NETWORKING

Application of 5G in Smart Campus

Emerging Technology on Network Infrastructure

5G, Wi-Fi 6, and Emerging Network Technologies

MEMBERS

KHAIRUN NAJIHAH

A21EC0037

WAN NORAZIRA

A21EC0143

LEE JUN KANG

A21EC0194

OMAR ABDULBASET

A21EC0271

9 Decemeber 2021

5G Smart Campus

Augmented Reality in Education

According to Pew Research Center research, smartphone usage has more than doubled in the past decade from 35% in 2011 to 81% in 2019. Young Americans are especially likely to own a smartphone - 96% of people ages 18 to 29 own one. These trends are creating opportunities for using **augmented reality in education.**

Immersive lessons and classes are one way for schools to use augmented reality as the new medium. Studies made on AR and VR have pointed out that using said technologies can improve interest in the curriculum and **potentially raise test scores**, as a result of students studying in methods they prefer.

Through virtual reality applications in higher education, students can now experience a new level of distance learning compared to written and audio formats by receiving the same lesson presentations as those in the classroom.

In addition, augmented reality can completely change the way field trips are taken. By switching to virtual field trips, students can explore the world right from the comfort of their homes.

Limited bandwidth and latency of wireless networks have typically posed challenges to wide-ranging adoption of AR, but thanks to faster wireless connectivity through **5G** cellular networks and next generation devices' improved processing power, opportunities to explore AR's full potential are expanding.

Reflection

Although the change to AR classrooms can be very drastic, the benefits are clearly worth the hassle. A plan can be by Higher Education institutes to slowly implement a new AR based-system, which would be greatly aided by the COVID-19 pandemic, Higher Education could be much more accesible to people all throughout the world.

References

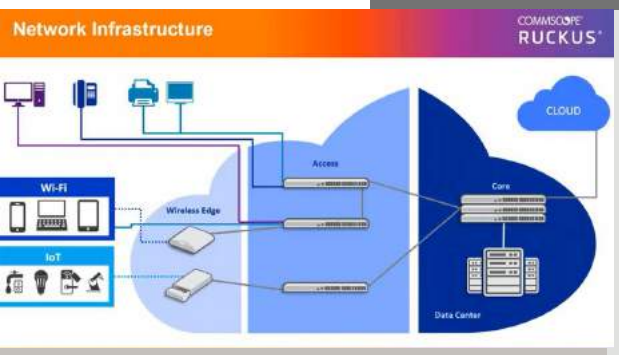
Augmented Reality in Education: Interactive Classrooms.(n.d.).Retrieved 9 December2021 from https://online.maryville.edu/blog/augmented-realty-in-education/

Adam Kimmel (n.d.). Augmented and virtual reality applications in higher education. Retrieved 9 December 2021 from https://www.verizon.com/business/resources/articles/s/augmented-and-virtual-reality-applications-in-higher-education/

COMMSCOPE®

EMERGING TECHNOLOGY ON NETWORK INFRASTRUCTURE

(CommScope Malaysia)



NETWORK INFRASTRUCTURE

The term "network infrastructure" refers to everything that makes up a computer network. This refers to the hardware (wires, routers, and software) that controls how a computer network functions. The network is continuously operating through the infrastructure. It can refer to the foundations of a single network or a collection of interconnected networks.

Although this is a simplified understanding of how networks work, the following are some of the most critical **network infrastructure components**:

- Servers are computers that run programs. It's usually a computer or a smaller device dedicated entirely to running a computer software. Websites are hosted on web servers, which allow Internet users to access them.
- Routers receive and direct packets from other parts of the network, as well as from other networks, to their intended destinations.
- Signals and packages are carried by wires and cables.
- Operating systems instruct a computer on how to run in order for it to correctly accomplish computing tasks.
- Data packets and transmission are governed by network protocols. TCP/IP, the Internet protocol for computer-to-computer communication, is a good example.
- Firewalls, as discussed in the following section, regulate access to a private network by allowing or rejecting data packets. They might be made of hardware or software.

WIFI 6 DEVICES IN THE MARKET

Wi-Fi 6 has been used for many devices for the efficiently used and the speedily network. Like iPhone 11, 11 Pro, Pro Max, iPhone SE, iPhone 12, 12 Pro, 12 Pro Max and 12 Mini, Huawei P40 Pro, OnePlus 8 and 8 Pro, Samsung Galaxy S10 and S10E, Samsung Galaxy Note 10, Samsung Galaxy S20, iPad Pro, and many more.

MULTIGIGABIT TECHNOLOGY

The possibility of a wired network presenting a performance bottleneck grew to the point that multigigabit technology was developed, allowing you to reach bandwidth between 1 and 10 Gbps using standard Cat 5e cabling. This allows to extend the life of your existing wired infrastructure.

