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5G & IoT Panel Discussion

It is predicted that within the three years, the number of IoT devices worldwide will be somewhere in the region of 40 billion. Each of those devices will need a network to connect and communicate, and hopes are high that 5G will meet the challenge and expand the capabilities of IoT. With the addition of LoRa and SigFox networks, the breadth and reach of IoT will be significant, ranging from small, precise data readings to complex interactions between devices and the cloud.

To gain a clearer picture of how 5G Network coverage will impact IoT, we reached out to a panel of experts. Comprised of researchers, analysts, and advisors, our respondents provided us with in-depth and insightful information on how frequencies and frameworks will impact 5G propagation and bandwidth, and what solutions and new strategies are emerging.

Our 5G and IoT panel includes Nader Famili, MTS leader at Radio Frequency Systems (RFS), Scott Terry, VP of Engineering at SureCall, Dr. Nikhil Adnani, CTO at ThinkRF, Brad Jolly, Sr. Application Engineer, Barry Scott, IoT Program Manager, and Roger Nichols, 5G Program Manager from Keysight Technologies, and Dr. Esteve Hassan, Ph.D., PEng, Industrial Research Chair for IIOT Applications, Mohawk
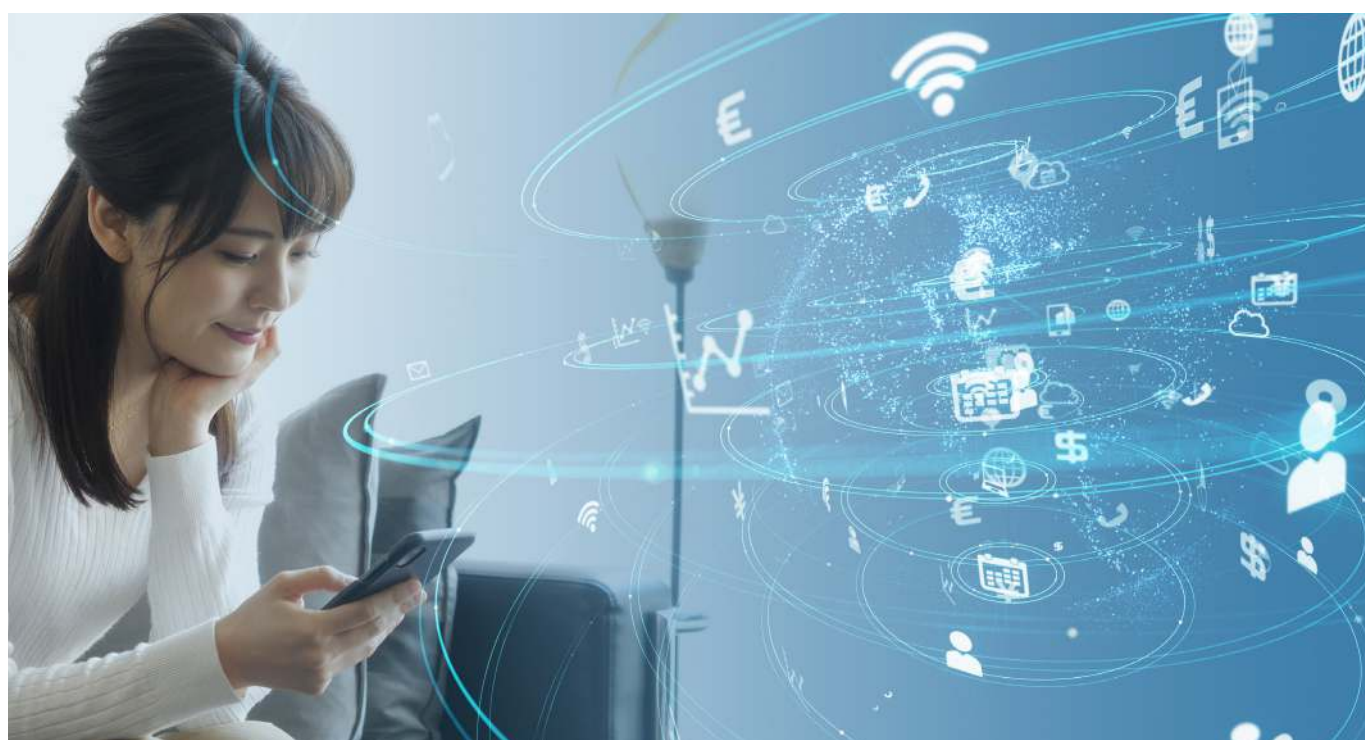
PANEL DISCUSSION

