

## **Precaution**

It should be tested in supervision and safety with 4 to 5 people at safer place because it needs proper practice.



**Source-bitrebels.com**

## **Conclusion:-**

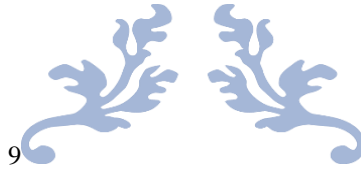
- To enhance the human capability for greater reach these boots can be very helpful as it improves performance.
- It opens the door for new mode of transportation between destinations.
- It helps to take a step in new direction of bio-mechanical engineering to facilitate the completion of bio-suits for future purposes and adventures.



Source- thehustle.co

## References

- <https://www.instructables.com/Bionic-Boots/>
- <https://www.nocarnofun.com/bionic-boots-run-faster-than-usain-bolt-and-jump-higher-than-jordan/2/>
- [https://www.linkedin.com/posts/ajjames\\_would-you-give-these-a-try-i-would-activity-6873725409079373824-bQxJ](https://www.linkedin.com/posts/ajjames_would-you-give-these-a-try-i-would-activity-6873725409079373824-bQxJ)
- <https://www.inverse.com/article/27221-bionic-boot-keahi-seymour-worlds-fair-nano#:~:text=Seymour%20says%20the%20Bionic%20Boots,d%20average%20on%20a%20bicycle.>



---

## IT RESEARCH WORK

---

**LINK- <https://www.qualcomm.com/5g/what-is-5g>**



**STUCRA**

**JANUARY 11, 2022**

**IT RESEARCH INTERN TEAM:**

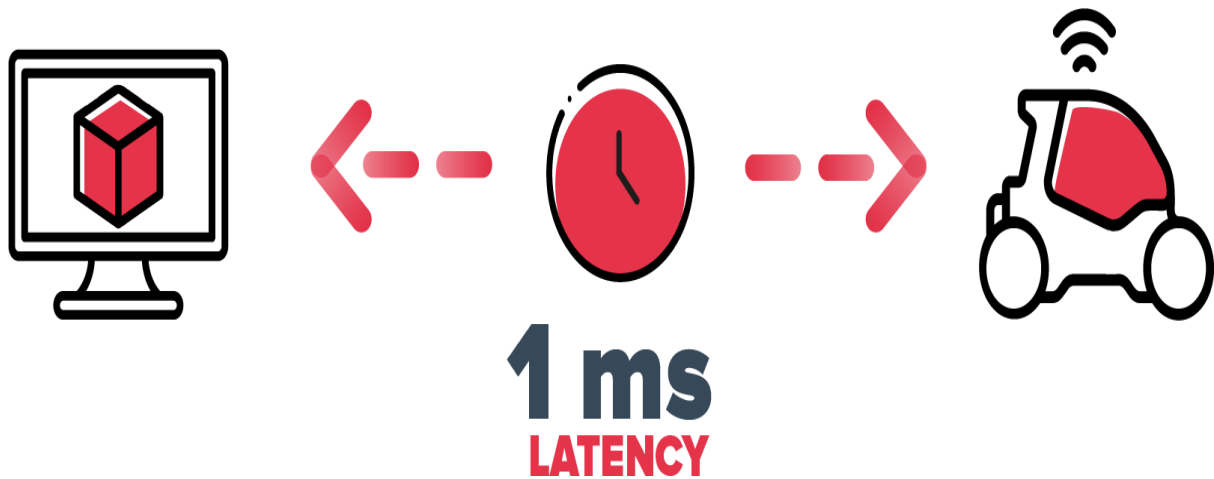
- 1. MILIND**
- 2. ARUNA**
- 3. RASHMI KUMARI**

## Introduction to 5G



Source -youtube.com

- 5g is technically improvement over existing 4g lte network. With 5g We will see the improvement in latency.
- Here, latency means the delay of one packet from one place to another. When we do gaming in Smartphone, we some time notice a lag that is due to latency.
- In case of 4g lte is 50 ms in best case scenario. With the help of 5g, the aim is to lower the latency as low as 1ms for real time communication.
- Another improvement in 5g will help to have lot more devices in a certain area. For example - In 1sq km area generally in 4g it can support 1lakh devices but in 5g it will be 10x of 4g devices.
- 5g Bands are divided into two categories –
  - 1) **Sub 6 ghz**- It ranges from 410 MHz -6GHz.
  - 2) **Millimetre waves**- It is technical faster implementation of 5g .It is not practical in every area.



