[INTRODUCTION TO ICT]

[MID-TERM]

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MID TERM ASSIGMENT

Q 1. Watch animated movie "Incredible 1" and discuss the technologies used by characters of the movie. Further, take note of the technologies used in making of this movie.

ANS: -

THE INCREDIBLES:

The Incredibles is a 2004 American computer-animated superhero film written and directed by Brad Bird, produced by Pixar Animation Studios, released by Walt Disney Pictures, and starring the voices of Craig T. Nelson, Holly Hunter, Sarah Vowell, Spencer Fox, Jason Lee, Samuel L. Jackson, and Elizabeth Peña. Set in an alternate version of the 1960s, the film follows the Parrs, a family of superheroes who hide their powers in accordance with a government mandate, and attempt to live a quiet suburban life. Mr. Incredibles desire to help people draws the entire family into a confrontation with a vengeful fan-turned-foe and his killer robot.

Now we will discuss about the technologies that were used by the making of this film and also discuss about that technologies that were used by characters.

The Incredibles Characters:

As he embarked on the intense journey of making "The Incredibles," writer/director Brad Bird knew that he would need to surround himself with devoted talent to bring his vision to life -- not just on the technical side, but also through gifted actors who could give his characters depth and dimension. He began the process by making sure the storyboards would communicate enough to the actors to elicit multi-tonal performances. Bird worked with story supervisor Mark Andrews, artist Teddy Newton, and supervising animator Tony Fucile, who each played a major role in designing the characters and bringing them fully to life.

"Brad would simply describe the characters to me -- he wouldn't use too many adjectives, but he would often do an impression or a voice for them," says Newton, who was the first to draw many of the film's characters. "Sometimes the voice alone would put enough pictures and ideas in my head. It's like when you listen to the radio and you start to imagine what the person would look like. You get inspired and everything starts to take shape."

With the characters well established, casting for "The Incredibles" could begin. The filmmakers began looking for actors capable of bringing out the ordinary, everyday feelings that reside inside these superhero characters. Here's a look at each character:

The Good Guys:

Bob Parr, aka Mr. Incredible

At the center of the film is Bob Parr, Mr. Incredible himself, the family's muscular powerhouse of a patriarch who is trying to come to terms with the changes in his life that have taken him from superhero to suburban dad. For Bob, the director was drawn to the combination of down-to-earth humor and tough-guy charisma represented by Craig T. Nelson ("Coach," "The District").

"Craig has an authoritative voice but also a wonderful, easygoing kind of humor that really lends itself to who Mr. Incredible is," says Bird. "You can definitely see his voice fitting into this big, strong, hulking body, yet there is also a real vulnerability in him -- enough so that you really relate to him simply as a man looking for something he has temporarily lost -- and when the scene needed to be intense, he was right there."

For Nelson, the character -- animated or not -- proved irresistible. "I really empathized with him," he says. "Here's a guy who is literally able to leap tall buildings and do all kinds of super-heroic things, but that isn't what makes him special. It's his value structure and his moral strength, not his mighty feats that I really responded to. He is one of those people I'd really like to meet and get a chance to shake his hand, because he knows what counts and he has a good sense of himself and his family."

Nelson faced an unexpectedly daunting task in voicing Bob:

"The role of Bob was probably one of the more difficult things I've ever done," he says. "I quickly discovered that Brad and his team had an extremely specific idea of what they wanted because they'd lived with this story so closely for such a long time. They perfected the script and knew this family inside and out, and every other which way. So, it was up to the actors to bring to life exactly what they had in their mind's eye.

"This isn't as easy as it might seem. The delivery has to be correct tonally and the energy has to be at precisely the right place at the right time. You end up doing a lot of experimenting and concentrating on your vocal energy, but at the same time you're also trying to imagine the situation as if you were involved in it. It was a real challenge as an actor, but it was definitely a fascinating ride."

Elastic girl, aka Helen Parr:

Coming to her husband's rescue when the chips are down is the family's petite matriarch, Helen, formerly known as the ultra-flexible superhero Elastic girl. This character was created in part as a celebration of the typical modern-day mom who, says Bird, "has to stretch in hundreds of different ways each day."

To get to the core of Helen's mix of maternal and stoic strength, Bird trusted the finely honed instincts of Academy Award winner Holly Hunter. "Holly struck me as a consummate actress who could portray someone sensitive, yet with a very sturdy center," says Bird. "You feel like there's a part of Holly that would never crack. She has such great resiliency in her, and that was something that I needed for Helen because she's such a very strong woman."

Hunter was intrigued by the film because it was an unconventional story about human dynamics. "What I really liked is that beneath all the superhero adventures, 'The Incredibles' is basically a story celebrating family -- real families with all their differences and quirks -- and what a family's individuals can do when they come together," she says.

For Hunter, who had not done any animated voice work previously, it was also an exciting way to step out of her usual terrain. "It was a really different and exciting experience for me, learning to be expressive through your voice alone," she says. "From the start, I was pulled into it by Brad, because his imagination is so alive and he really knows this character. Brad thinks musically. For him, it's about finding a rhythm and an intonation that can be really more related to music more than anything else. The back-and-forth exchange is very staccato and very dynamic, which was very interesting to me as an actress and a lot of fun."

Violet Parr:

Rounding out the family of Bob and Helen Parr are their three children: the reclusive teenage Violet; the speedy 10-year-old Dash; and baby Jack-Jack. In developing their individual superpowers, personalities and human foibles, Bird looked at typical American families all around him for inspiration. "Violet is a typical teenager, someone who's not comfortable in her own skin, and is in that rocky place between being a kid and an adult," he says. "So, invisibility seemed like the right superpower for her."