While gigabit technology has been present for almost two decades, the current surge of bandwidth-intensive applications and the Internet of Things has caused some businesses to hit their bandwidth limits.

Multigigabit technology, created in collaboration with the NBASE-T Alliance, leverages existing Cat 5e or Cat 6 twisted cable to give 2.5G, 5G, and even 10G speeds.

UNIFIED NETWORK MANAGEMENT

Unified NMS revolutionizes the vertical management concept by supporting unified management at the elements, network and service management layers.

Before unified management, vertical management silos introduced complexity and repetition that resulted to increased cost and decreased customer satisfaction like for the traditional approach to on-premises LAN/WAN network management.

With the introduction of unified management, a single network management system solution manages the whole network with multiple benefits, both technological and financial.

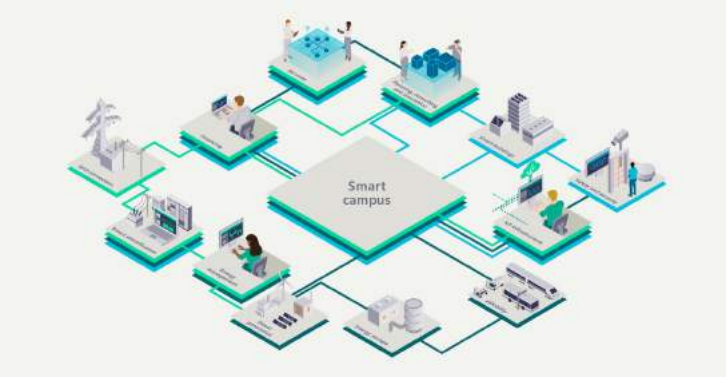
INTERNET OF THINGS (IOT)

Evolution of network begins in 1970s where it only used the wired devices in a local area network. And then in 1990s, the technology involving with wireless devices by a wireless local area network. And finally in 2010s internet of devices produced a huge benefit to humanity by using IoT Access Networks. In this modernization era, it proof the growing opportunities on the Internet of Things (IoT). Like for the example for IoT Forecast, 50 billion new devices expected to be connected by year 2025. Moreover, Smart building market will grow to $108b by year 2025 and also smart hospitality market growing to $12b by year 2025. The benefits of implement of IoT solutions are cost reduction, enhance customer experience all around the world, Increases efficiency and productivity and lastly increasing the business opportunities.

EXAMPLES INTERNET OF THINGS (IOT)

IoT used in education room and schools, school authorities provided many devices of internet of things like window sensors, asset tracking, occupancy management, vape detection, environment air monitoring smart thermostats, and smart lighthing.

SMART CAMPUS



Smart Campus is a smart city places infrastructure on its network infrastructure which create situational awareness for new services, lower costs and public safety like for the examples by using internet of things (IOT) to connects buildings, vehicles, peoples and things.

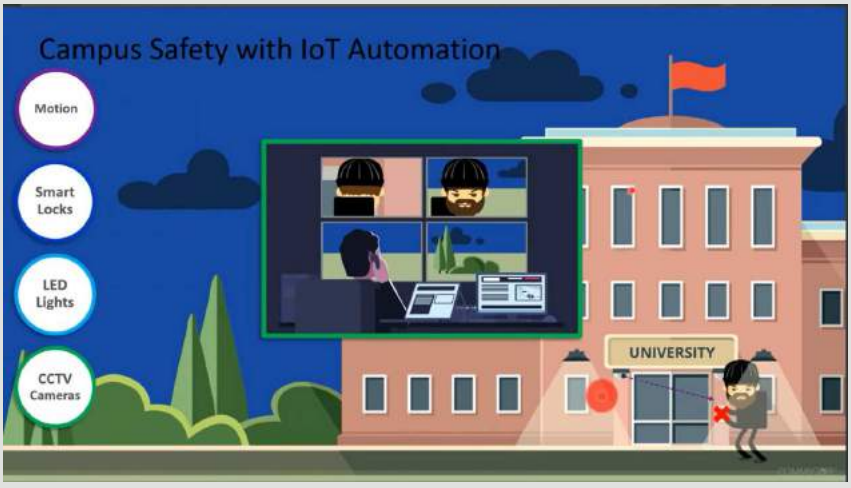
There are 3 things that must have provided. The first one is **smart learning**. Smart learning like Flexible Learning Spaces, Digital Portals, Virtual Labs, Distance Learning, Lecture Capture and Library of the Future.

For the examples of the used of smart learning is learning app that is data-driven curriculum. The goal of smart learning for this app is the campus data collected and used for assignments. Because of this, projects become more interesting and personal Students are engaged in campus life.

