TECHNOLOGY INFORMATION SYSTEM, EMERGING NETWORK TECHNOLOGIES

"Application of 5G in Smart Campus"

"Emerging Technology on Network Infrastructure"

"5G, Wifi6 and Emerging Network Technologies"

Prepared by:

KAGINESWARAN – A21EC0035
NURUL 'AFIFAH – A21EC0120
LUQMAN HAKIM – A21EC0050
AIN SAFIAH – A21EC0155

5G NETWORK ↓ SMART CAMPUS

"Application of 5G in Smart Campus"

Figure 1 (a): Innovation Implementation

5G is a mobile network technology with high capacity, high speed, and low latency that enables a slew of new services across a variety of locations, including smart airports, smart ports, smart stadiums, and university campuses. Edge computing and a private 5G network, also known as 5G network slicing, allow specialized apps and experiences to run at their best.

In the Real World, 5G Applications that are 5G will provide artificial intelligence (AI) and Internet of Things (IoT) applications a huge boost across a variety of sectors and use cases, thanks to its enormous capacity and ultra-low latency. Consumers will notice enhancements such as enhanced retail experiences and more immersive games.

One of the applications for 5G in the smart campus is fire extinguishing that collaborates with the smart campus intelligent operation center (IOC) to help the students and lecturer be notified if any fire break up happens on the campus. This fire extinguishing system will also integrate with field systems which are access control, fire extinguishing department, ventilation system, and more. Plus, all of this will be controlled by the intelligent operation center (IOC). The IOC will also create a flow when a fire breakup happens and will show the best escape routes by using a digital platform that can give a view of the whole campus environment. Then, the system also can plan the best route for you to escape. In conclusion, having 5G technology in the smart campus can save human lives and also notify us if any danger will happen.

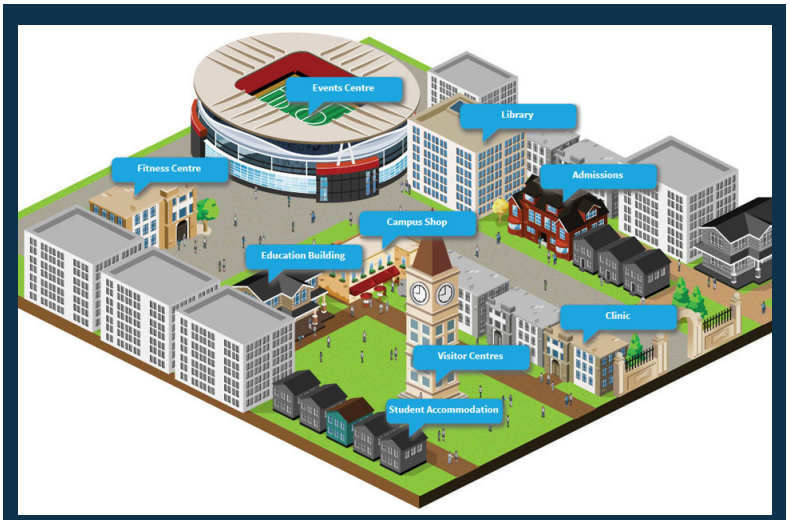


Figure 1 (b): Example of common campus's condition
cc: https://visionid.ie/smart-campus

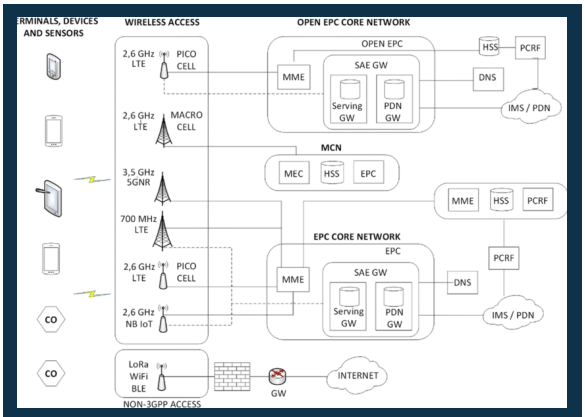


Figure 1 (c): Example of Smart Device Implementation

cc: https://www.researchgate.net/figure/Realization-of-Smart-Campus-5G-Architecture_fig4_340131385

Figure 1 (d): Decoration purposes

Reflection:

To sum up, 5G is significant not just because it can handle millions of devices at superfast speeds, but it also has the potential to change people's lives all around the world. My reflection on the application of 5G in the smart campus is it can help to protect the campus from any danger and make the campus more secure. As an example, barrel gates. This barrel gate has access control based on facial recognition and video cloud. As an example, when we want to enter campus or office, we can use our face as the punch card to enter campus. Plus, this barrel gate can block and restrict some people from entering campus. This can be done by the system which will create a blacklist that will not allow any face from the blacklist to enter the campus; so the campus will be more secure from any criminal. In conclusion, 5G technology can make our lives better.