What are the differences between the 5G IoT layer and the LoRa and Sigfox networks?

Along with enhanced mobile broadband and ultra-reliable low latency communication, massive connectivity has been one of the essential requirements for enabling technologies of 5G. While 5G IoT, LoRa, and Sigfox are often portrayed as competing technologies, the truth is that each plays an important role when it comes to IoT.

Ultimately, the difference is one of scale. While both LoRA and Sigfox are primarily based on unlicensed frequencies, which may limit their use to small and medium enterprises, 5G IoT is based on licensed frequencies and can be used wherever 5G coverage is available. Nevertheless, as Dr. Esteve Hassan, Ph.D., PEng, Industrial Research Chair for IIOT Applications, Mohawk College points out, " for IoT, low power consumption and wide area coverage for end devices (ED) are important figures of merit, which make LoRa and SigFox are dominant technologies."

Dr. Nikhil Adnani, CTO at ThinkRF adds another layer, explaining that because of its broader coverage capabilities, 5G IoT is "more suited for more ubiquitous applications, anytime, anywhere."

"The ecosystem for 5G IoT is considerably larger," Nader Famili, MTS leader at RFS explains. "In the longer term, that means a lot more frequent upgrades, cheaper devices, and ever-evolving technology and applications."

"Broadly speaking, the three technologies are appropriate for different application sizes," summarizes Brad Jolly, Sr. Application Engineer, Barry Scott, IoT Program Manager, and Roger Nichols, 5G Program Manager at Keysight.

LoRa also operates in unlicensed bands, with data rates from 300 bps to 50 kbps, allowing it to be used in applications where the data volumes are simply too much for Sigfox. LoRa is also supported by a prominent alliance comprised of some 500 members.

At 0G, Sigfox is the lightest network that Brad Jolly describes as "the polar opposite of 5g."

"It operates in unlicensed spectrum, has very low data rates between 100 and 600 bps, and has a long battery life in applications with small amounts of data, such as environmental sensors that measure something once or twice a day and sleep the rest of the time," Jolly adds.

Unlike Sigfox and LoRa, 3GPP standards for IoT were designed for primary operation in a licensed spectrum. The 3GPP IoT standards support higher data rates and a larger device-connection scale, with 1 Mbps for LTE Cat M1 and 250 kbps for NB-IoT (as of 2016). As a result, much denser applications are supported, as Keysight puts it, "tens of thousands of IoT devices per cell."

"The 5G standards, especially starting with 3GPP Rel-16, will take the next step in terms of capacity and flexibility," concludes Keysight. "(Enabling) large range of data-rates, much higher connection density and quantity, and compatibility with existing cellular infrastructure."

Discussion Panel Expert: RFS

RFS positions itself as the telecommunications partner of the transportation industry featuring field-proven innovations spanning in-tunnel, in-building, and outdoor wireless coverage solutions for the transportation market, including turnkey solutions for optimized communications.

Radio Frequency Systems provides the most advanced active, passive and hybrid RF distribution systems for in-tunnel coverage, railway station coverage, and outdoor track-side rail coverage.

Why is 3.5 GHz a core candidate for 5G?

IoT in the 5G system will be a game-changer in the future generation. It will open a door for new wireless architecture and smart services. Existing cellular networks, like LTE (4G), will not be sufficient and efficient to meet the demands of multiple device connectivity, which will require higher data rates, more bandwidth, low-latency quality of service (QoS), and low interference.

