FUTURE EDUCATION

Future Institute of Technology

NEWSLETTER

2021-2022

Message from Head of the Department

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MCA, B.Tech, M.Tech

I take the privilege to welcome you to the Department of Computer Science & Engineering, Future Institute of Technology, Kokata, India..
Technology changes rapidly, especially in the field of computing, whereas the science, if it changes at all, does so much more gradually.
Our understanding is that persons who are clear and thorough about the fundamentals can adapt to rapid changes in technology relatively easily.
We want the education imparted to our students to be the basis of a life time of learning.
Ever since we started our journey way back in 2014, our department has produced hundreds of professionals and has established a name for itself in the country and abroad. They have consistently excelled in the highly competitive industrial environment, in top-ranking companies.
I attribute this success to the winning combination of a dedicated faculty team that works hard at imparting quality education to our students.
Learning is a continuous process and does not end with the acquisition of a degree, especially because steady and rapid advances in computing technologies shorten the life of tools and techniques prevalent today.
Therefore we do not aim to make our students walking manuals of any language or package. Instead, they are given a strong foundation in computer science and problem-solving techniques, and are made adaptable to changes.
We believe that this approach to teaching-learning, coupled with practical experience gained during Industrial Training in reputed organizations, equips our students to handle the challenges posed by the software industry.

Computer-Related Risks and Remediation Challenges

THIS INSIDE RISKS COLUMN FOCUSES ON SOME OF OUR COMPUTER TECHNOLOGIES THAT ARE DIRECTLY OR TANGENTIALLY INVOLVED IN UNDESIRABLE MISUSES, AND WHAT EFFECTIVE REMEDIES MIGHT BE DESIRABLE. THE FOLLOWING ENUMERATION IS ILLUSTRATIVE: THE ITEMS ARE BY NO MEANS COMPREHENSIVE, AND SOME CASES FALL INTO MULTIPLE CATEGORIES.

- USES of technology to address problems that are otherwise inherently not purely technological: for example, cryptocurrencies being used to address dissatisfaction with financial systems perceived as rigged in favor of Wall Street and banks, including money-laundering and other illegal activities used to avoid law enforcement. Increases in electronic gambling (including offshore) are yet another step toward depriving addicts and others of their well-being.
- Uses of technology to facilitate crimes that were hitherto not technology-oriented: for example, online spear-phishing scams with ransomware and demands for cryptocurrency payments, with no real assurance of ultimate recovery in the absence of demonstrable defenses. Law enforcement seems to not have much leverage here, and offshore attacks make the problems even more difficult.
- Uses of technology with well-defined legitimate purposes but poorly established or administered foundations; for example, elections that have inadequate oversight and no worthy audit trails, irrespective of whether administered in-person or using the Internet. Even the compositional trustworthiness of integrated electronic systems (voting machines, ballot scanners, vote counters) needs much more assurance from a total-system perspective, given the interfaces among the components may themselves be compromised.b Furthermore, abuses of social media with character assassination and disinformation—including Chatbots—are creating enormous problems. Misuses of digital commerce also fall into this category.
- Uses of technology that is not sufficiently trustworthy for its intended application needs. This is particularly relevant to high-end national security and life-critical applications, with respect to security, privacy, system and network integrity, human safety, high probability system survivability, and more. Artificial intelligence is seen by some as a panacea, even when embedded in untrustworthy systems and networks whose compromise might in turn decrease its integrity, total-system safety, and predictability. Of course, these problems can also arise in many less-critical applications where exploits are unfortunately surprisingly easy to perpetrate—as in the ubiquity of the Internet of Almost Everything where very little assurance exists today.
- Uses of technology that have been compromised in favor of questionable business models: for example, targeted advertising in social media and gaming that results in widespread privacy violations, devious operation, greed, and obliviousness to the risks. Zeynep Tufekci's op-ed in The New York Times, "The Shameful Secret of Southwest's Failure," (Jan. 5, 2023), examines Southwest Airlines' repeated failures to upgrade their archaic computer software, which resulted in the recent total system-wide meltdown. The drive to get self-driving cars on the road quickly appears to be quite controversial, and full of dangerous behavior. Short-term optimization and failure to consider long-term risks seem to be much more important to many organizations than long-term stability. The book by Earl Boebert and James Blossom, Deepwater Horizon: A Systems Analysis of the Macondo Disaster, Harvard Press illustrates hasty iatrogenic technological remediations motivated by a compromised business model. This list highlights just a few potential types of misuse of technology that remain widespread from year to year, with relatively few repercussions—a long-time topic in the ACM Risks Forum.

Also, colloquial speech often can result in potentially serious ambiguities. Books may also cause trouble, as reading abilities seem to be diminishing and respected classic books are being banned for being subversive.

Unfortunately, the notion of socioeconomic equality in educational and employment opportunities is politically challenged— although technology might offer some help if it were easy to master and was used more wisely. In addition, education of technology (in the U.S., at least) seems to have lost the incentive to consider systems in the large, instead stressing programming languages that are too easy to misuse and that have inherent failings. For example, Bruce Debruhl has nicely amplified the lack of system orientation in U.S. colleges and university curricula.d Even the so-called memory-safe languages (such as Java and Rust) can be badly misused, and allow elements that are not memory safe to be invoked. An interesting discussion of technology education and its relation to the public interest, with various short-term and long-term potential remediation, seems to be of considerable interest.

