

CRS Insights

What Is 5G? Implications for Spectrum and Technology Policy

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In the progression of improvements to mobile communications, 5G refers to fifth-generation technologies, the next cycle in expected communications technology breakthroughs. Although no officially recognized definition of 5G exists, it is presumed to include progressive improvements in existing technologies as well as unspecified new technologies.

The wireless industry has responded to increased demand for mobile services linked to the arrival of smartphones with significant investments in infrastructure for 4G technologies. It is again investing billions of dollars in new infrastructure and devices to meet accelerating demand, fueled by continued growth from existing markets and by the communications needs of new categories of mobile devices. These devices, often tiny sensors and optical readers, are part of trends often classified as the [Internet of Things](#) or the [Industrial Internet](#). These concepts might be considered a subset of the field of [cyber-physical systems](#), the joining of digital and physical systems to perform complex [tasks](#).

Some predictions from industry observers are:

- 5G networks will provide instantaneous connections of everything, anytime, anywhere.
- 5G devices will be able to operate across networks on almost any available radio frequency.
- 5G service providers will rely heavily on sharing spectrum resources, using licensed or unlicensed technologies as needed.
- 5G technology might provide a point of convergence for communications technologies and cyber-physical systems.

To accommodate the increased demand for mobile data communications from the existing consumer and business markets for mobile services and the coming wave of new users and uses, 4G technologies using standards such as Long Term Evolution ([LTE](#)), [LTE Advanced](#), and the Institute of Electrical and Electronics Engineers (IEEE) 802.11 [suite](#) would need to become increasingly powerful. Needed breakthroughs are typically discussed as improvements in speed, capacity, and throughput; reduction in latency (time delays); and other performance criteria.

To achieve the necessary improvements, many industry experts believe that new standards and new network and device solutions must be introduced for 5G. These technological innovations would likely require or create new ways of doing business.

5G represents opportunities for new business models and new forms of innovation and competition. (See CRS Report R43595, [Mobile Technology and Spectrum Policy: Innovation and Competition](#).) 5G possibly represents a reversal of the existing business model for the wireless industry from one that creates markets by delivering a constantly changing flow of new technology to one that responds to demand from totally new markets, such as the ones being created through the advances in cyber-physical systems. Since current spectrum policy—the provision of electromagnetic spectrum for the deployment of wireless technologies—is shaped around the existing wireless company business model, one that notably favors economies of scale, the introduction of new business models might require new spectrum policies. Conversely, changes in spectrum policy might be conducive for the arrival of new communications industry business models that have been developed in response to potentially vast new demand from other industrial sectors.

One characteristic of the typical wireless industry business model is that companies act as gatekeepers for the introduction of new mobile devices. In marketing terms, this practice might be described as "push" marketing—the ability of a supplier to create consumer demand by taking its product or service to the customer. The converse, "pull" marketing, occurs when consumers create demand by insisting

on a product. The iPhone, the iconic smartphone, was pushed into the mobile marketplace when AT&T agreed to carry it on its network. The success of the iPhone created consumer demand that pulled in much of the rest of the industry. This helped to power the shift from 3G to 4G networks.

Incumbent wireless service providers often discuss the arrival of 5G in terms of pushing breakthrough technologies delivered to eager customers. 5G might, however, be shaped not by carriers pushing new technology but by demand from new customers, customers that are the mainstay of important industrial sectors other than telecommunications. These include transportation, agriculture, energy, mining, defense and public safety, entertainment, medicine, and finance, to cite some examples where new technologies are influencing whole industries. These industries might prefer not to manage important parts of their business based on somebody else's business model, and may demand new techniques and new service providers.

Around the world, a number of consortia have formed to study the opportunities presented in the development of 5G, often with the stated intention of becoming the global leader in communications technologies. (See CRS Insight IN10110, [***Deploying 5G \(Fifth Generation\) Wireless Technology: Is the United States on Track?***](#)) A number of American companies are members of these consortia. In the United States, the Federal Communications Commission (FCC) has issued a Notice of Inquiry (NOI) that, among its objectives, seeks a better understanding of the development of 5G and future spectrum needs. The United States, however, does not have a cohesive effort specifically focused on accelerating development of 5G technologies and exploring the potential impact of 5G on national policy.

National efforts to take the lead in 5G appear to be building mainly on the push theory of delivering a better product through existing [channels](#): primarily the four major wireless carriers. Some analysts have observed that spectrum policy is often customized to meet the business plans of these few leaders. They note that the United States has the opportunity to develop a broader approach, embracing the potential of cyber-physical systems and the many industries that it is transforming. Although communications links are only part of the complex interactions that characterize these new systems, they are often an essential component. The United States is currently characterized both as a leader in mobile broadband technologies and in cyber-physical systems. Leaders in these fields believe that policies that permit a convergence of the two technological forces might provide an opportunity to boost national economic growth and create wealth in the form of jobs and return on capital investments. Some observers question whether the FCC has sufficient authority to exploit these opportunities, possibly requiring action from Congress to establish policies and direction that encourage multi-stakeholder development of 5G and the Internet of Things.