"To address these challenges, we consider 5G as the most promising technology," says Dr. Hassan. "In the context of wireless technology, fifth-generation (5G) technology has become the most challenging and interesting topic in wireless research."

5G is built around considerably higher throughput (x10), much shorter latency (<1 ms), and the use of a lot higher concentration of devices.

As Nader Famili explains, the high concertation of devices is, "specifically targeted toward IoT applications."

"A 5G gNodeB will be capable of maintaining connections with 100s of thousand devices and, as such, can accommodate any type of IoT application," he says.

5G will also allow for an expansion of IoT use-cases, including both the kinds of things for which SigFox or LoRA were designed (low data-rate, large-area, low power), as well as applications that require higher speeds (e.g., automotive and industrial), low latency, and very high reliability. 5G will also "increase the infrastructure footprint available for IoT applications, especially those requiring real-time handoffs for mobile devices," says Jolly. "The limiting factor is, however, that 5G IoT systems will be available only where 5G networks are deployed."

For Adnani, the key improvements and differentiators for 5G are low latency and faster throughput.

"Within the context of IoT, low latency is key to real-time processing required in smart factories, robotics, and automation," he says. "As data flows across network IoT sensors, for instance, 5G means higher throughput with the capacity to process data from a larger number of sensors than previously possible."

"Furthermore, low latency results in faster response times where required."

"When you combine this with the 5G technology, those devices can take advantage of what5G offers," adds Scott Terry, VP of Engineering at SureCall. "Where this will mostly be seen is in devices that can take advantage of very high speed and/or very low latency, which are the two main benefits of 5G."

"This will be very big for industries like factory automation, construction sites, and automotive transportation. But in the end, every industry will get benefits from what 5G does for IoT."

Discussion Panel Expert: Keysight

Keysight Technologies is a leading provider of RF test and measurement equipment. From parametric test of semiconductor wafers to functional and production test of PCBs to the final test of computer systems, Keysight products help engineers achieve the best performance possible. Keysight can also help designers of high-speed digital devices achieve cutting-edge performance while verifying compliance and interoperability with industry standards.