**Source -Reply.com**

- We have 5GHz and 2.4 GHz but in case of sub 6GHz speeds are much higher also the range as compared to older generation .That's why it's always advised to buy new Smartphone with multiple 5g bands. In India we get the mid bands -mixture of all depending on the area.
- In millimetre wave we get high speeds, but the range is less, due to bad weather there can be blockage in internet connection. For millimetre waves ISP needs to setup many mini towers, which is very expensive. So it can be combination of 6GHz and millimetre waves.



**Source- cnet.com**

- For proper 5g Smartphone should have multiple 5g bands but some Smartphone brands are making fool just providing less than 3 bands which is just gimmick. In every city or a particular location of a country ISP will provide support for different bands due to licensing agreement. So it's always advised to have multiple bands support.

- In India 5g spectrum auction is delayed till 5 may. So it will take more time for proper 5g service in India.



Source – 91 mobiles.com

### References

- <https://www.electronicdesign.com/technologies/embedded-revolution/article/21171679/multitech-5g-in-reality-if-when-how>
- <https://www.stl.tech/blog/the-reality-of-5g-in-india/>
- <https://www.infosys.com/iki/insights/hype-around-real.html>
- <https://www.qualcomm.com/5g/what-is-5g>

### Technologies used in 5G:





## **1. Millimeter Wave Technology (mmWave):**

- 5G specified radio frequencies are higher than frequencies used by 4G, which has advantages and challenges.
- Higher frequencies provide larger network bandwidth, lower latency and much higher connection density.
- Higher frequencies also have challenges with reduced transmission distances, requiring a larger number of smaller cells.

### **MmWave Advantages:**

- Reduced network latency and data transfer rates
- Large network connection capacity, supporting more devices and subscribers
- Reduced overhead cost which should reduce cost per network connection

### **MmWave Disadvantages:**

- Higher frequency radio waves have reduced ranges of about 300 meters
- Smaller cell sizes, increased number of cell antennas.

## **2. Device-to-Device (D2D) Communications:**

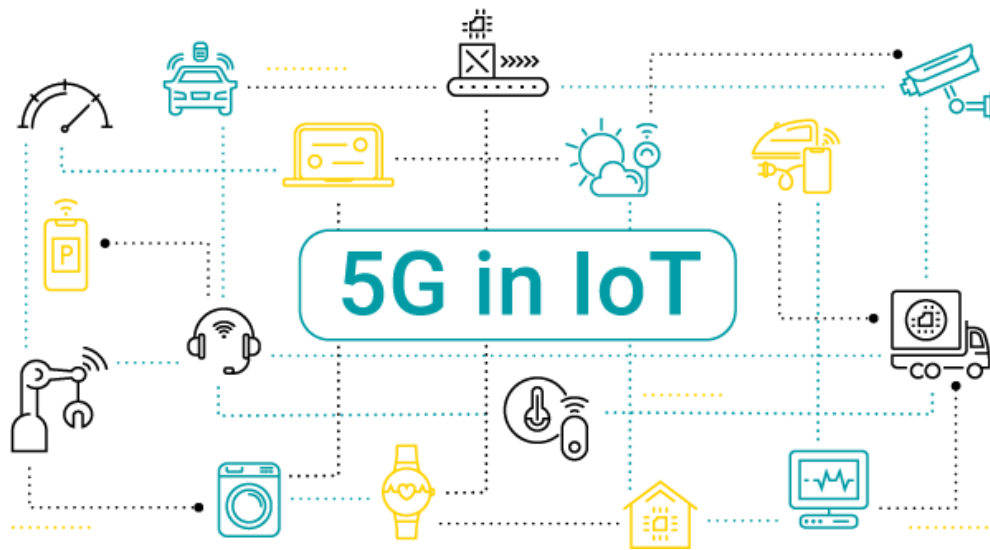
Device-to-device communications is an emerging trend in “smart” systems and IoT devices that communicate and share data and knowledge, and then to potentially act on this knowledge. Fog computing, for example, is based on IoT devices communicating and sharing data.