For the voice of Violet, the director had an epiphany that resulted in an unusual choice. "I'm a big fan of the National Public Radio show 'This American Life,'" he says. "And there's this wonderful author of books and essays who appears regularly on that show: Sarah Vowell. One day I was driving in the car listening to Sarah's voice, and I immediately thought, 'That's Violet.' When I called Sarah to ask her if she'd play the part of a teenage girl who just wants to be invisible, she was kind of scratching her head and telling me that she had never done voices before. She turned out to be perfect."

Dash Parr:

Dash is the diminutive and mischievous son of Bob and Helen Parr, gifted with super-speed and endlessly frustrated by the fact that he is forbidden to show it off. "Dash moves at lightning speed because the average 10-year-old boy can move twice as fast as anybody else, and something always has to be happening or they just crash and fall asleep," says Bird. "So, he goes so fast you can barely see him."

To play Dash, the boy whose parents have to cheer "slow down" when he enters a school race, the filmmakers cast then-11-year-old Spencer Fox. Fox made his feature-film debut in "The Incredibles," but began his professional acting career at age eight with community theatre credits, commercials for Domino's Pizza, Staples and Tide, and voice roles in ads for Hershey's, Coca-Cola and Campbell's Soup. Fox's big break in "The Incredibles" led to roles in "Kim Possible" and several films, including Disney's upcoming animation film "Meet The Robinsons."

Frozone:

With the family cast, the filmmakers set out to find an actor cool enough to portray Frozone, a superhero who can always put his enemies on ice. Bird was thrilled to be able to cast Oscar nominee Samuel L. Jackson. "Nobody sounds cooler than Sam Jackson," says Bird. "And he makes it seem so effortless, too. He can be funny, soft, or tough as nails. I think he's one of the most versatile actors around today. We were blessed to get him for the part of Frozone, and he just nailed it right away. The animators had a blast working with his voice because there's so much happening inside his performance."

The Bad Guys

Syndrome:

For the voice of Syndrome, the film's villain, the filmmakers turned to Jason Lee ("Almost Famous," "My Name Is Earl"). Says Bird, "I've enjoyed Jason's work in some great independent films, and he has a very quirky sensibility. He put his all into creating this unique voice for a villain. You can hear the kid in it, but he's definitely not a kid."

Lee empathized with the character, despite his dastardly ways. "It was fun to play a really mean guy who wanted to be something more," says Lee. "This was an amazing experience for an actor, especially to be a part of Pixar, which is one of the most unique and creative studios I've ever seen. It's full of youthfulness and spontaneity and imagination. They're interested in creating true classics and going way beyond the expected. I look forward to the day when my kid is old enough, and I can say, 'Let's watch 'The Incredibles.' I was in that movie.'

Mirage:

Syndrome's attractive henchwoman, Mirage, lures Mr. Incredible out of his domestic duties and delivers him into the villain's evil clutches. There's more to Mirage than meets the eye, and she proves she's a classic combination of beauty and brains. In her first role for an animated film, prolific film, TV, and stage actress Elizabeth Pena gave Mirage her seductive voice.

The Underminer:

This newly emerging supervillain is determined to declare war on peace and happiness. He is performed vocally by accomplished screenwriter, director, producer, and Emmy-nominated actor John Ratzeberger, who is best known as know-it-all postman Cliff Claven on "Cheers."

But around the Pixar production offices, he's known as part of the studio's Oscar-winning animation team, since he is the only actor to participate in every single Pixar film. He began as the charming and witty Hamm the piggy bank in "Toy Story" (reprised in "Toy Story 2"), then became P.T. Flea in "A Bug's Life," Yeti the snow monster in "Monsters, Inc.," and a school of Moonfish in "Finding Nemo" before voicing The Underminer in "The Incredibles." He also voiced Mack in Pixar's subsequent film, "Cars."

Gilbert Huph:

Bob's boss at the insurance company, Gilbert Huph is the personification of everything petty and bureaucratic that's ruining Bob Parr's life. Huph tyrannizes Bob in his dogged pursuit of the bottom line and squelches Bob's every attempt to help the public.

Huph is played by Wallace Shawn, one of the film industry's most recognizable character actors and a highly respected playwright. The proud bearer of a long and distinguished list of movie and television credits, Shawn is a three-time Pixar feature voiceover actor -- "Toy Story" and "Toy Story II" in addition to

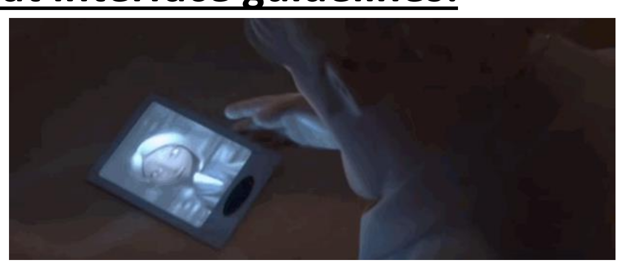
"The Incredibles" -- and has the honor of adding the cry "Inconceivable!" to the popular lexicon. He has also lent his voice to the animated features "The Goofy Movie" and "Teacher's Pet."

TECHNOLOGIES:

Historically, the tech in superhero movies is groundbreaking. When playing in the same genre as the Batmobile, the Iron Man suit, and — for all intents and purposes — every James Bond gadget ever used, you're in the playground of the most creative and genius billionaires in the universe. However, the inventions in the Incredibles, for the most part, are underwhelming. GPS trackers are controlled by a single button, Syndrome's TV remote is controlled by a single button, and Syndrome's civilization-destroying robot is controlled by a wristband with three buttons, making it presumably three time more complicated than the aforementioned devices.

The closest the Incredibles get to Tony Stark's or Lucius Fox's lab is Edna Mode's workshop and her character is intentionally excessive. Her garbage cans double as incinerators, her gate is lined with lasers and she requires a passcode, handprint, eye scan, and vocal sample to enter her shop. Her character is coated with a thick layer of satire and is therefore difficult to critique. We can, however, shred the interfaces that appear to genuinely try to impress.