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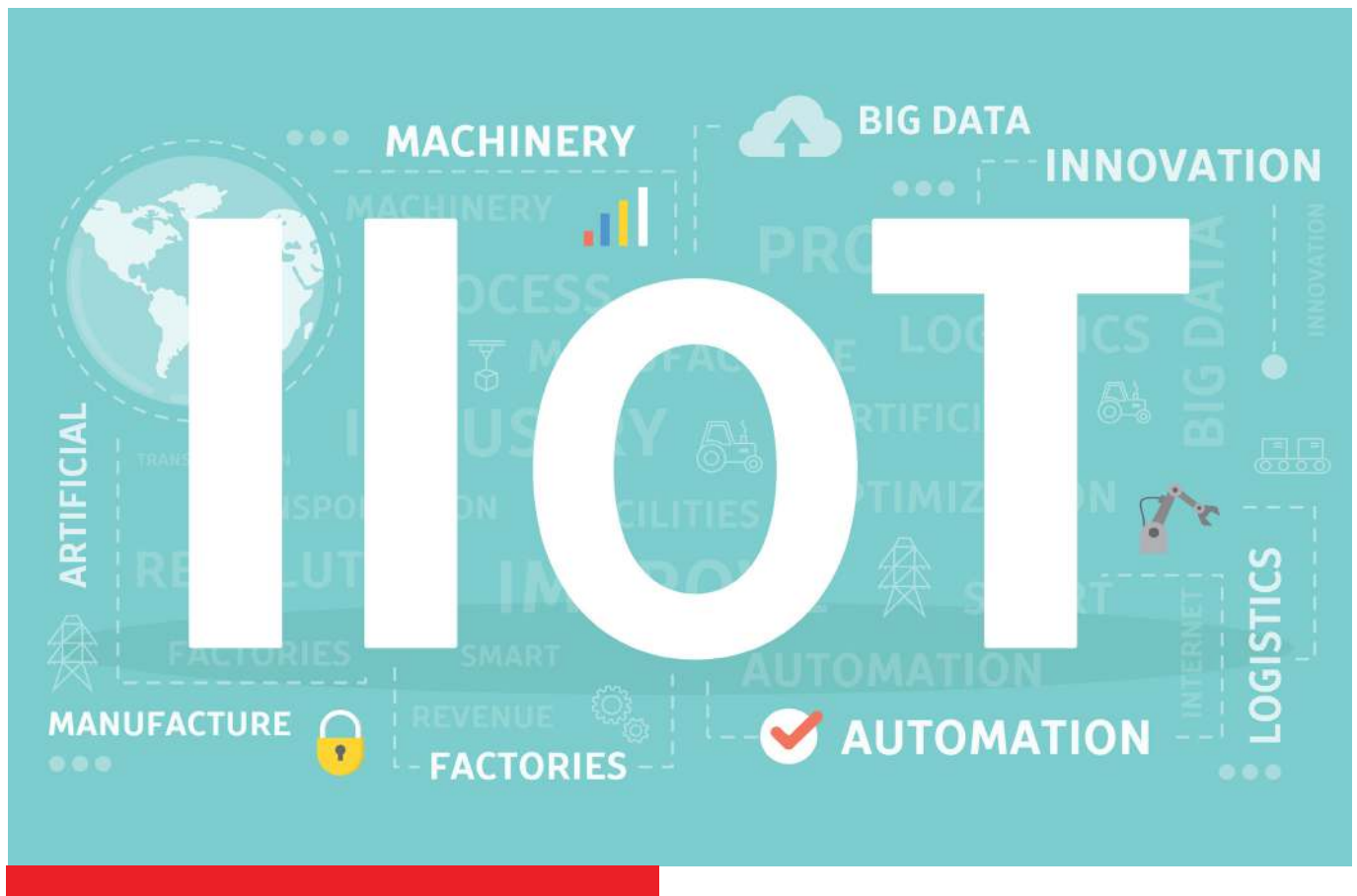
What is the Internet of Things (IoT), and how is it different from IIoT (Industrial Internet of Things)?

"When you think of "the Internet," you think of people exchanging information via social media, videos, web sites, e-mail, etc. The IoT is similar, except it is electronic devices exchanging information (on behalf of people). If all people suddenly disappeared, traffic on the traditional internet would quickly plummet, while the IoT would tick along as usual until batteries started to run out. IoT allows for the connection of "smart" objects to the internet. These smart objects are devices that receive, transmit, and possibly analyze data," says Brad Jolly.

"Industrial IoT is just that subset of the IoT used for industrial purposes, such as manufacturing and process control and industrial applications in areas such as automotive manufacturing and the Oil and Gas Industry. These objects could be sensors, home appliances, city furniture, or anything else for that matter. IIoT also has the characteristics of connectivity and intelligence. However, IIoT refers to applications used for industrial purposes such as manufacturing and transportation. The goals of an IIOT deployment broadly speaking are enhancements in productivity and reduction in cost.

The IIoT requires a lower latency than many other IoT segments, which is significant for activities like machine monitoring and control, where fractions of a second matter," says Dr. Adnani

"There are two other primary challenges in IIoT," says Jolly. "The first is a reliability requirement given that IIoT will likely involve some mission-critical functions for the industry in question. The second is that IIoT will have a majority of installations indoors where connection densities are high, and radio interference issues become more significant."

"Important considerations for IIOT are security, reliability, accuracy, and precision," adds Dr. Adnani. "IoT also includes wearables and other products for consumer applications where the impact of lower reliability or accuracy, for instance, isn't as high."

"Industrial Internet of Things (IIoT) plays an indispensable role in Industry 4.0, where people are committed to implementing a general, scalable, and secure IoT system to be adopted across various industries," concludes Dr. Hassan.