The second one is **Smart Living.** Smart living is used for everyone like smart ID cards, In building LTE, Smart lighting, Smart parking/ transit, Wayfinding, Personal networks and IPTV

Lastly, **Smart security** likes CCTV and VMS, Connected Entry, Tracking Assets, Sounds Detection and Motion Detection is useful for students from any harm incidents because they have no control when or where a campus security incident may happens. With the used of campus safety with IoT Automation like Motion, Smarts Locks, LED Lights, CCTV Cameras, the government can check if there's incidents like, thief, shooting, or bombing occurred in university.

When the three aspects of smart living, smart learning and smart safety are attract and retain students with a Smart Campus, this will have a greater students experience.



Campus Safety with IoT Automotion

REFLECTION

From the industry talk, we can conclude that having a technology hightlight like network infrastructure, Wi-Fi 6, multigigabit technology, unified network management, internet of things in this modernized era is important. It is because it will lighten the workload with automation with using the internet of things devices like smart mobiles, smart watches and any others else. Having a device doing most the work means that we can save more time and cost. This greatly reduces human efforts. It also results in devices being created that need little to no human intervention, allowing them to operate entirely on their own.

REFERENCE

What is network infrastructure?: Webopedia Definition & meaning. Webopedia. (2021, May 24). Retrieved December 8, 2021, from https://www.webopedia.com/definitions/network-infrastructure/amp/.

9 DECEMBER 2021

5G, WIFI6 AND EMERGING NETWORK TECHNOLOGIES (HUAWEI)

INDUSTRIAL TALK 6
MR NICHOLAS YONG

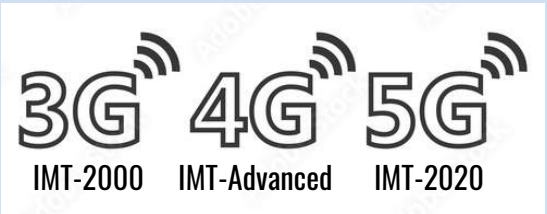
5G

The next (and fifth) generation of wireless technology systems is known as 5G.

It offers quicker speeds than earlier generations, comparable to those offered by fibre-optic cables. Early testing of this technology reveals real-world speeds ranging from 700 to 3025 Mbps (3.025 Gbps), which users may encounter once 5G becomes commercially available.

Movies that took minutes to download on 4G will take seconds to download on 5G.

ITU formally adopt the term 'IMT-2020' as 5G



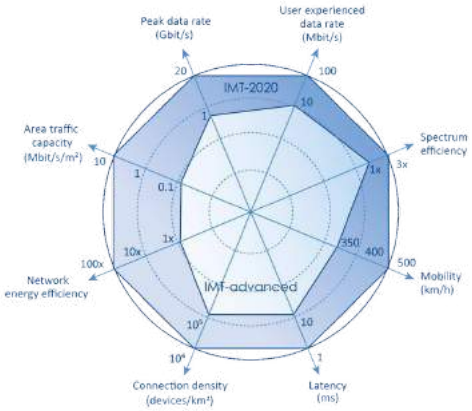
WHY DOES VR NEED 5G

1. High throughout for retina experience VR
   - >5037x5705 resolution for retina experience per eye
   - 6 angles for full-view panoramic video mosaics
2. Low latency to avoid motion sickness

When 5G becomes widely available, the impact on these businesses might be revolutionary for three key reasons:

1. Because 5G devices have lower latency, they can transmit larger data streams more quickly.
2. 5G devices are more dependable, allowing for improved data transfer under severe environments.
3. 5G is more flexible than Wi-Fi, supporting a broader range of devices, sensors, and wearables

5G REQUIREMENTS WILL SUPPORT MORE APPLICATIONS



5G FUTURE USE CASES EVALUATION & PRIORITISATION

Augmented Reality, Virtual Reality, Smart Grid and Automation in the vehicle top the list, infact they are part of key relevant use cases. Other than that, there's Driver Information, Entertainment in the vehicle, and Delivery Drone.

The most important index can be shortened as 1, 10, 100, which means 1ms of E2E latency. 10Gbps peak data rate and 1 million connections within 1 square kilometre.