Mirage ignores flat interface guidelines:

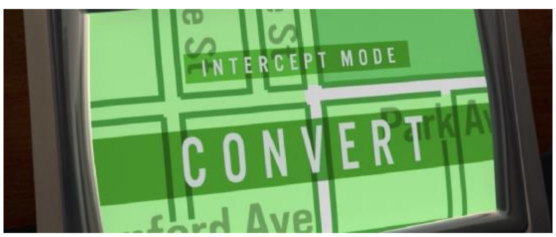


What it is: Mirage sends an automated message that begins playing as soon as it scans and identifies its recipient. The message is tablet-based, but the device explodes after the message is completed.

What works: Predicts the invention of the iPad AND the future face scanning tech used by the iPhone. I wouldn't be surprised if I saw this clip as the keystone argument in the future IP case between Pixar and Apple.

What doesn't work: Tries to translate a three-dimensional experience to a two-dimensional platform by shifting the image depending on the tablet angle. This ignores every flat interface guideline and creates a horrifically nauseating experience. If this isn't enough, the device also explodes after one use.

Mr. Incredibles car provides good but not great information:



What it is: A dashboard that shows Mr. Incredibles proximity to a nearby police chase. The dashboard can reroute the driver if emergencies appear en route to the target destination.

What works: The location proximity and rerouting features make this interface remarkably similar to services like Uber Pool and Lyft Line. Automated driver will prevent crashes as you change outfits and watch the screen.

What doesn't work: I'm now holding it to same interface standards as Uber and Lyft and it is not meeting the benchmarks. Where's my route? Can I see street traffic? Do I have the option to reject a "rider" in my path? Do I have ETAs for different stops? This is trash, Pixar.

I'd expect the 2018 sequel to exhibit a more dynamic interface. It can take cues from Google Maps and will spotlight different crimes in a city with icons that fade with the age of the crime. The user can spotlight specific crimes, select the quickest route towards the sirens, or modify their path to cross other crimes along the way. You can filter your map to only show specific crimes and track the suspects get-away if you choose to.

Syndrome refuses to guide his user:

What it is: A lock screen to the villain’s computer.

What works: This is definitely the most dramatic desktop setup I’ve ever seen. Find me another football-field sized screen in a volcano anywhere before we even consider having a debate about this.

What doesn’t work: Ignoring the lack of functionality in this enormous desktop (it’s essentially a glorified power point) or the LITERAL FIREWALL that guards it lets simply focus on the simplistic design of the login screens.

No username? No email address? No checkbox to remember my password for future logins? Just “PASSWORD_” and I don’t even get a field to enter it in? These screens are almost comparable to a MacBook’s lock screen, but displaying my password on a stadium-sized monitor for everybody to see? What sort of security is that? Where’s my instruction leading me to the next page? Am I allowed to include lowercase in my password or are we all onboard with six capitalized characters? C’mon, Syndrome. I’m guessing an unfriendly UI is the last line of defense to the gladiatorial design iterations documented in this database.

Technologies Uses in Making The Incredibles:

After tackling the sheer scale and intricacy of production design for "The Incredibles," the filmmakers took on their most difficult task: animating the characters so that they appeared alive throughout the broadest possible gamut of human-like movements and expressions.

This would take the film's crew into a "forbidden zone": It was widely believed that computer animation wasn't equipped to generate subtle human qualities. For instance, it was considered impossible to animate muscles that would flex and ripple, hair that would flip and bounce, skin that would pucker and stretch, and clothing that would move independently of the body. Because of this, computer animators had long avoided human-like characters. Director Brad Bird, however, was convinced the technology could be invented to allow his characters far more "life."

"Everyone at Pixar knows that the closer to reality you try to make something, the easier it is to fail -- but the secret Brad used with 'The Incredibles' was to produce something that the audience knows doesn't exist, something so stylized that they are ready to believe in it if it all works seamlessly," executive producer John Lasseter explains. "With the technology that we've been pioneering at Pixar, we were ready to achieve that. Our goal on 'The Incredibles' was to create very stylized human beings who could never pass as real humans but have hair, skin, and clothing so true-to-life that their reactions have a stronger, more dramatic impact."

Skeletons and Muscles:

The skeleton and its surrounding musculature is where all human motion begins, so this, obviously, was where the Pixar team started. It began with the body of Bob Parr, Mr. Incredible, and literally created him from the inside out.

"Bob was definitely the toughest character for us to model and rig because he is such a muscular guy," says Rick Sayre, the film's supervising technical director. "As we began to create him, we developed a completely new and different approach for his skeleton and the way muscle, skin, bones, and fat would attach to it. We used a fantastic new technology called 'goo,' which allows the skin to react to the muscles sliding and sticking underneath in a very true fashion."

This changed the entire animating process. Animators are not so much technicians as they are artists -- actors or puppeteers who creatively choreograph the characters' movements and expressions through specially programmed computer controls. Now the animators had more control of the characters than ever before.

"You may have noticed that it is very hard to get a convincing shoulder motion in CG animation," Sayre says. "This is why you often see animated characters that have shoulders that are too broad. We wanted to make a shoulder breakthrough on this film, so to speak."

Once Bob was completely modeled, he served as a template for the skeletons of the other characters. "With Bob, we really concentrated on achieving a high level of complexity in body motion," says character supervisor Bill Wise. "Once we were able to rig his movements, we were able to use that same articulating skeleton for the other characters -- with some changes, of course. A female character, for example, isn't going to have as defined a musculature, but she's still got a deltoid that pulls down over the top of the humorous. There's still a collarbone there. And so, you could reshape that same rig to fit any character."

Special Effects:

The special effects included every possible natural element -- from water to fire to ice (for Frozone super-cool antics) -- and needed to be created for more than one-third of the final 2,200-plus shots in the film.