How will 5G latency be lower if the processing is being done in the cloud?

According to the team at Keysight, there are two major technical contributors to lower latency in 5G systems. The first is a redesign of the air-interface protocol, which allows for, among other things, connectionless data-exchange (data is sent without the complexities complex handshakes), and self-contained sub-frames which will enable for successful packet communication to be acknowledged in much less time. The second area is in establishing more computing in the network—on the "edge" so that information travels through much less of the network before being addressed by the application in question.

Part of the latency is core processing. Clearly, the core processing will have more delay if done in the cloud, which is why an important aspect of 5G is edge services.

"By using the concept of CUPS (control and user plane separation), 5G networks will try to process as much of the data at the edge (close to the user) and process the control data on the cloud," says Nader Famili. "This will reduce the latency for user plane data tremendously. In addition, other techniques in 5G air interface and IP flatness also contribute to the reduction of the latency."

"Not all processing will be done in the cloud," adds Jolly. "Some processing will take within single edge devices, some will be done in the "fog" of edge devices, and some data will be locally cached."

"Cloud computing is great for applications with huge amounts of data and processing power, but getting data to and from the cloud can be problematic," he adds. "The 5G networks will have large bandwidth to transfer data from towers to the cloud, but will also take full advantage of mobile-edge computing to process information quicker."

"Through adopting a hierarchical edge cloud-based traffic networking, low latency is expected to be much lowered in 5G," adds Hassan.
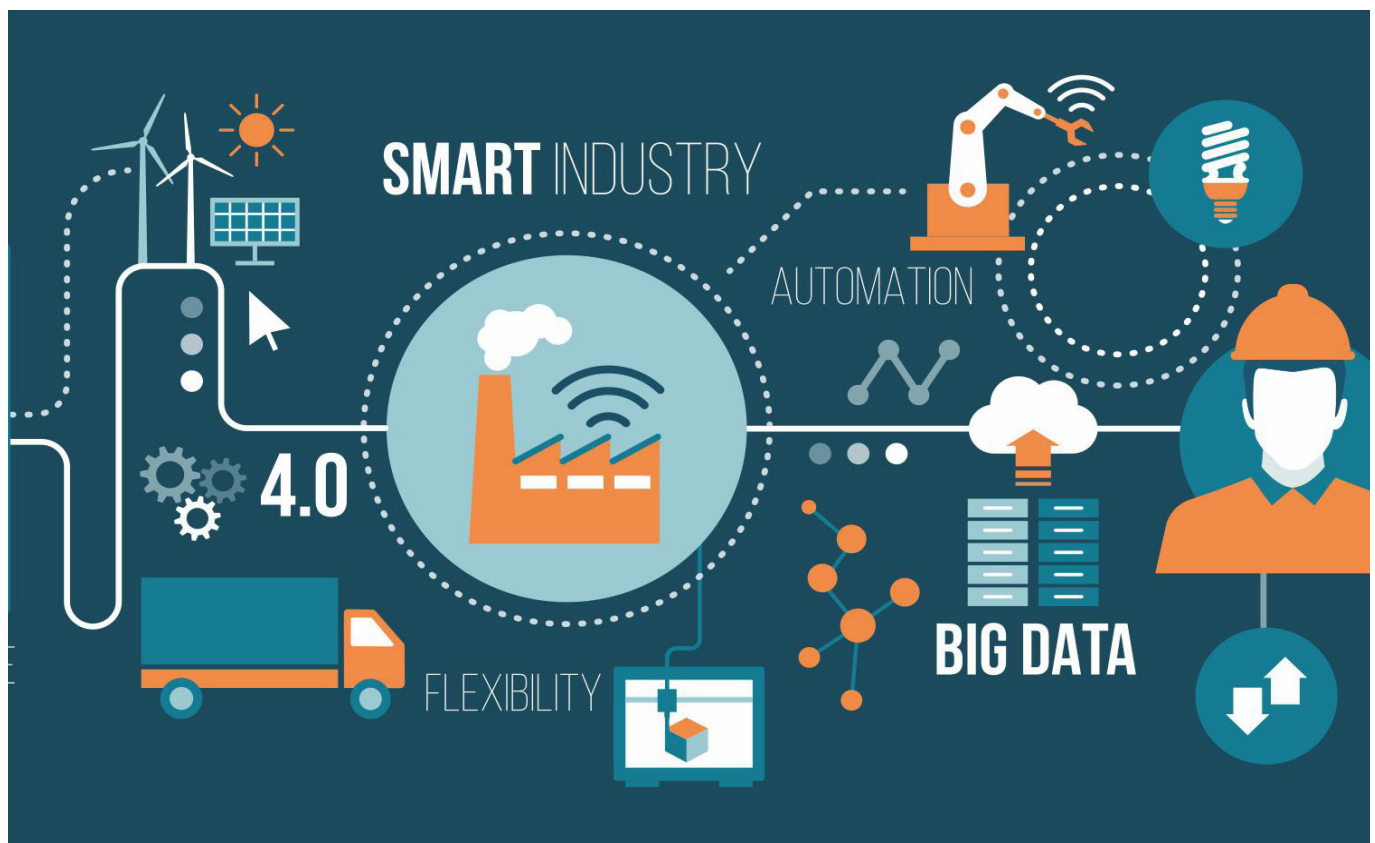
What do you see and believe that 5G technology will have important implications for the logistics industry?

