounts of data from content providers and sensor networks, aggregated through applications and delivered to a wide variety of systems and devices.

The capability to carry data packets has made it possible to build innovative applications that can benefit society in many different ways. Perez warns that history has shown that the successful players in the installation phase are not necessarily the winners in the deployment phase – unless some sort of business transformation takes place. In other words, the players that built today's networks will not necessarily be part of the development phase unless they adapt.

This theory is clearly illustrated in the use of voice and data in telecom networks. Figure 3 shows the recent trend and predications for global monthly traffic carried by cellular networks. The zero growth in voice has led operators to invest in new technology like cloud and virtualization – which reduces the complexity of managing networks and improves business flexibility.

WHY DO WE NEED 5G?

5G is a shift in mindset: moving from the one-size-serves-all networks with vertical infrastructures to agile networks that can be programmatically built for specific high-level use cases.

Today's networks support just over 7 billion subscriptions with voice, data and mobile-broadband services. The mobile data traffic in Q1, 2014 exceeded the total mobile data traffic in 2011. In 2020, there will be more than 9 billion subscriptions, and billions of things will be connected – all with varying needs. Some will need low-cost connectivity or solutions that consume a minimal amount of energy. Others will require very high speeds to transfer critical data in real time or will need massive amounts of bandwidth.

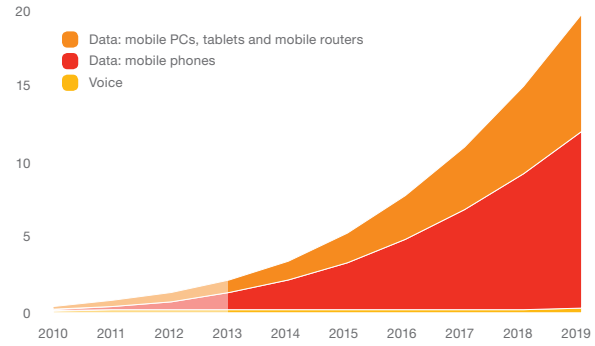
Initially, cellular networks provided people with a way to talk to each other free of location constraints (provided that coverage was available). Today, cellular networks provide people and businesses with access to information and entertainment instantly – as well as the ability to talk – anywhere. As a result, industries are transforming, creating new business cases that use connectivity and in some cases abandoning traditional ones.

Evidence of that transformation is everywhere. The changes in the music and film industries have been dramatic. Music and films are now often consumed as data streams delivered over a network – eliminating the need for physical products that require packaging and shipping.

People in cities can commute more efficiently by using apps that aggregate multiple information streams into short, meaningful information snippets about delays and traffic congestion. But the real benefit will come when a city can aggregate real-time information from multiple sources, when everything – people, cars, trucks, bikes, trains, boats, buses, taxis, and rickshaws – is connected, enabling a seamless transportation infrastructure.

In a connected vehicle scenario, cars and trucks will notify emergency services of their locations in the event of an incident. In similar applications, animals can be tracked to help maintain their safety, assess their health and breeding patterns and prevent poaching and disease, and sensor networks can monitor water supplies to identify leaks and match supply with demand.

Figure 3: Global mobile traffic (monthly exabytes)



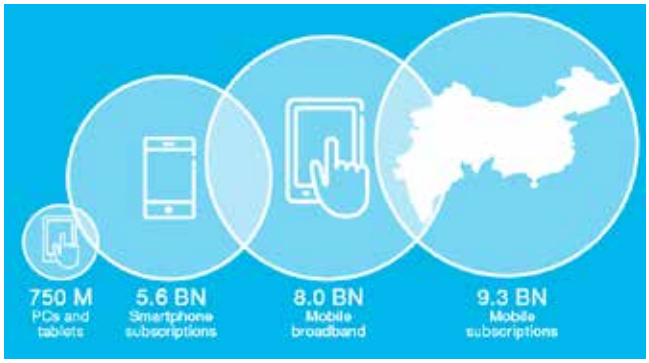
Source: Ericsson

In short, 5G will enable everything and anything to be securely, automatically and remotely monitored – allowing things, systems and infrastructures to run within their operational limitations, with built-in alarm systems, and end-to-end machine-to-machine (M2M) communication – a resource-friendly and cost-efficient platform for a sustainable society. A platform thet will support many use cases that we cannot even imagine possible today.

WHY DO WE NEED 5G?

In the same way that virtualization has made computational power and storage available as a service, capacity, coverage and spectrum will be sold as virtual slices to people, businesses and society. This approach optimizes the use of network resources, ensures that applications run according to their level of security – and above all provides

Figure 4: Network use by 2019



Source: Ericsson

telecoms as a service that is affordable.

Today, services and business processes have to adapt to available performance capabilities, which may not – during busy hours for example – always be enough for some bandwidth-hungry or time-dependent applications. The architecture of 5G systems will be designed to do the opposite, namely to provide the right performance to the use case at hand. Of course, such guarantees will have to be paid for, but people and businesses will have the option to balance their performance requirements against additional cost.