**3. Massive MIMO:** it Uses large antenna arrays at base stations to simultaneously serve many autonomous terminals. The rich and unique propagation signatures of the terminals are exploited with smart processing at the array.

## **4. Ultra-Reliable Low Latency Communications (URLLC):**

Like mMTC, this is also machine-centric but with a focus on reliability and latency. Applications include AR/VR, advanced wearables, autonomous vehicles, real-time industrial control, and more.

## 5. Internet of things:



Link from:

[https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.avsystem.com%2Fblog%2F5giot%2F&psig=AOvVaw2RzekiwNSGXwLT9nJjfHk&ust=1641906104437000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCODEv8Cfp\\_UCFQAAAAAdAAAAABAD](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.avsystem.com%2Fblog%2F5giot%2F&psig=AOvVaw2RzekiwNSGXwLT9nJjfHk&ust=1641906104437000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCODEv8Cfp_UCFQAAAAAdAAAAABAD)

The Internet of Things (IoT) is rising as the number of connected devices is set to increase from 700 million to 3.2 billion by 2023. While there are a number of factors contributing to this rise, one of the most important will be the development of 5G networks.

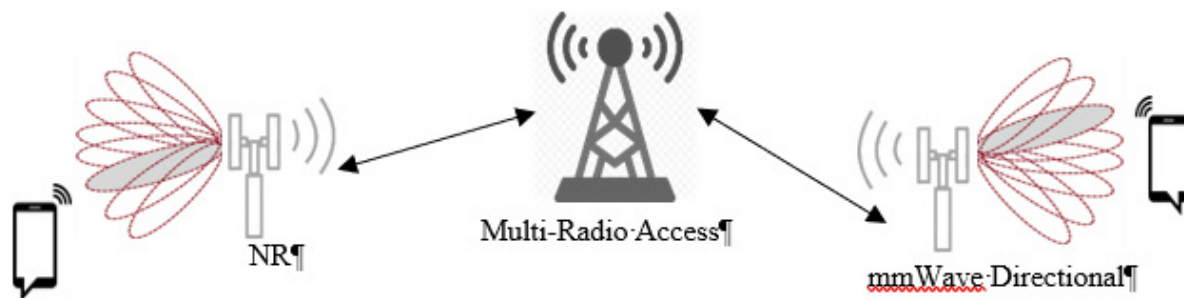
The upcoming launch of the fifth generation of cellular mobile communications or 5G is great news for the IoT market. This is primarily due to the fact that 5G networks will go a long way towards improving the performance and reliability of these connected devices.

- Data transfer speed
- Greater network reliability
- Bluetooth and wifi connections



## 6. Radio access networks:

Radio access networks have evolved over the years as cellular technology is now at 5G. Today, RANs can support multiple-input, multiple-output (MIMO) antennas, wide spectrum bandwidths, multi-band carrier aggregation and more. This evolution of RAN for 5G will have a huge impact on wireless technologies, including enabling Mobile Edge Computing (MEC) and network slicing. These RANs of the future will also contribute to the lower latency that makes 5G so powerful.



[https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.researchgate.net%2Ffigure%2FOptions-of-the-5G-architecture-multiple-radio-access-technologies-RATs-28\\_fig4\\_335577972&psig=AOvVaw04JI8wKSQtgVaUavWvOb2g&ust=1641906964634000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCJj5-diip\\_UCFQAAAAAdAAAAABAA](https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.researchgate.net%2Ffigure%2FOptions-of-the-5G-architecture-multiple-radio-access-technologies-RATs-28_fig4_335577972&psig=AOvVaw04JI8wKSQtgVaUavWvOb2g&ust=1641906964634000&source=images&cd=vfe&ved=0CAsQjRxqFwoTCJj5-diip_UCFQAAAAAdAAAAABAA)