The logistics industry has long relied on wireless technology for tracking and delivery time estimation. Nader believes the expansion of 5G will allow for an expanded ability to track accounts with exact time and location.

"5G technology, given its low latency and high throughput capabilities, will also allow the logistics industry to develop much more sophisticated applications that suit their needs," he says. "The addition of drones relying on 5G for control and guidance, will also further expand logistics industry capabilities."

Terry disagrees. "It is erroneously thought that 5G will help the logistics industry due to more coverage of 5G signals; however, 4G will continue to have better coverage going forward for logistics services that use IoT devices for tracking," he says. "Where 5G can help is in certain logistics applications that can take advantage of the much higher data rates. This can be applications that benefit from high-resolution video to remote locations for providing assistance or navigation, or to logistics that can benefit from virtual reality (VR) or augmented reality (AR) to allow intelligent remote assistance."

"Low latency is a key one, especially for vehicle safety," adds Jolly. "The amount of data that can be shared is much greater, which opens up real-time video applications inside of vehicles and warehouses, (and) real-time tracking creates opportunities for optimizing vehicle routing, improves delivery estimation, and reduces the need for incoming inspection since the data trail is so much more complete."

"The on-going digital transformation is key to progress towards a new generation of more efficient, sustainable, and connected industrial systems," concludes Hassan. "This new generation, commonly referred to as industry 4.0, will be accompanied by a new wave of use cases that will allow companies from logistics and manufacturing sectors to increase flexibility, productivity, and usability in the industrial processes executed within their factory premises."

"Unlike typical use cases from other vertical sectors (e.g., energy, media, smart cities), industry 4.0 use cases will bring very stringent requirements in terms of latency, reliability, and high-accuracy positioning. The combination of 5G technology with enterprise network solutions becomes crucial to satisfy these requirements in indoor, and private environments."

Are testing standards in place for IoT devices and networks?

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Discussion Panel Expert: **Surecall**

SureCall develops industry-leading cellular signal boosters that provide people and businesses with enhanced connectivity using superior technologies that improve their ability to stay connected at home, in the office or on the go. SureCall leads by innovation. Since 2001, SureCall has been the first-to-market leader in new signal booster technology. Premium parts and innovative design result in the longevity and reliability of SureCall boosters.

Will large numbers of connected objects increase exposure to radio signals?

Large numbers of connected objects will indeed increase exposure to radio signals. In fact, Ericsson has predicted that there will be over 5 Billion cellular IoT devices in 2025. However, in total, including unlicensed band technologies, Dr. Adnani predicts that the total number of IoT devices will probably be closer to 40 billion.

