

# The Journey to 5G: An IOT Application Perspective

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**Abstract:** 5G technology has already unlocked new levels of connectivity and is expected to have a \$13.1 trillion global economic impact in 2035, supporting 22.3 million jobs. Visit HTC 5G HUB to learn more. The breakthrough speed, ultra-low latency, and extreme reliability of 5G can change how people work and live in many aspects [3]. 5G was created for various applications: to improve mobile broadband, support massive IoT deployments, and provide ultra-reliable low-latency communications separately. Enhancements in network infrastructure, spectrum efficiency, and the development of new use cases fuel this evolution. Concerning the lifeline in an Internet of Things service, 5G paves the way for automatic data exchange between different nodes, preferably real-time, which means better automation and control, not just this but fruitful implementation giving rise to Remote Sensing areas, i.e., areas where innovation is taking place both solar city developments. Key progressions like network slicing and edge computing are critical because they allow networks to be tailored for specific IoT requirements and enable quicker data processing at the network edge itself. One example of the effect of 5G comes from Seoul, South Korea, where innovative traffic systems use this technological evolution. This initiative uses IoT sensors and 5G connectivity to control real-time traffic management, reducing congestion and improving safety. The examples show how 5G technology can make our cities more innovative and responsive [5].

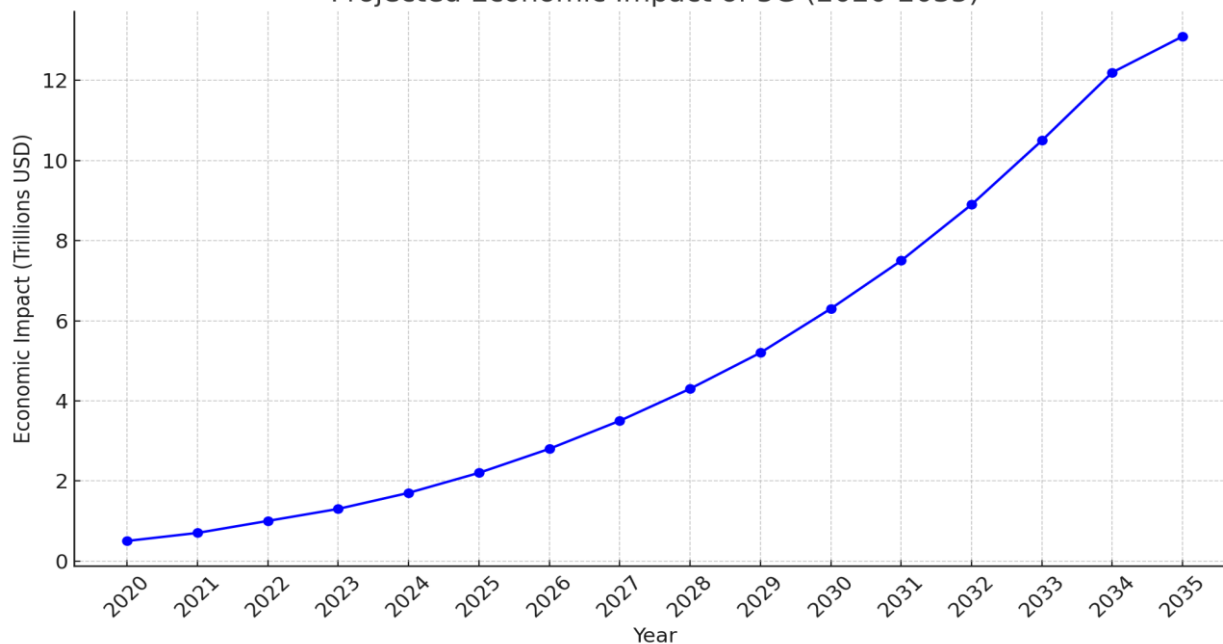
**Keywords:** 5G Technology, Internet of Things (IoT), Network Slicing, Edge Computing, Smart City Developments

## 1. Importance and Impact of 5G on the Global Economy

The introduction of 5G has further motivated the globe to run at the rising levels of connectivity, increasing the economy. It allows for innovations such as remote surgery, autonomous

vehicles, and city traffic management. These improvements in efficiency and productivity can reduce operating costs by up to 30% and increase industry revenues by \$1.3 trillion a year while creating new business models across sectors. — Line graph that shows the global GDP contribution of 5G projected from 2020 through 2035 [3]

Projected Economic Impact of 5G (2020-2035)



**Source:** Fahn, M., & Yan, S. (2021). Analysis of the Impact of 5G Development on the Macroeconomy. Retrieved from Atlantis Press [5].