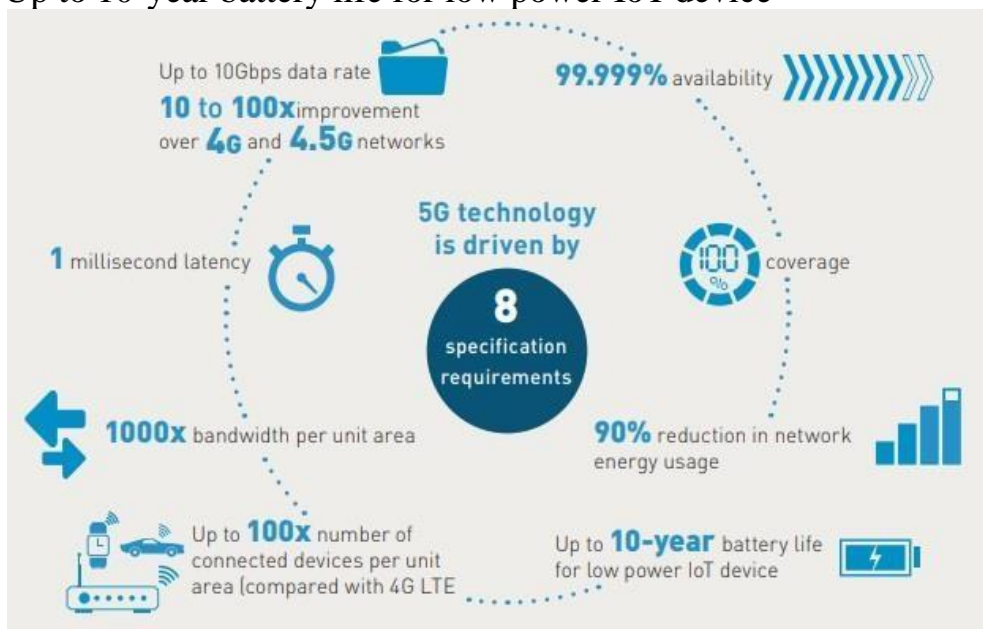
## 7. Green communication:

Green communications will be another major attribute of 5G systems, as power consumption from the information and communication technology sector is forecast to increase significantly by 2030. Accordingly, energy-efficient SCN design has attracted significant attention from researchers in recent years. In addition, to enable the ubiquitous deployment of dense small cells, service providers require energy-efficient backhauling solutions. In this paper, we present an energy-efficient communication model for 5G heterogeneous networks (HetNets). The proposed model considers both the access and backhaul network elements.

## Requirements:

5G technology driven by 8 specification requirements that are:

- Up to 10Gbps data rate - > 10 to 100x speed improvement over 4G and 4.5G networks
- 1-millisecond latency
- 1000x bandwidth per unit area
- Up to 100x number of connected devices per unit area (compared with 4G LTE)
- 99.999% availability
- 100% coverage
- 90% reduction in network energy usage
- Up to 10-year battery life for low power IoT device



## 5G technology benefits:

5g technology is meant to deliver

1. Higher multi –Gbps peak data speed
2. Ultra low latency
3. More reliability
4. Massive network capacity
5. Increased availability
6. Higher performance and improved efficiency empower new user experience.

## **Disadvantages of 5g:**

The main disadvantage of 5g technology is limited global coverage and is available only in specific locations.

1. Obstructions can impact connectivity
2. Initial costs for rollout are high
3. Limitations of rural access
4. Battery drain on devices
5. Upload speeds don't match download speeds.
6. Detracting from the aesthetics.

## **Conclusion:**

- 5G will lead to a big transformation in the field of technology with multiple possibilities.
- Drones working with mobile networks will speed up emergency responses, for example by carrying a first aid kit or defibrillator. Ambulances will get to the emergency scene much faster thanks to the interconnectivity between smart cars. Surgeries will be made possible anywhere thanks to the remote connectivity of robots.
- One of the most promising applications of 5G is autonomous driving. The sensor technology of connected and react appropriately to them a process that requires the processing of enormous amounts of data in real-time.
- The higher speed of internet and the new levels of connectivity means that everything we can do with our smart phones now, we'll be able to do much faster and better.

**Approved by:**

**Vineeth,**

IT Innovation Administrator.