"Many of these devices are wideband, and systems that utilize cellular and Wi-Fi technologies are relatively high power as well," he says. "The rapid proliferation of communicating devices will increase exposure to radio signals across the electromagnetic spectrum."

Hassan concedes that expanding IoT means "radiofrequency electromagnetic field (RF-EMF) exposure limits have become a critical concern for fifth-generation (5G) mobile network deployment." Increased exposure is a given, says Jolly, "due to the increased number of transmitters."

"There are some IoT applications, especially indoors in industrial settings, where radio interference mitigation will become a significant challenge. But there are also countervailing trends, such as increased edge and "fog" computing, limiting the need to transmit data. In addition, we see improvements in collision avoidance schemes that limit retransmissions."

"The RF density from connected devices is extremely low," Nader Famili counters. "Exposure to radio signal will continue to be dominated by personal smartphones which are close to the person's organs."

Are 5G smart devices safe?

It has been established that RF density from connected devices is extremely low.

"Exposure to radio signal will continue to be dominated by the personal smartphones which are close to the person's organs," says Nader "The Rf emanating from smart devices is very low and very infrequent. Almost all smart devices will be on the sleep mode for the great majority oftime, and when they emanate RF, it is at extremely low power."

"5G smart devices are definitely safe," states Terry. "They are basically the same as a cell phone, except they are transmitting for MUCH shorter durations, and they are not located right next to a person. There should be no concern with safety regarding 5G devices."

"I am neither a doctor nor a biologist, so I would refer you to two scientific authorities," says Jolly, who suggests those with concerns review information provided by the World Health Organization (https://www.who.int/news-room/q-a-detail/5g-mobile-networks-and-health) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

"I also consider safety in terms of what 5G enables in terms of telemedicine and emergency response," he adds. "Is there a safety benefit in having 5G for emergency responders? Is there a safety benefit in having video access to a medical specialist I could not otherwise consult?"

Discussion Panel Expert: ThinkRF

ThinkRF is the leader in software-defined spectrum analyzers that monitor, detect and analyze complex waveforms in today's rapidly evolving wireless landscape.

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Can RFID and IoT work together?

"Passive RFIDs can be viewed as indirect IoT, and active RFIDs are simply IoT devices," says Nader. "As such, they are complementary and in the great scheme of things the same thing."

How this works is based on radio technology and device requirements. RFID is the use of radio technology to automatically identify and track tags that are attached to objects. RFID is used in asset tracking and inventory management. Connecting the RFID reader, a computing device, to the internet as an IOT device enables access to this data, opens up a number of possibilities by way of applications, and where and how it can be utilized.

"(RFID and IoT) can work very well together," says Jolly. "For example, RFID can be an authentication mechanism to help secure an IoT application. Also, RFID can help in inventory, smart security, smart agriculture, and smart logistics applications."

Are IoT deployments on track with projections?

"There are so many projections out there, and they range from billions to trillions of devices," says Jolly. "Based on my reading, I would make two observations:

1) IoT deployments have slowed in some areas due to the global economic situation. This is especially true where the initial costs of the IoT application were to be funded by governments or by increased product sales.

2) The trend towards increasing "things" operating in places where human beings used to interact face-to-face will accelerate in some areas, particularly in medical applications and routine check-in/check-out applications (ticket-takers, cashiers, hotel front desks, and so on).