"The effects seen in 'The Incredibles' are completely fresh and spectacular," says Sandra Karpman, effects supervisor. "The biggest leap from an effects standpoint is the fact that we have beautiful, amazing, 3-D volumetric clouds that you can actually fly through. Most clouds in other effects movies, or even previous CG films, are matte paintings or stock photography. In our film, when Helen is in the airplane flying through the clouds, it's very 3-D, and you see the clouds moving against each other. They're transparent, and if you stack them, they become opaque."

As great as the special effects are, the personalities of the characters are what really give "The Incredibles" its human feel. In the next section, we'll take a closer look at each character.

Q 2. Write a note on the following embedded technologies in detail.

(a) Machine Learning **(b) 5G Technology**

(c) Virtual reality **(d) Robotics**

ANS: -

(a) Machine Learning:

Machine learning (**ML**) is the study of computer algorithms that improve automatically through experience. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop conventional algorithms to perform the needed tasks.

Types of Learning:

The primary categories of machine learning are supervised, unsupervised, and semi-supervised learning. We will focus on the first two in this article.

In supervised learning, the data contains the response variable (label) being modeled, and with the goal being that you would like to predict the value or class of the unseen data. Unsupervised learning involves learning from a dataset that has no label or response variable, and is therefore more about finding patterns than prediction.

As I'm a huge NFL and Chicago Bears fan, my team will help exemplify these types of learning! Suppose you have a ton of Chicago Bears data and stats dating from when the team became a chartered member of the NFL (1920) until the present (2016).

Since you have historic data of wins and losses (the response) against certain teams at certain football fields, you can leverage supervised learning to create a model to make that prediction.

Now suppose that your goal is to find patterns in the historic data and learn something that you don't already know, or group the team in certain ways throughout history. To do so, you run an unsupervised machine learning algorithm that clusters (groups) the data automatically, and then analyze the clustering results.

With a bit of analysis, one may find that these automatically generated clusters seemingly group the team into the following example categories over time:

- Strong defense, weak running offense, strong passing offense, weak special teams, playoff berth
- Strong defense, strong running offense, weak passing offense, average special teams, playoff berth
- Weak defense, strong all-around offense, strong special teams, missed the playoffs
- and so on

An example of unsupervised cluster analysis would be to find a potential reason why they missed the playoffs in the third cluster above. Perhaps due to the weak defense? Bears have traditionally been a strong defensive team, and some say that defense wins championships. Just saying…

In either case, each of the above classifications may be found to relate to a certain time frame, which one would expect. Perhaps the team was characterized by one of these groupings more than once throughout their history, and for differing periods of time.

To characterize the team in this way without machine learning techniques, one would have to pour through all historic data and stats, manually find the patterns and assign the classifications (clusters) for every year taking all data into account, and compile the information. That would definitely not be a quick and easy task.

Alternatively, you could write an explicitly coded program to pour through the data, and that has to know what team stats to consider, what thresholds to take into account for each stat, and so forth. It would take a substantial amount of time to write the code, and different programs would need to be written for every problem needing an answer.

Or… you can employ a machine learning algorithm to do all of this automatically for you in a few seconds.

Machine Learning Algorithms:

We've now covered the machine learning problem types and desired outputs. Now we will give a high-level overview of relevant machine learning algorithms.

Here is a list of algorithms, both supervised and unsupervised, that are very popular and worth knowing about at a high level. Note that some of these algorithms will be discussed in greater depth later in this series.

Supervised Regression:

- Simple and multiple linear regression
- Decision tree or forest regression
- Artificial Neural networks
- Ordinal regression
- Poisson regression
- Nearest neighbor methods (e.g., k-NN or k-Nearest Neighbors)

Supervised Two-class & Multi-class Classification:

- Logistic regression and multinomial regression
- Artificial Neural networks

- Decision tree, forest, and jungles
- SVM (support vector machine)
- Perceptron methods
- Bayesian classifiers (e.g., Naive Bayes)
- Nearest neighbor methods (e.g., k-NN or k-Nearest Neighbors)
- One versus all multiclass

Unsupervised:

- K-means clustering
- Hierarchical clustering

Anomaly Detection:

- Support vector machine (one class)
- PCA (Principle component analysis)

Note that a technique that's often used to improve model performance is to combine the results of multiple models. This approach leverages what's known as ensemble methods, and random forests are a great example (discussed later).

If nothing else, it's a good idea to at least familiarize yourself with the names of these popular algorithms, and have a basic idea as to the type of machine learning problem and output that they may be well suited for.

(B) 5G Technology:

5G is the 5th generation of mobile networks, a significant evolution of today's 4G LTE networks. 5G has been designed to meet the very large growth in data and connectivity of today's modern society, the internet of things with billions of connected devices, and tomorrow's innovations. 5G will initially operate in conjunction with existing 4G networks before evolving to fully standalone networks in subsequent releases and coverage expansions

In addition to delivering faster connections and greater capacity, a very important advantage of 5G is the fast response time referred to as latency.
Latency is the time taken for devices to respond to each other over the wireless network. 3G networks

had a typical response time of 100 milliseconds, 4G is around 30 milliseconds and 5G will be as low as 1 millisecond. This is virtually instantaneous opening up a new world of connected applications.

WHAT WILL 5G ENABLE:

5G will enable instantaneous connectivity to billions of devices, the Internet of Things (IoT) and a truly connected world.

5G will provide the speed, low latency and connectivity to enable a new generation of applications, services and business opportunities that have not been seen before.