Conclusion

Recent years have been a period in which certain computer-related technologies are being relied upon, with relatively little reflection on their short-and long-term effects. It is also an era in which other issues relying on those technologies also became challenged by extreme views that ignored the nuances relating to those issues, and that disregard sound science. The COVID-19 pandemic seems to have considerably changed our views of the future. The ChatBot craze is riddled with problems. However, personal, institutional, and governmental integrity has become challenged, where many nontechnical issues are tightly interwoven with technology and must also be understood - for example, as part of the threat models and business models, as well as development practice and oversight.

We need considerably more attention to total-system and application assurance in our educational efforts and in responsible system developments.

-Subhasree Sengupta,HOD

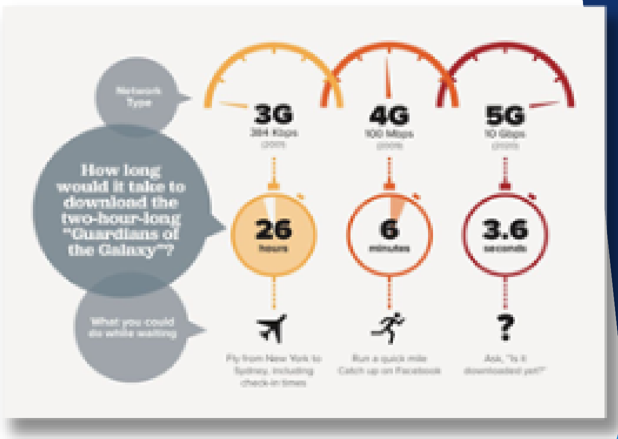
5G Technology

5G is next big evolution in cellular networks from its previous technologies of LTE, UMTS, and GSM. 5G is simply named as 5G, unlike 4G aka LTE, or 2G aka GSM. 5G offers very high throughput with ultra-low latency and more connected devices. With these new capabilities, 5G can support diverse applications including AR/VR, IoT, autonomous driving, 4K streaming, and more.

The underlying technologies of 5G include millimeter wave, small cells, massive MIMO, beamforming, and full duplex. Network components, signal processing, network element interfaces, and protocol stack are among the areas where the 5G architecture has undergone significant changes. A Service-Based Architecture (SBA) that makes use of web services and APIs is another transition made by 5G from conventional telecom-style protocol interfaces.

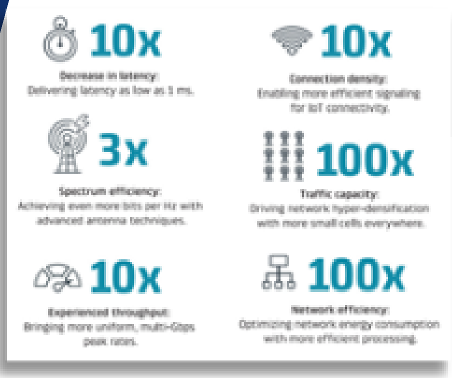
3GPP Release 15 specs (2018) introduced the first 5G standards. In April 2019, the first 5G networks were made available for purchase.

What are the key features or capabilities of 5G?



Understanding what 5G has to offer requires comparing it to 4G. The following characteristics of 5G are superior to those of 4G: latency (1 ms vs 10–50 ms), throughput (20 vs 2 Gbps), spectral efficiency (100 vs 30 bps/Hz), density (1M vs 100K conns/km2), traffic capacity (1000 Mbps/m2 vs 10 Mbps/m2), and network energy efficiency (15% savings).

A different source claims that 5G technology would enable data rates of up to 10 Gbps, 1 millisecond latency, 1000x bandwidth per square meter, 100x greater device density than 4G, 99.999% availability, 100% coverage, 90% energy savings, and up to 10-year battery life for low-power IoT devices.



How is 5G technology able to promise 1000x data throughput?

In cellular networks, capacity refers to the number of bits that may be transmitted per second over a specific portion of the spectrum. It is bits/s/km2 in size. Generally speaking, cell density, spectral efficiency, and accessible spectrum make up the three components of capacity. By enhancing each of these components, 5G increases capacity. Nokia first proposed to attain 1000x by enhancing each component by a factor of 10. SK Telecom put out advances in the range of 56x, 6x, and 3x in 2012.

Cell density can be increased provided interference is managed. Spectral efficiency can be improved by using an array of antennas so that all users in a cell can be sending/receiving at the same time using narrowly focused beams. This is what Massive MIMO is all about. Finally, more spectrum can be obtained if we go to millimeter waves, usually in the range of 30-300 GHz. However, this requires new hardware and signal propagation is limited.

With proper interference control, cell density can be raised. When a cell's users can all send and receive data simultaneously utilizing narrowly focused beams, spectral efficiency can be increased. It ultimately comes down to this with Massive MIMO. Going to millimeter waves, which are often in the 30-300 GHz region, will yield greater spectrum, as well. Signal propagation is constrained and new hardware is needed.