"It depends on many factors such as the size of the IoT deployment, type of used communication protocols, and data connectivity," adds Dr. Hassan.
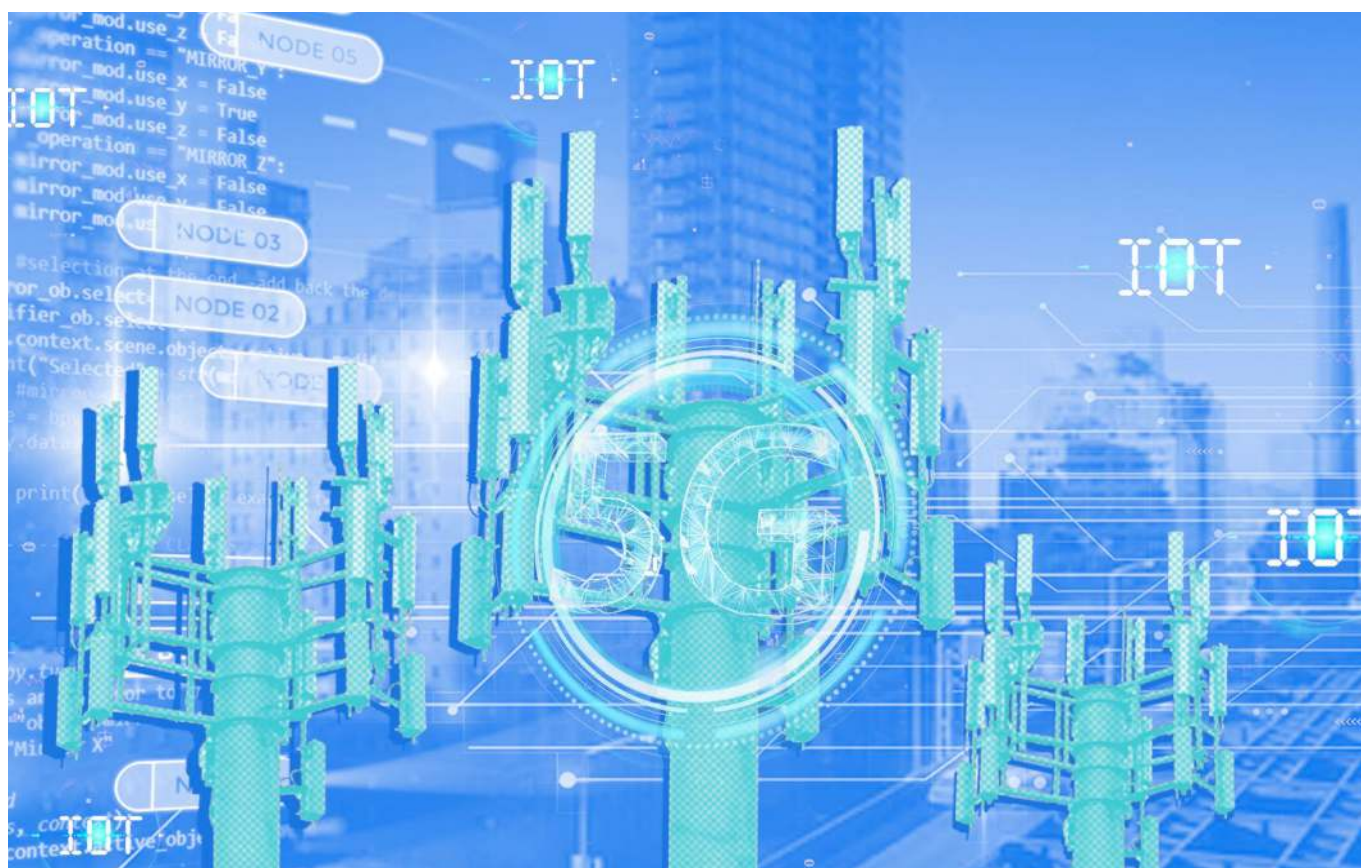
Unquestionably, 5G technology will expand the uses and capabilities of IoT, especially when combined with other technologies like LoRa and SigFox networks.

"The main vision of the Internet-of-Things (IoT) is to create an intelligent world where the real," says Hassan. "The digital and the virtual are converging to create smart environments that provide more intelligence to energy, health, transport, cities, industry, buildings, and many other areas of our daily life. RFID is a key part of this version representing an efficient sensor communication technology that enables a ubiquitous computing network."

RFS, Surecall, Keysight Technologies, and ThinkRF all have several 5G solutions available at Gap Wireless.

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