One of today's biggest concerns is security. When the data for a system is provided by the system builder or by a trusted content provider and the service is packaged and delivered by a single enterprise, a given level of security can be guaranteed. But the way services are being built is changing: application programming interfaces (APIs) expose data from their sources, application builders create services by mixing APIs from several content providers, people use information from within a secure network on one device, and on public networks with yet another device. With so many actors involved, providing security from the start to the end of the service chain is no easy task.

Methods to provide secure communication have evolved with the telecom generations. Legacy systems used encryption to protect data, and additional techniques (like network-to-user authentication to protect users against connecting to a rogue base station) have been added as threats evolve.

But in the future, security needs to go beyond the access layer. Security measures need to be included on the application level – and measures will be needed to provide end-to-end security as well as data integrity on a model of trust, with third-party accreditation, in an agile way.

Throughout the evolution of cellular technology, each generation brought with it a fundamental architecture change and a new modulation scheme, which has resulted in a lack of integration among the systems of different generations.

Building bridges between the various technologies has been the traditional approach to overcoming this problem. This patchwork approach will no longer be needed with 5G, whose design is more of a logical evolution, where complementary technologies will be integrated from the outset, than a complete change of architecture. Spectrum-compatible radio design, for example, is one important aspect of 5G architectures that will help to ensure coexistence with legacy wireless access technologies.

Early cellular networks were designed to carry voice. As networks evolved, they started to carry data, and LTE was specifically designed to increase the capacity and speed of carrying data. 5G and its associated technologies will be specifically built for carrying different types of data – notably data for machine-type communication (MTC) and mission-critical MTC – as well as varying network characteristics.

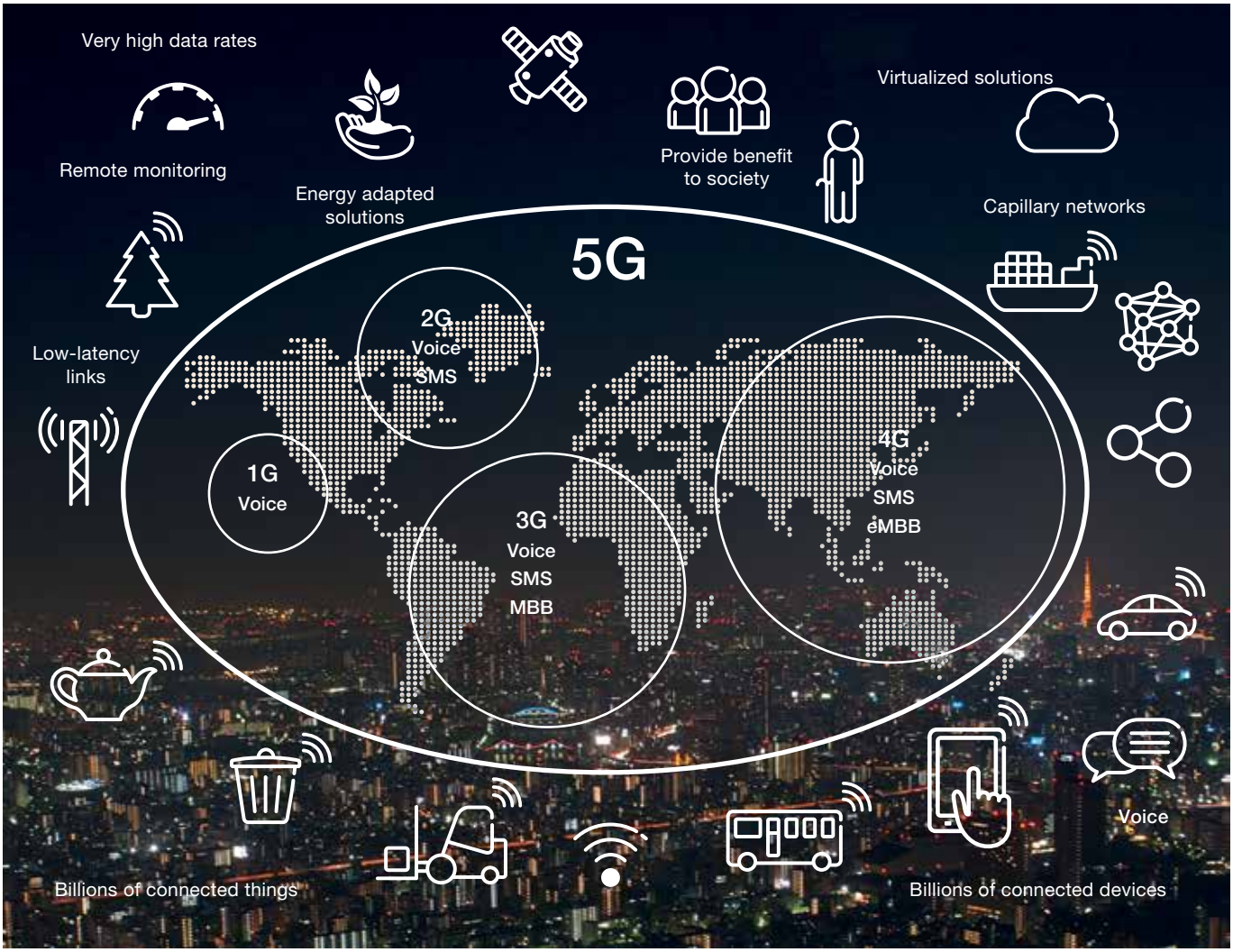


Figure 5: A world where everything is connected

NEW USE CASES

Business transformation is just one aspect of the Networked Society enabling change and change-makers. As an enabler of transformation, 5G is not just about building the future network because we can, but because it makes sense. Higher connection speeds have been shown to have a positive impact on GDP. Connectivity enables people to do things that have previously not been possible: it facilitates entertainment services, and creates new opportunities for businesses to develop. It creates new types of jobs, particularly in developing economies where people and businesses are quick to adapt to new opportunities.

