Northeastern University
College of Engineering

Weekly STEM Newsletter - Week 30 (MARCH 08 - MARCH 15, 2021)

Impacts of 5G

Introduction

5G is the fifth-generation mobile network. It promises faster speeds, low latency, continuous connection, and better communication between devices. For more information about 5G and how it works, check out Part 1 of this newsletter: CfSE Newsletter - What is 5G?. In this newsletter, we will be discussing the impacts and applications of 5G. Where can 5G be used? How does 5G change these fields? Will 5G affect the economy?

When we think about 5G the first thing that might come to mind is our phones. “3G” or “4G” show up in the top left corner of our devices, making us associate this network mainly with our phones. But 5G is much more than that. 5G can be used for autonomous vehicles, education, medicine, leading more sustainable lives, the internet of things, robotics, and augmented reality. When it comes to autonomous vehicles, 5G is a crucial technology. Autonomous vehicles are self-driving cars that reduce accidents and provide an easier way to transport from one place to another. Since no one is driving them, the cars will need to communicate to share data about route and speed with other self-driving cars. This is called Vehicle-to-vehicle communication and is needed for the management of routes to prevent accidents or even minimize damage if one were to occur. 5G can help with this communication and transfer of data over the wireless network, possibly transforming our roads, the way we deal with parking, and even streetlights.

Another application of 5G is in the Education Sector. 5G can allow better access to educational material such as documentaries and videos. 5G guarantees faster downloading and better streaming. 5G can also transform the way we approach learning in the future. Video conferencing is now vastly used during the pandemic, and can be continued to be used and

even enhanced through 5G. It can help with attending sessions abroad and remote learning. In addition to this, classrooms can become more interactive with 5G (increases the bandwidth and latency) improving Augmented Reality and Virtual Reality. They can become more integrated tools for education as they provide an immersive learning experience for students, helping them understand through 3D models, and can facilitate experiential learning.

Another sector impacted by 5G is the Healthcare industry. 5G can enable better virtual consultations with higher quality video, detailed photographs, and better connection between devices such as the heart monitor in your home to the one in the doctor's office. It can also provide a faster way for first responders to communicate with doctors in a hospital from the place of emergency. Another possibility is remote surgery. This can allow a doctor to perform a precise surgery from abroad! Patient follow-ups can also improve as a result of device connectivity (home device to doctor's device) and allow doctors to be informed much more easily in case of a decrease in quality of health.

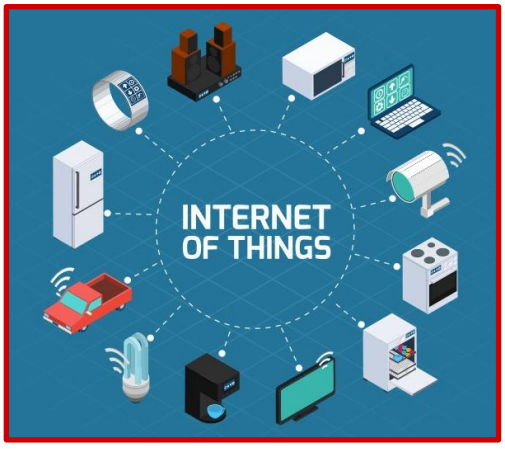
Finally, 5G can also help with conserving water, potentially reducing food waste, and optimizing energy usage. Through all this, 5G is driving global growth, with an increase in global economic output and the creation of more and more jobs.

Northeastern Connections

Faculty Connection

Last Newsletter we talked about Edmund Yeh and Tommaso Melodia (you can read about them here!) For this Newsletter, we'll be diving into the Internet of Things(IoT), one of the applications of 5G!

The Internet of Things is an umbrella term for any device that is connected to the internet, but now we start to think about it in terms of having a network where devices can "talk" to each other. The devices have sensors, software, and other features that allow



for this connectivity with other devices over the Internet. An example of this is to possibly have a smart home, where your lighting, air conditioning, and other devices can be connected. They can communicate and save energy when residents are not home. With 5G, this communication and connection can be even stronger; more data can be shared and it can happen at a faster speed.

Northeastern has a newly launched university research center, Northeastern SMART Center, that "aims to conceive and pilot disruptive technological innovation in smart devices and systems to make everyday life safer, easier and more efficient.". They aim to create a new generation of smart devices and systems that are required by industries such as 5G, the Internet Of Things, Healthcare, Robotics, and Digital Architecture.

Matteo Rinaldi is the director of the Northeastern SMART Center and an Assistant Professor in the Electrical and Computer Engineering department at Northeastern University. He researches micro and nanoelectromechanical systems (these are devices that enable precise control of very small interactions) as well as radio communication systems. He has multiple publications with the national IEEE, which links us to our next connection!