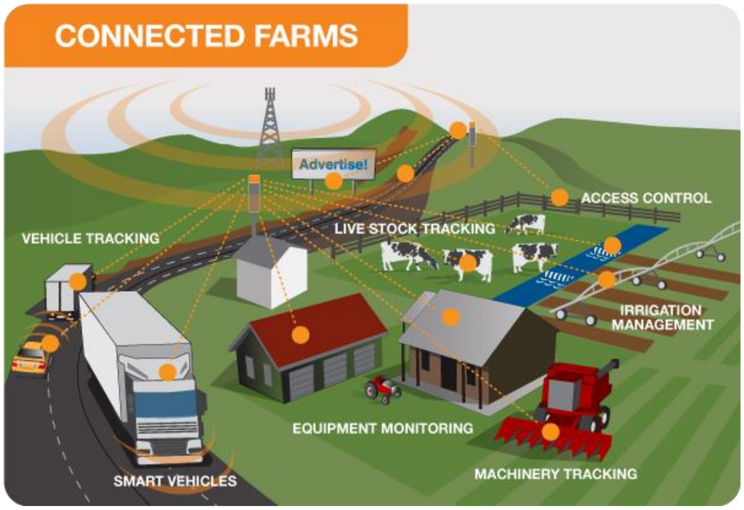
There are three major categories of use case for 5G:

1. **Massive machine to machine communications** – also called the Internet of Things (IoT) that involves connecting billions of devices without human intervention at a scale not seen before. This has the potential to revolutionize modern industrial processes and applications including agriculture, manufacturing and business communications.

2. Ultra-reliable low latency communications – mission critical including real-time control of devices, industrial robotics, vehicle to vehicle communications and safety systems, autonomous driving and safer transport networks. Low latency communications also open up a new world where remote medical care, procedures, and treatment are all possible

3. **Enhanced mobile broadband** – providing significantly faster data speeds and greater capacity keeping the world connected. New applications will include fixed wireless internet access for homes, outdoor broadcast applications without the need for broadcast vans, and greater connectivity for people on the move.

5G will keep us connected in tomorrow's smart cities, smart homes and smart schools, and enable opportunities that we haven't even thought of yet.



5G Enhanced Mobile Broadband and IoT will revolutionize agriculture and farming.

WHEN DID 5G LAUNCH:

Initial 5G services commenced in many countries in 2019 and widespread availability of 5G is expected by 2025.

WHAT ARE THE FIRST APPLICATIONS FOR 5G:

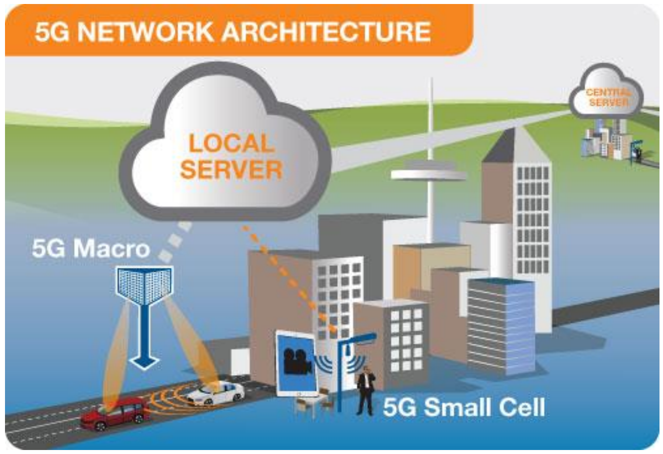
Fixed wireless access for homes and enhanced mobile broadband services are the first applications using new 5G phones, tablets, wireless access modems and hot spots.

WHAT DO 5G DEVICES OFFER:

The prime benefits of 5G devices will be significantly faster speeds in data access, downloading and streaming content. In addition, 5G devices will have increased computing power and make use of the lower latency, meaning that the devices will enjoy virtually instantaneous connections to the network, as well as greater connectivity when on the move due to the use of advanced antenna beam steering.

WHAT DEVICES ARE AVAILABLE FOR 5G:

Mobile handsets, tablets and hot spots equipped with 3G, 4G and 5G connectivity were launched in 2019 and low latency and widespread machine to machine applications using 5G will be developed in the coming years.

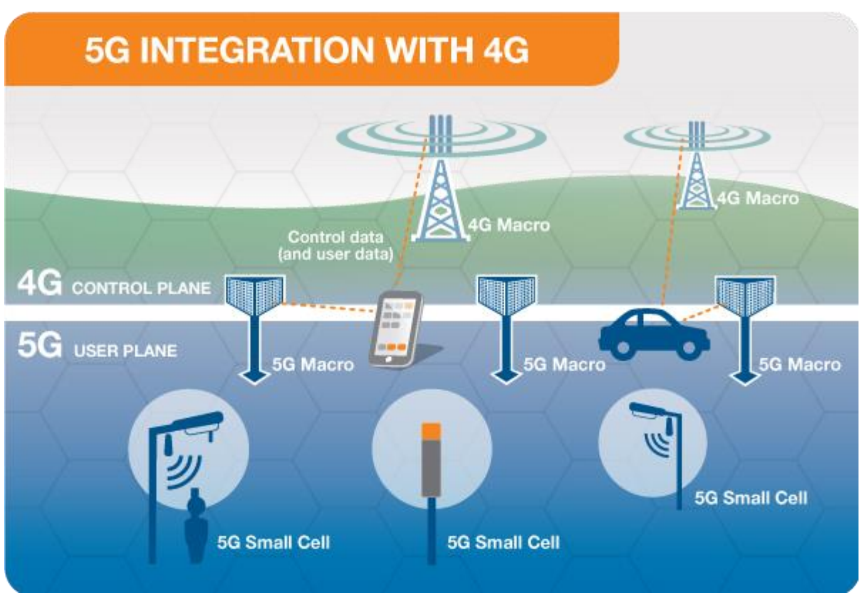


Example of a local server in a 5G network providing faster connection and lower response times

<u>Network Slicing</u> – enables a smart way to segment the network for a particular industry, business or application. For example, emergency services could operate on a network slice independently from other users.