The applications that are built on 5G will bring a benefit to society, support resource sharing, enable smart use of available resources, and deliver connectivity at an affordable price.

Use case – automotive

The automotive industry has been one of the early adopters of connectivity technology – and the benefits it brings to this industry and society are many. The connected vehicle, for example, basically puts a secure local network into a moving vehicle. This network can provide on-demand entertainment and trip-advisory services in the vehicle, but probably more significantly for the benefit of the greater community, it can provide location, weather and status information while the vehicle is moving.

Based on driver behavior and in-vehicle health monitoring, vehicle-to-preferred-supplier service booking becomes automatic, insurance can be adapted to a pay-as-you-drive model, and advanced

diagnostics may be able to repair a vehicle when it is on the road. And this is just what is possible today. In the future, vehicles will assist drivers based on location awareness using near-zero latency communication. Through its ability to create networks for specific use cases, 5G will support communication links to be built with the extremely low latency requirements that such a use case requires.

Use case – remote machinery

Remotely controlling heavy machinery – like excavators in mines or wood processors in forests – could remove the need for people to work in hazardous environments as well as increase efficiency. In some cases, drivers will only be needed to monitor the actions of a machine and be able to monitor multiple machines, while in other cases time-efficiencies can be made by not having to have a driver on location.

CHARACTERISTICS OF 5G NETWORKS

- **flexible** – supporting massive numbers of applications; a multitude of subscriber offerings; varying performance criteria, scalability;
- **secure** – to ensure that people and society are protected;
- **spectrum efficient** – make the most of limited resources, pooling spectrum to avoid industry-specific allocation, and use higher frequencies;
- **affordable** – provide low-cost connectivity for billions of devices;
- **fast** – provide ultra-high speeds for specific applications and subscriber packages; and
- **sustainable** – built using lean architecture and operated using lean communication.

Crucial to this use case is the transmission of high quality video, audio and other sensory information from the remote machine's environment. To control machinery in real time, the latency (delay) of the communication link between the machine and the operator needs to be kept extremely low. This need not only puts requirements on radio access, but also on the transport and core networks. In such scenarios, long transport links should be avoided, and processing may need to be moved closer to the machinery or to the remote driver. In addition, as the machinery and the driver are likely to be on the move, the supporting network will need to be able to adapt.

Through its ability to create networks for specific use cases, 5G will support communication links to be built with the extremely low latency requirements and high reliability requirements that such a use case requires.

Use case – media

TV viewing is shifting from a traditional broadcast over the air model and cable-provided over fiber or satellite to TV anywhere over the cellular network, Wi-Fi and fiber. People no longer gather around the TV set to watch the news at a specific time. Instead they use multiple screens to consume video while sitting indoors or outside, and while on the move – in their cars, on public transportation and while traveling on high speed trains and airplanes. People consume different types of media from scheduled TV, live TV streams, video on demand (VOD), as well as radio and music streaming feeds, and web-based video content.

5G for TV and other media will provide an optimized media delivery service that meets the different usage patterns for media content consumption in different places. Typical use in the home currently tends toward longer viewing with high quality content over fiber and Wi-Fi. But by 2020, billions of video-enabled devices will require indoor coverage at home, as well as in public places like hotels, malls, and coffee shops.

The billions of video-enabled devices will, to a large extent, be industrial video for machine monitoring, remote-doctor applications, security, surveillance and image recognition, where large amounts of media and binary data will need to be supported for both up- and downlink communication.

Ericsson is the driving force behind the Networked Society – a world leader in communications technology and services. Our long-term relationships with every major telecom operator in the world allow people, businesses and societies to fulfill their potential and create a more sustainable future.

Our services, software and infrastructure – especially in mobility, broadband and the cloud – are enabling the telecom industry and other sectors to do better business, increase efficiency, improve the user experience and capture new opportunities.

With more than 110,000 professionals and customers in 180 countries, we combine global scale with technology and services leadership. We support networks that connect more than 2.5 billion subscribers. Forty percent of the world's mobile traffic is carried over Ericsson networks. And our investments in research and development ensure that our solutions – and our customers – stay in front.

Founded in 1876, Ericsson has its headquarters in Stockholm, Sweden. Net sales in 2013 were SEK 227.4 billion (USD 34.9 billion). Ericsson is listed on NASDAQ OMX stock exchange in Stockholm and the NASDAQ in New York.

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