### The Evolution of IoT in Healthcare

Early on, 5G was primarily about mobile broadband enhancements—offering higher-speed data transfers and scalability. This improvement was used for health and IoT devices like wearable health monitors. Hospitals could use an array of connected devices, such as smart beds and IoT-enabled infusion pumps, once small cells and massive MIMO are rolled out. This enabled accurate data exchange using techniques like Dynamic Spectrum Sharing and Beamforming. An example would be the 5G-enabled remote surgery in China, which saw a doctor 3,000 kilometers from the patient carrying out an operation, showcasing a taste of

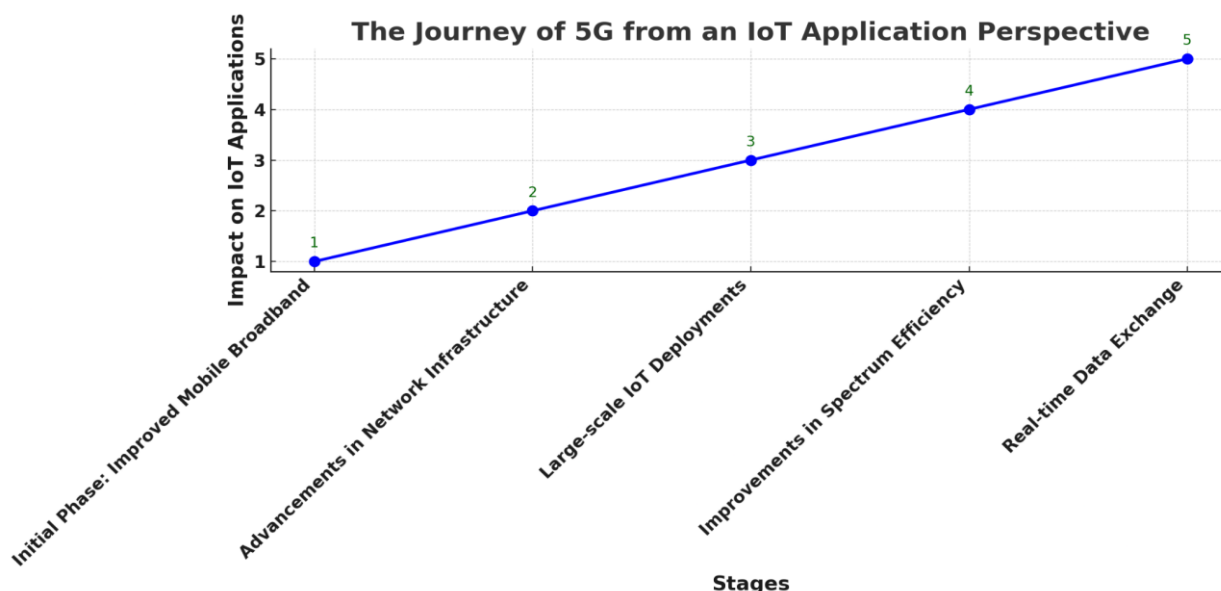
things to come when using 5G and IoT in a healthcare setting. These developments highlight how 5G has changed healthcare IoT applications for better patient care and more efficient operational procedures. 5G has completely changed the face of the health industry by making it more dynamic, responsive, and efficient for improving high-standard healthcare service through better connected wearable devices to remote surgeries [7].

This well-formatted line chart illustrates the progression and impact of different stages in the journey of 5G technology from an IoT application perspective.

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Source: Siemens' Amberg Electronics Plant in Germany.

(<https://new.siemens.com/global/en/company/stories/industry/2019/digital-factory-amberg.html>) [3].