<u>Network Function Virtualization (NVF)</u> - is the ability to instantiate network functions in real time at any desired location within the operator's cloud platform. Network functions that used to run on dedicated hardware for example a firewall and encryption at business premises can now operate on software on a virtual machine. NVF is crucial to enable the speed efficiency and agility to support new business applications and is an important technology for a 5G ready core.

5G WORKING WITH 4G:

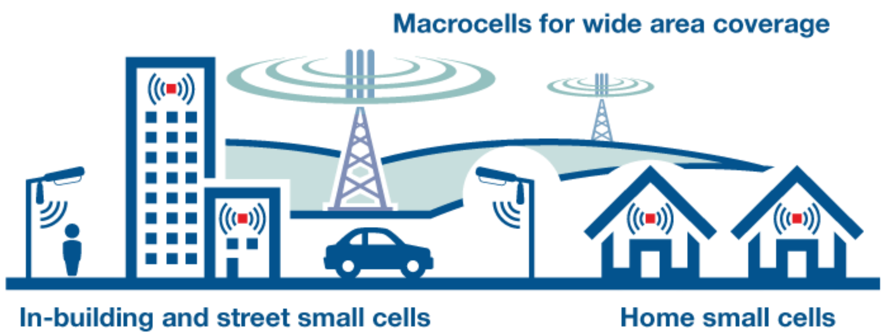


When a 5G connection is established, the User Equipment (or device) will connect to both the 4G network to provide the control signaling and to the 5G network to help provide the fast data connection by adding to the existing 4G capacity.
Where there is limited 5G coverage, the data is carried on the 4G network providing the continuous connection. Essentially with this design, the 5G network is complementing the existing 4G network

HOW DOES 5G DELIVER CONTINUOUS CONNECTION, GREATER CAPACITY, AND FASTER SPEED AND RESPONSE TIMES?

BETTER CONNECTION - ALWAYS CONNECTED:

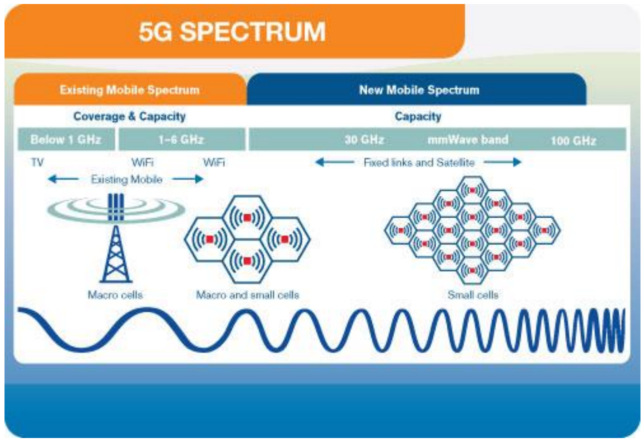
5G networks are designed to work in conjunction with 4G networks using a range of macro cells, small cells and dedicated in-building systems. Small cells are mini base stations designed for very localized coverage typically from 10 meters to a few hundred meters providing in-fill for a larger macro network. Small cells are essential for the 5G networks as the mmWave frequencies have a very short connection range.



INCREASED SPECTRUM – GREATER CAPACITY, MORE USERS AND FASTER SPEED:

In many countries the initial frequency bands for 5G are below 6 GHz (in many cases in the 3.3-3.8 GHz bands) and similar frequencies to existing mobile and Wi-Fi networks. Additional mobile spectrum above 6 GHz, including the 26-28 GHz bands often referred to as millimeter (mm) Wave, will provide significantly more capacity compared to the current mobile technologies. The additional spectrum and greater capacity will enable more users, more data and faster connections. It is also expected that there will be future reuse of existing low band spectrum for 5G as legacy networks decline in usage and to support future use cases.

The increased spectrum in the mmWave band will provide localised coverage as they only operate over short distances. Future 5G deployments may use mmW frequencies in bands up to 86 GHz.



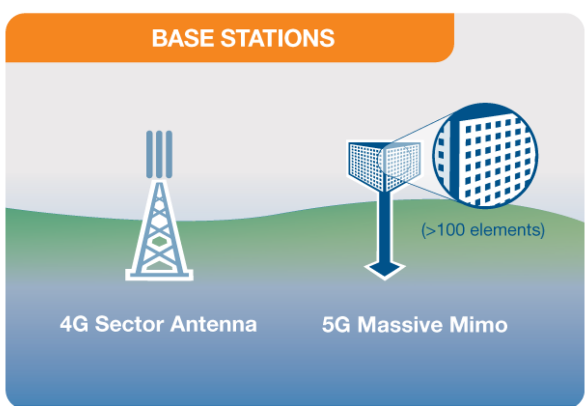
Mobile spectrum showing the radio frequency range from 3-100 GHz with new 5G spectrum above 6GHz.

Other radio services (TV, Wi-Fi, Fixed links & Satellite) are shown for reference. Additional information on the Electromagnetic Spectrum is available

MASSIVE MIMO:

multiple element base station - greater capacity, multiple users, faster data

5G will use 'massive' MIMO (multiple input, multiple output) antennas that have very large numbers of antenna elements or connections to send and receive more data simultaneously. The benefit to users is that more people can simultaneously connect to the network and maintain high throughput. The overall physical size of the 5G massive MIMO antennas will be similar to 4G, however with a higher frequency, the individual antenna element size is smaller allowing more elements (in excess of 100) in the same physical case.
5G User Equipment including mobile phones and devices will also have MIMO antenna technology built into the device for the mmWave frequencies.



4G sector base station and 5G base station with a new multi element massive MIMO antenna array. The overall physical size of the 5G base station antenna is expected to be similar to a 4G base station antenna.