MAIN TECHNIQUES THAT MAKE 5G POSSIBLE

We note the following technical foundations of 5G:

•**Millimeter Wave:** Above 24 GHz, there are spectrum bands referred to as millimeter waves. Extreme data rates and capacity that will completely transform the mobile experience can be delivered by the ample spectrum that is accessible at these high frequencies.

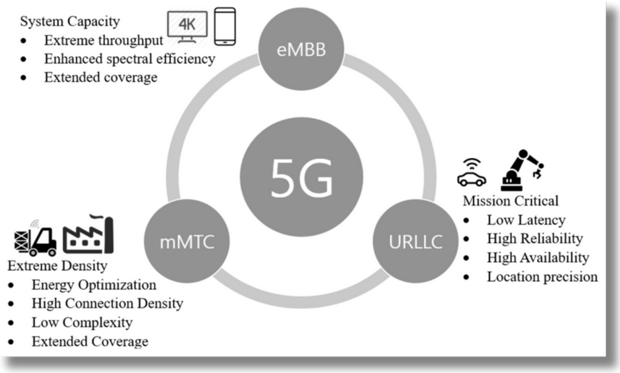
•**Massive MIMO:** This technology makes use of big antenna arrays at base stations to simultaneously serve a lot of independent terminals. Intelligent processing at the array makes use of the terminals' rich and distinctive propagation characteristics.

•**Beamforming:** Beamforming is a method of RF management where a network access point use several antennas to transmit a single signal. It guarantees a user receives data in an effective manner and lessens interruption from other users. Beamforming boosts spectrum capacity and efficiency in addition to massive MIMO.

•**Full Duplex :** This allow us to transmit and receive on same channel. There are several advantages, such as improved interference coordination, symmetric fading characteristics, better filtering, and more efficient use of the spectrum.

•**Small Cell :** Low-power tiny base stations are known as "small cells." Based on cellular technology or Wi-Fi, they operate in licensed or unlicensed spectrum. 5G's 1000x throughput can be achieved with the use of small cells.

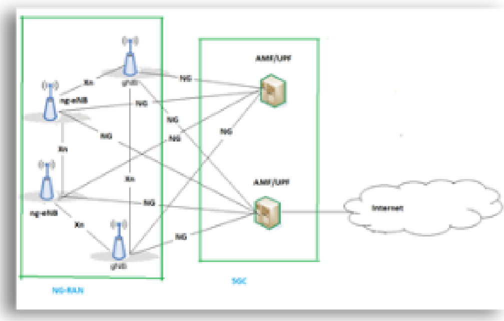
WHAT ARE SOME USE CASES AND APPLICATIONS OF 5G?



Based on performance criteria, the ITU has divided 5G applications into three primary categories:

- **Enhanced Mobile Broadband (eMBB):** Allows for extremely high data rates and significant amounts of data transfer. applies to laptops, tablets, and mobile phones. covers use scenarios that are human-centered.
- **Critical Machine Type Communications (cMTC):** and Massive Machine Type Communications (mMTC) are similar terms. This serves a large number of low-complexity, low-bandwidth devices that deliver sparse amounts of data in the context of the Internet of Things and machine communications. Effective coverage is crucial. provides battery-powered, low-cost wearables, trackers, meters, and actuators.
- **Ultra-Reliable Low Latency Communications (URLLC):** is a machine-centric technology similar to mMTC but with a focus on reliability and latency. Applications include augmented reality and virtual reality, cutting-edge wearables, autonomous vehicles, real-time industrial control, and more.

OVERVIEW OF THE 5G ARCHITECTURE



Next Generation Radio Access Network (NG-RAN) consists of gNB and ng-eNB. gNB serves a 5G UE over 5G New Radio (NR), a new air interface developed for 5G. gNB connects to 5G Core, though some can connect to 4G EPC as well. ng-eNB connects to 5G Core but serves a 5G UE over 4G radio.
5G NR brings performance, flexibility, scalability and efficiency to spectrum usage. Spectrum includes low-band (600 MHz), mid-band (3-5 GHz), and high-band (24-86 GHz) regions.
The Next Generation Radio Access Network (NG-RAN) is made up of the gNB and ng-eNB. 5G New Radio (NR), a brand-new air interface created for 5G, is how gNB connects to a 5G user equipment. Although certain gNBs also support 4G EPC connectivity, gNB connects to 5G Core. A 5G UE is served by a ng-eNB over a 4G radio while connected to the 5G core.
With 5G NR, spectrum consumption is improved in terms of performance, adaptability, scalability, and efficiency. Low-band (600 MHz), mid-band (3-5 GHz), and high-band (24-86 GHz) spectrum areas are all included.
AMF (Access and Mobility Management Function) and SMF (Session Management Function) are two components of the 5GC control plane. UPF (User Plane Function) is part of the 5G user plane. Control and User Plane Separation (CUPS) is implemented by 5GC. In order to improve performance, this enables it to distribute user plane functions closer to users while centralizing control plane functions.

-Sourav Das,asst prof.