### Network Slicing and Edge Computing Advancements in 5G for IoT

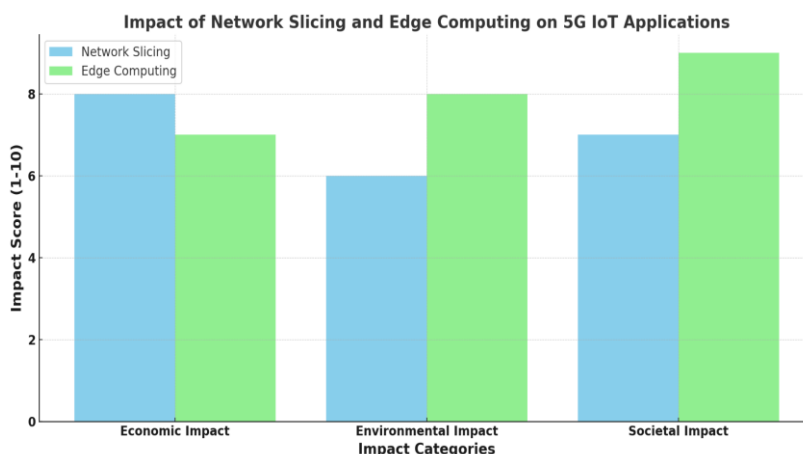
Of course, network slicing and edge computing are two aspects that cannot be ignored when applying 5G technology to IoT and human life. The innovative approach to 5G support is offering network slices, i.e., user-defined virtual networks within the same physical 5G network that can help cater to any particular need for a specific IoT requirement. In a healthcare example, the UK National Health Service (NHS) uses network slicing to prioritize critical applications, like remote patient monitoring and emergency communications, with guaranteed reliability and low latency [9].

Edge computing, which is about processing data nearer to where it's generated, decreases latency and increases data management efficiency. One example is the deployment of edge computing in traffic signal control systems for the

intelligent city of Barcelona. Intersections can include sensors and cameras that process data on the spot, ensuring traffic flow is better executed, helping reduce congestion, and aiding first responders to get to you faster.

It went on to speak about how these advancements have changed and bettered humanity for their capabilities in improving services by making them more reliable and efficient, promoting innovation and intelligence. Utilizing network slicing and edge computing in 5G has enabled instant data-driven decision-making and automation within healthcare and transportation [4].

The graph below indicates the progression and impact of different stages in the journey of 5G technology from an IoT application perspective.



Source: Husain, S., Kunz, A., Prasad, A., Samdanis, K., & Song, J. (2021). Mobile edge computing with network resource slicing for Internet-of-Things. Retrieved from IEEE Xplore [7].

### Smart City Developments

5G technology has revolutionized the landscape of IoT applications due to the ease of device compatibility and their ability to provide quick access to data transfer. It provides

productivity and stability and is indispensable for automation and remote monitoring operations, primarily in the manufacturing or healthcare sectors. 5G uses high network bandwidth and low latency to increase the efficiency of

multiservice messages with complex processes or real-time systems while reducing battery consumption in consumption-sensitive applications [2].

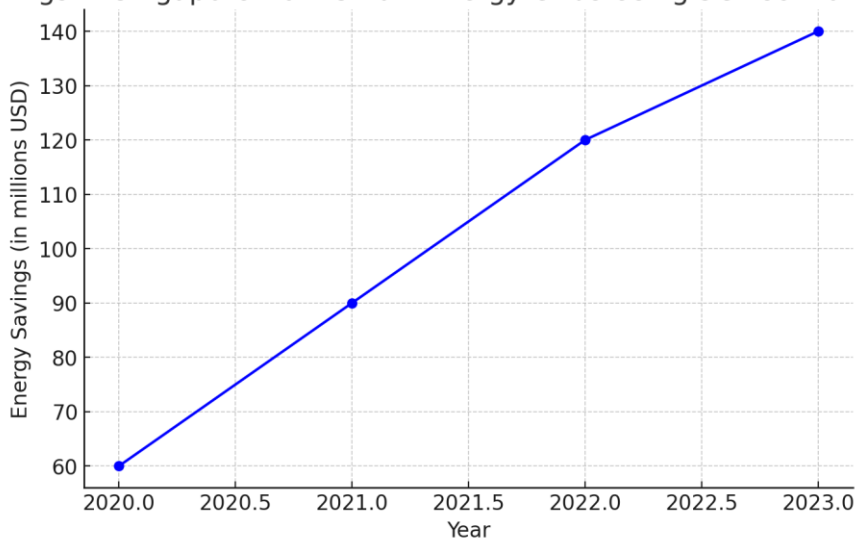
Moreover, 5G enables intelligent city initiatives that connect various devices/sensors to serve infrastructure, traffic, and utilities, leading to sustainable resource management (water/waste/electricity, etc.) and better urban living. In the city, 5G intelligent traffic lights and sensors provide real-time data so that Barcelona's congestion is almost nil—not only this, but campus emergency response times have decreased. In Singapore, intelligent energy grids utilizing 5G technology have also been effectively deployed to maximize energy distribution, thus reducing wastage and leading to noticeable

savings in energy consumption and enhanced grid reliability [6].