5G APPLICATION SCENARIO: FROM PEOPLE TO VERTICAL & IOT

Major application scenario defined by ITU:

- Enhanced Mobile Broadband
- Massive Machine-Type Communications
- Ultra-reliable and Low-latency Communications

9 DECEMBER 2021

Wi-Fi 6

Wi-Fi 6 is the next version of Wi-Fi technology.
It will still perform the same basic thing – link you to the internet — but with a slew of new technologies to make that happen more efficiently, therefore speeding up connections. [Jacob Kastrenakes, 2019]

THE EVOLUTION PATH OF Wi-Fi TECHNOLOGY

IEEE Standard	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ax
Release	1999	1999	2003	2009	2014	2019
Frequency	5Ghz	2.4Ghz	2.4Ghz	2.4Ghz 5Ghz	2.4Ghz 5Ghz	2.4Ghz 5Ghz
Maximum Data Rate	54Mbps	11Mbps	54Mbps	600Mbps	1.3Gbps	10-12Gbps

[Avnet, 2020]

New Wi-Fi 6 (802.11ax) Standards, Empowering Entreprises' Digital Transformation

1. Large Bandwith
2. Low Latency
3. IoT-oriented Energy Saving
4. Anti-Interference
5. 1024-QAM, OFDMA, UL/DL MU-MIMO, BSS Coloring, and TWT

Wi-Fi 6 Supports Gigabit Broadband Promotion: 1Gbit/s To Mobile Phones/PCs, Fast Download/Cloud Backup Experience

- 1K QAM/ 160M/ frame length/ subcarrier optimization, improving bandwidth by 2.8 times
- High-speed uplink and downlink experience, with an actual rate of over 1 Gbit/s

How Wi-Fi 6 Improves Bandwidth? The factors:
Spatial stream, sub-carrier quantity, symbol duration, and coding mode

Wi-Fi 6 Improve Coverage: Full-house Coverage of 5 GHz Signals
RF enhancement / Dedicated algorithm / DCM / Narrowband transmission, breakthrough another barrier

- Wi-Fi 6 chip RF optimisation, increasing TX power and sensitivity while maintaining signal quality
- When connecting to standard Wi-Fi 5 STAs, a dedicated algorithm improves performance and omnidirectional coverage.

5GHz coverage is available for a 120 square meter residence.
Wi-Fi 6 New Video Service: Multi-screen IPTV, Online Education, VR, eSports

- OFDMA/BSS colouring, Anti-interference / Reduced latency
- Supports the evolution of home value-added services

Wi-Fi Supports Better Multi-user Experience: More than 100 Terminals are Connected, and The Power Consumption Of Terminals Reduced By 30%

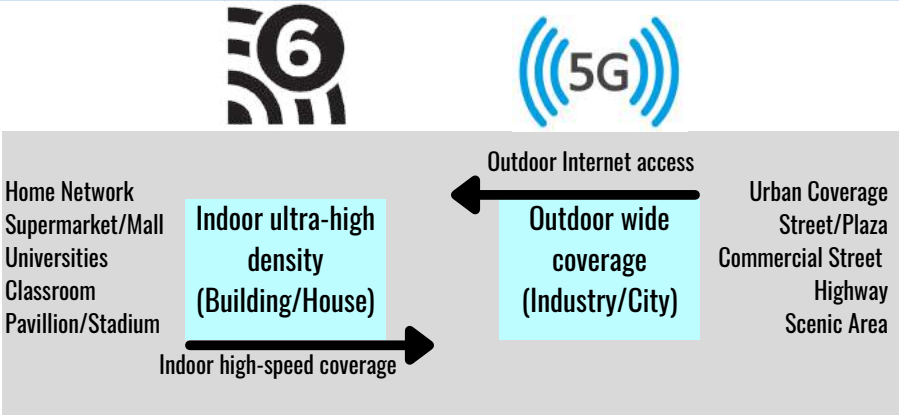
- Better multi-user experience, reducing terminal power consumption by 30%
- Enhance the positioning of gateways as the control centre of smart home

Core Technologies of Wi-Fi 6 (vs Wi-Fi 5)

- Large Bandwidth
- Low Latency
- High Concurrency
- Low Power Consumption

ADVANTAGES OF Wi-Fi 6

- Bandwidth improved by 2.8 times
- Coverage range improvement increased by 40%
- Network capacity and efficiency improvement. A maximum of 128 users are supported.
- The power consumption of STAs is reduced by 30%



REFLECTION

From this industrial talk, we learnt that 5G and Wi-Fi 6 are extraordinary technologies. We can't compare them because each technology has its significant use. What we do know is that both technologies provide faster connections. This will help us in our daily tasks where we can save time and effort. Besides, having a faster connection also ensures more efficient work. So, in a nutshell, having 5G and Wi-Fi 6 is extremely beneficial for us.

REFERENCES

Avnet. Feb 1, 2020. Wi-Fi 6 is here. Is it time to make a move?. Retrieved Dec 8, 2021, from https://www.avnet.com/wps/portal/apac/resources/article/wifi6-is-here/

Jacob Kastrenakes. Feb 21, 2019. Wi-Fi 6: is it really that much faster?. Retrieved Dec 8, 2021, from https://www.theverge.com/2019/2/21/18232026/wi-fi-6-speed-explained-router-wifi-how-does-work