Core Network Changes With the redesigned core network, signaling and distributed servers, a key feature is to move the content closer to the end user and to shorten the path between devices for critical applications. Good examples are video on demand streaming services where it is possible to store a copy or ‘cache’ of popular content in local servers, so the time to access is quicker.

(C) Virtual Reality:

Virtual Reality (**VR**) is the use of computer **technology** to create a simulated environment. Unlike traditional user interfaces, **VR** places the user inside an experience. Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds.

Types of virtual reality:

"Virtual reality" has often been used as a marketing buzzword for compelling, interactive video games or even 3D movies and television programs, none of which really count as VR because they don't immerse you either fully or partially in a virtual world. Search for "virtual reality" in your cellphone app store and you'll find hundreds of hits, even though a tiny cellphone screen could never get anywhere near producing the convincing experience of VR. Nevertheless, things like interactive games and computer simulations would certainly meet parts of our definition up above, so there's clearly more than one approach to building virtual worlds—and more than one flavor of virtual reality. Here are a few of the bigger variations:

Fully immersive:

For the complete VR experience, we need three things. First, a plausible, and richly detailed virtual world to explore; a computer model or simulation, in other words. Second, a powerful computer that can detect what we're going and adjust our experience accordingly, in real time (so what we see or hear changes as fast as we move—just like in real reality). Third, hardware linked to the computer that fully immerses us in the virtual world as we roam around. Usually, we'd need to put on what's called a head-mounted display (HMD) with two screens and stereo sound, and wear one or more sensory gloves. Alternatively, we could move around inside a room, fitted out with surround-sound loudspeakers, onto which changing images are projected from outside. We'll explore VR equipment in more detail in a moment.

Non-immersive:

A highly realistic flight simulator on a home PC might qualify as non- immersive virtual reality, especially if it uses a very wide screen, with headphones or surround sound, and a realistic joystick and other controls. Not everyone wants or needs to be fully immersed in an alternative reality. An architect might build a detailed 3D model of a new building to show to clients that can be explored on a desktop computer by moving a mouse. Most people would classify that as a kind of virtual reality, even if it doesn't fully immerse you. In the same way, computer archaeologists often create engaging 3D reconstructions of long-lost settlements that you can move around and explore. They don't take you back hundreds or thousands of years or create the sounds, smells, and tastes of prehistory, but they give a much richer experience than a few pastel drawings or even an animated movie.

Collaborative:

What about "virtual world" games like Second Life and Minecraft? Do they count as virtual reality? Although they meet the first four of our criteria (believable, interactive, computer-created and explorable), they don't really meet the fifth: they don't fully immerse you. But one thing they do offer that cutting-edge VR typically doesn't is collaboration: the idea of sharing an *experience* in a virtual world with other people, often in real time or something very close to it. Collaboration and sharing are likely to become increasingly important features of VR in future.

Web-based:

Virtual reality was one of the hottest, fastest-growing technologies in the late 1980s and early 1990s, but the rapid rise of the World Wide Web largely killed off interest after that. Even though computer scientists developed a way of building virtual worlds on the Web (using a technology analogous to HTML called Virtual Reality Markup Language, VRML), ordinary people were much more interested in the way the Web gave them new ways to access *real* reality—new ways to find and publish information, shop, and share thoughts, ideas, and experiences with friends through social media. With Facebook's growing interest in the technology, the future of VR seems likely to be both Web-based and collaborative.

Applications of virtual reality:

VR has always suffered from the perception that it's little more than a glorified arcade game—literally a "dreamy escape" from reality. In that sense, "virtual reality" can be an unhelpful misnomer; "alternative reality," "artificial reality," or "computer simulation" might be better terms. The key thing to remember about VR is that it really isn't a fad or fantasy waiting in the wings to whistle people off to alternative worlds; it's a hard-edged practical technology that's been routinely used by scientists, doctors, dentists, engineers, architects, archaeologists, and the military for about the last 30 years. What sorts of things can we do with it?

Scientific visualization:

Anything that happens at the atomic or molecular scale is effectively invisible unless you're prepared to sit with your eyes glued to an electron microscope. But suppose you want to design new materials or drugs and you want to experiment with the molecular equivalent of LEGO. That's another obvious application for virtual reality. Instead of wrestling with numbers, equations, or two-dimensional drawings of molecular structures, you can snap complex molecules together right before your eyes. This kind of work began in the 1960s at the University of North Carolina at Chapel Hill, where Frederick Brooks launched GROPE, a project to develop a VR system for exploring the interactions between protein molecules and drugs.

Industrial design and architecture:

Architects used to build models out of card and paper; now they're much more likely to build virtual reality computer models you can walk through and explore. By the same token, it's generally much cheaper to design cars, airplanes, and other complex, expensive vehicles on a computer screen than to model them in wood, plastic, or other real-world materials. This is an area where virtual reality overlaps with computer modeling: instead of simply making an immersive 3D visual model for people to inspect and explore, you're creating a mathematical model that can be tested for its aerodynamic, safety, or other qualities.

Games and entertainment:

From flight simulators to race-car games, VR has long hovered on the edges of the gaming world—never quite good enough to revolutionize the experience of gamers, largely due to computers being too slow, displays lacking full 3D, and the lack of decent HMDs and data gloves. All that may be about to change with the development of affordable new peripherals like the Oculus Rift.

Pros and cons of virtual reality:

Like any technology, virtual reality has both good and bad points. How many of us would rather have a complex brain operation carried out by a surgeon trained in VR, compared to someone who has merely read books or watched over the shoulders of their peers? How many of us would rather practice our driving on a car simulator before we set foot on the road? Or sit back and relax in a Jumbo Jet, confident in the knowledge that our pilot practiced landing at this very airport, dozens of times, in a VR simulator before she ever set foot in a real cockpit?