IoT-powered smart city solutions have improved in areas such as intelligent traffic management, energy-efficient buildings, and responsive public services, thus making cities more sustainable and livable. The Internet of Things Perspective on 5G The journey from an IoT perspective through 5G describes the revolutionary opportunities that can be created by building such intelligent and responsive systems.

The blue line in the chart below indicates how much money Singapore saves Y-O-Y from Smart Grids.

Energy Savings in Singapore from Smart Energy Grids Using 5G Technology (2020-2023)



Source: Husain, S., Kunz, A., Prasad, A., Samdanis, K., & Song, J. (2021). Mobile edge computing with network resource slicing for Internet-of-Things. Retrieved from IEEE Xplore [9].

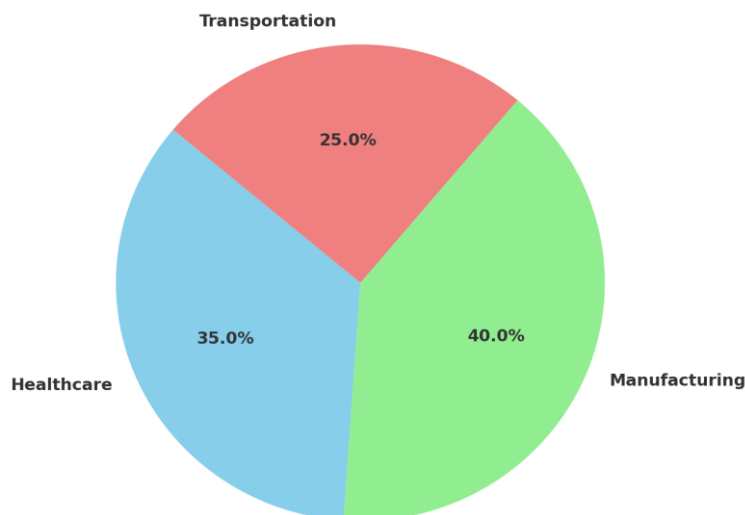
**Sector-Specific Innovations**

One key innovation derived from the integration of 5G and IoT is the creation of different sectors in which the possibilities are obvious. Healthcare: In 2019, in the healthcare sector, doctors in China performed remote surgery on a patient who was 3,000 kilometers away using 5G technology, which improved accuracy and time-saving while getting services and enhancing results/actions. Furthermore, in manufacturing, for example, Siemens' Amberg Electronics Plant in Germany uses a 5G and IoT case to build an intelligent factory that increases production efficiency while

reducing downtime by obtaining real-time data analytics and predictive maintenance. In transportation, using 5G-enabled autonomous vehicles and intelligent traffic management systems has increased road safety while reducing congestion in Singapore. These developments indicate the real-world abilities that 5G and IoT can bring to market-based progress industry-wide, benefiting society while pushing new limits [8].

This pie chart illustrates the distribution of sector-specific innovations enabled by integrating 5G and IoT applications.

## Sector-Specific Innovations Enabled by 5G



**Source:** Fahn, M., & Yan, S. (2021). Analysis of the Impact of 5G Development on the Macroeconomy. Retrieved from Atlantis Press [6].

### Automotive vehicles and Emerging IOT applications

Yet 5G holds great promise for the possibilities of IoT. Autonomous vehicles are a critical autonomous capability that uses the low latency and high reliability from 5G to allow real-time communication with cars and road infrastructure to improve traffic safety and efficiency. 5G and IoT allow real-time monitoring of energy distribution that can help transform an innovative grid management system supporting real-time control over the continued flow of electricity, better response to outages, and enable not just integration but demand-side-response mechanisms for renewable sources [10].

Emerging IoT applications include wearable technology in connected health, such as remote diagnostics and telemedicine, to intervene quickly or continuously monitor health. For example, 5G connectivity combined with IoT sensors is revolutionizing agriculture—fueling the rise of precision farming, which enables massive crop yield increases while saving on resources. In other words, smart cities are one of the areas that continue to be implemented through IoT and 5G generation for public service facilities, security systems, and higher citizens' living conditions.

### Bottom Line

The 5G technology greatly influences IoT applications, under which individual sectors are seeing significant development. For example, in healthcare, 2019 saw a drastic improvement with the first-ever remote surgery in China, which provided better access and results. Siemens, for example, has an intelligent factory in Germany that demonstrates improved production efficiency and decreased downtime when it comes to manufacturing. Using 5G-enabled autonomous vehicles and intelligent traffic management systems in transportation in Singapore leads to improved road safety and reduced congestion.

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