Student Connection

The IEEE is a large association, so we'll be looking at the IEEE at NU, or the Institute of Electrical and Electronics Engineers, NU Student Chapter. IEEE at Northeastern University's goal is to "promote the engineering process of creating, developing, integrating, sharing, and applying knowledge about electro and information technologies and sciences for the benefit of humanity and the profession." This is the third-largest student branch of the IEEE in the Boston Area, with over 90 students involved. It is a technical association with different fields such as computer engineering, aerospace engineering, electric power, telecommunications. The national IEEE is known for producing electrical and computer science literature, with many resources, in fact, many of them are about 5G! The IEEE at Northeastern has weekly meetings, sometimes featuring companies like Microsoft and Dell. They are affiliated with the College of Engineering and the Department of Electrical and Computer Engineering at Northeastern, as well as the national IEEE. Electrical and

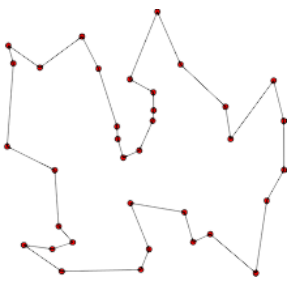
Computer Engineers are the ones who developed the 5G technology, and the IEEE helps bring together these engineers and scientists together to create more technology such as 5G!

Do Now

This newsletter's "Do Now" activity will be short and help you recall and think more about the applications of 5G. Closely observe the picture and think about how it links to 5G, then answer the questions below it.

Answer the following questions about this image:

- List all the applications you see in the image
- What is the link between each area and 5G?
- How will 5G improve them?
- What do you think is the most important application? Why?
- Which application do you think is the least important? Why?



Activity

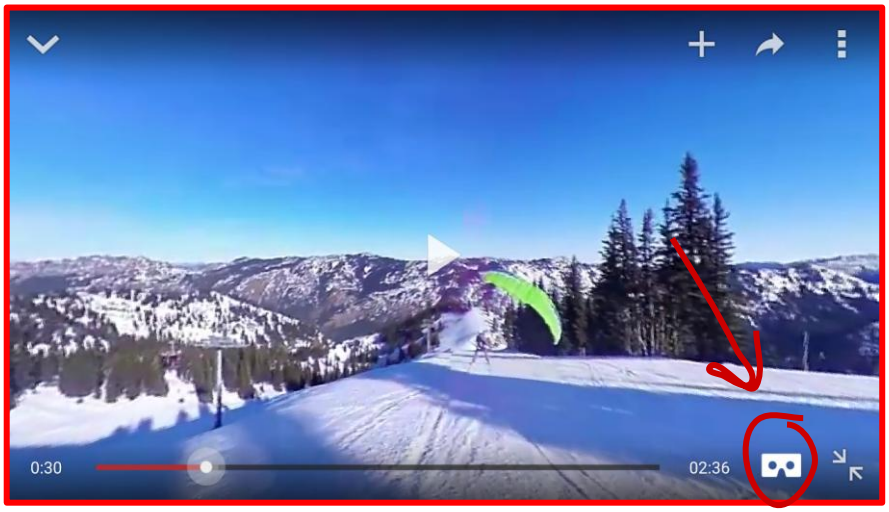
Virtual Reality seems to be the future of education, gaming, and even possibly travel. Maybe virtual vacations will be the new norm! Video game controllers could possibly even be a thing of the past! This newsletter's activity is going to be a little different from our traditional activities. We'll be exploring and having a bit of fun with virtual reality and 360 videos. VR and AR (Augmented Reality) need the following network requirements: low latency, high reliability, and high bandwidth, something that can be achieved through using 5G.

Materials Needed:

- Smartphone or tablet
- VR cardboard set (optional)

Steps:

- Choose one of these videos (or multiple) and watch it:
  - 360° Underwater National Park | National Geographic
  - Lions 360° | National Geographic
  - Journey To The Edge Of Space (360 Video)
- If you have a VR set you can choose the VR setting:



- If you don't have a VR headset, don't worry! You can still watch the video as a 360-degree video and move your device to see the different angles. These videos were made using an omnidirectional camera or a collection of cameras, to ensure that every direction is recorded and we can see all those angles.

- After watching several of the videos (or any other educational 360/VR video), answer the discussion questions below!

Discussion Questions:

- Do you think 5G can transform VR? How?
- What are the uses of VR? Can you see yourself using it more in the future? Where?
- What do you dislike about VR? What would you change about it?

Share Your Results

We'd love to know how the activity and/or the "do now" turned out! What worked and what didn't work? Please share with us something you learned and/or send us pictures! Email us at stem@northeastern.edu.

Related links/Extensions

- What is 5G | Everything You Need to Know About 5G | 5G FAQ
- Why 5G is a Crucial Technology for Autonomous Vehicles
- Potential impacts of 5G on the education sector
- 5G: What are the Possibilities in Medicine?
- Forbes: How the 5G Era Could Help Build a More Sustainable Future
- What is the Internet of Things? WIRED explains
- IEEE: Institute of Electrical and Electronics Engineers, NU Student Chapter
- Northeastern SMART Center