Critics always raise the risk that people may be seduced by alternative realities to the point of neglecting their real-world lives—but that criticism has been leveled at everything from radio and TV to computer games and the Internet. And, at some point, it becomes a philosophical and ethical question: What is real anyway? And who is to say which is the better way to pass your time? Like many technologies, VR takes little or nothing away from the *real* world: you don't have to use it if you don't want to.

(D) Robotics:

Robotics is an interdisciplinary research area at the interface of computer science and engineering. **Robotics** involves design, construction, operation, and use of **robots**. The goal of **robotics** is to design intelligent machines that can help and assist humans in their day-to-day lives and keep everyone safe.

Types of Robots:

Mechanical bots come in all shapes and sizes to efficiently carry out the task for which they are designed. From the 0.2 millimeter-long “RoboBee” to the 200-meter-long robotic shipping vessel “Vindskip,” robots are emerging to carry out tasks that humans simply can’t. Generally, there are five types of robots:

Pre-Programmed Robots:

Pre-programmed robots operate in a controlled environment where they do simple, monotonous tasks. An example of a pre-programmed robot would be a mechanical arm on an automotive assembly line. The arm serves one function — to weld a door on, to insert a certain part into the engine, etc. — and its job is to perform that task longer, faster and more efficiently than a human.

Humanoid Robots:

Humanoid robots are robots that look like and/or mimic human behavior. These robots usually perform human-like activities (like running, jumping and carrying objects), and are sometimes designed to look like us, even having human faces and expressions. Two of the most prominent examples of humanoid robots are Hanson Robotics' Sophia (in the video above) and Boston Dynamics' Atlas.

Autonomous Robots:

Autonomous robots operate independently of human operators. These robots are usually designed to carry out tasks in open environments that do not require human supervision. An example of an autonomous robot would be the Roomba vacuum cleaner, which uses sensors to roam throughout a home freely.

Teleoperated Robots:

Teleoperated robots are mechanical bots controlled by humans. These robots usually work in extreme geographical conditions, weather, circumstances, etc. Examples of teleoperated robots are the human-controlled submarines used to fix underwater pipe leaks during the BP oil spill or drones used to detect landmines on a battlefield.

Augmenting Robots:

Augmenting robots either enhance current human capabilities or replace the capabilities a human may have lost. Some examples of augmenting robots are robotic prosthetic limbs or exoskeletons used to lift hefty weights.

Uses of Robotics:

Manufacturing:

The manufacturing industry is probably the oldest and most well-known user of robots. These robots and co-bots (bots that work alongside humans) work to efficiently test and assemble products, like cars and industrial equipment. It’s estimated that there are more than three million industrial robots in use right now.

Logistics:

Shipping, handling and quality control robots are becoming a must-have for most retailers and logistics companies. Because we now expect our packages arriving at blazing speeds, logistics companies employ robots in warehouses, and even on the road, to help maximize time efficiency. Right now, there are robots taking your items off the shelves, transporting them across the warehouse floor and packaging them. Additionally, a rise in last-mile robots (robots that will autonomously deliver your package to your door) ensure that you’ll have a face-to-metal-face encounter with a logistics bot in the near future.

Home:

It’s not science fiction anymore. Robots can be seen all over our homes, helping with chores, reminding us of our schedules and even entertaining our kids. The most well-known example of home robots is the autonomous vacuum cleaner Roomba. Additionally, robots have now evolved to do everything from autonomously mowing grass to cleaning pools.

Travel:

Is there anything more science fiction-like than autonomous vehicles? These self-driving cars are no longer just imagination. A combination of data science and robotics, self-driving vehicles are taking the world by storm. Automakers, like Tesla, Ford, Waymo, Volkswagen and BMW are all working on the next wave of travel that will let us sit back, relax and enjoy the ride. Rideshare companies Uber and Lyft are also developing autonomous rideshare vehicles that don’t require humans to operate the vehicle.

Q 3. Write a note on the following.

- **(a) Write a note on prevailing generation of computers in use and discuss its characteristics in detail.**
- **(b) Multiply the given binary numbers 10001001 with 10010011.**

- **(a) Write a note on prevailing generation of computers in use and discuss its characteristics in detail.**

ANS: -

Present Generation:

The **Fifth Generation Computer Systems** (**FGCS**) was an initiative by Japan's Ministry of International Trade and Industry (MITI), begun in 1982, to create computers using massively parallel computing and logic programming. It was to be the result of a massive government/industry research project in Japan during the 1980s. It aimed to create an "epoch-making computer" with supercomputer-like performance and to provide a platform for future developments in artificial intelligence. There was also an unrelated Russian project also named as a fifth-generation computer.

Characteristics:

The period of fifth generation is 1980-till date. In the fifth generation, VLSI technology became ULSI (Ultra Large-Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components.

This generation is based on parallel processing hardware and AI (Artificial Intelligence) software. AI is an emerging branch in computer science, which interprets the means and method of making computers think like human beings. All the high-level languages like C and C++, Java, .Net etc., are used in this generation

AI includes –

- Robotics
- Neural Networks
- Game Playing
- Development of expert systems to make decisions in real-life situations
- Natural language understanding and generation

The main features of fifth generation are –

- ULSI technology
- Development of true artificial intelligence
- Development of Natural language processing
- Advancement in Parallel Processing
- Advancement in Superconductor technology
- More user-friendly interfaces with multimedia features
- Availability of very powerful and compact computers at cheaper rates

Some computer types of this generation are –

- Desktop
- Laptop
- Notebook
- Ultrabook
- Chromebook

(b) Multiply the given binary numbers 10001001 with 10010011.

ANS: -

```
          10001001
          10010011
          10001001
         100010010
        0000000000
       00000000000
      100010010000
     0000000000000
    00000000000000
   100010010000000
   100111010101011
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PROGRAM: BS-SE