Emerging Technology ON Network Infrastructure

5th INDUSTRIAL TALK BY MR. NICHOLAS YANG

Figure 2 (a): Network Representation

The technologies that are commonly involved directly and indirectly with the network infrastructure are Wi-Fi and access point, multigigabit technology, unified network management, Internet of Things (IoT), and also cloud analytic.

Due to the recent pandemic outbreak, we may see a tremendous advancement in the IT world, especially in Malaysia. The remote environment like in working and learning has become one of the factors that forced this advancement to occur. This advancement includes the network infrastructure.

The network infrastructure of a campus may consist of the wireless access point connecting users and the Internet of Things (IoT) devices to the distribution switch. The distribution switch will then connect to the core switch, usually located at the data center. Then it'll be connected to the cloud or the Internet.

Network infrastructure is referred to the resources (hardware and software) that enable network connectivity, communication, and enterprise network process and management. It provides the communication path for the users, services, applications, processes, and perhaps the external network.

Wi-Fi & Access Point

Wi-Fi and its wireless access points have evolved throughout the years from the original IEEE 802.11a, to the latest IEEE 802.11ax (Wi-Fi 6) with a lot of improvement. These day, more and more devices have started to support Wi-Fi 6.

Wi-Fi 6 the improvement that it brings is it offer a better network capacity with higher network rates up to 9.6 Gbps. It increase the efficiency for data transmitted using Orthogonal Frequency Division Multiple Access (OFDMA) which makes bandwidth management more manageable. Also, the access point are capable of connecting up to eight devices with multi-user, multiple-input, multiple outputs (MU-MIMO) technology.

The usage of Basic Service Set (BSS) colouring may increase network capacity while enhancing the Wi-Fi co-existence of overlapping BSSs (OBSS) and allow spatial reuse within one channel. It also provide better power efficiencies, which may prolong the device battery life. Beside that, it did support 1024-QAM (Quadrature amplitude modulation) that may increase throughput capabilities in wireless devices. The long OFDM symbol in Wi-Fi 6 also may improves outdoor reliability and peak throughput.

For your information, the Wi-Fi standards do not put all the manufacturers on the same level because even if those manufacturers use the Wi-Fi 6, the performance for each is different. For example, between TP-Link and D-Link. The TP-Link router is a high-speed router with excellent signal strength and dependability. The TP-Link AC1750, for example, can deliver rates of up to 1750Mbps. The first 2.4GHz frequency band has a maximum speed of 450Mbps, while the second 5GHz frequency band has a top speed of 1300Mbps. This ensures minimal latency and buffering for resource-intensive applications. On the other hand, D-Link has a rapid HD/3D speed. It's dual-band, with the 2.4GHz band capable of 500Mbps and the 5GHz band capable of 867Mbps, for a total rate of 1,367Mbps. This is enough to ensure simultaneous Wi-Fi stream transmission for numerous connected devices at the same time.

Unified Network Management:

The traditional approach of the network management consists of two network elements: the WLAN controller that will centralize multiple access points and the Network Management System that will manage switches. The latest Unified Network Management will use Network Controller to centralize and manage all the access points and switches. This is to increase the management efficiency.

Multigigabit Technology:

The campus/enterprise core is under much stress because of rapid increases in Wi-Fi speeds and the increased number of IoT devices connected to it. Multigigabit infrastructure has a higher transmission speed than the existing campus infrastructure consisting of 40/100 GbE (Gigabit Ethernet) speeds for a core switch, 10/40 GbE for aggregation switch, and 2.5/5 GbE for access switch. The bottleneck also has changed and shifted throughout the years. The old bottleneck is for 802.11n between clients and access points with less than 1Gbps throughput. The new bottleneck is introduced for 802.11ac between the access point and multigigabit switch, with more than 1Gbps throughput or 2.5GbE. There is also a new bottleneck for 802.11ax between the access point and multigigabit switch, which have up to 5Gbps throughput or 5GbE.

Reflection:

The evolution of technology in network infrastructure has brought a new era in network technology. Wi-Fi 6 that we think the speed rate is the most high-speed, can be improved in the future to give birth to Wi-Fi 7 and so on that will have far more speed rate than Wi-Fi 6 in line with the need in the future. This improvement is needed perhaps to support the new invention to improve human life. As long as there are problems, technology will continuously evolve to help humans overcome the challenges.

5G, WIFI6 AND EMERGING NETWORK TECHNOLOGIES

6th INDUSTRIAL TALK BY MR. NICHOLAS YANG

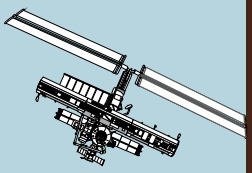
5G

5G is the next (and fifth) generation of wireless technology systems. It provides speeds faster than any previous generation even comparable to those delivered via fiber-optic cables. Early testing of this technology shows real-world speeds of 700-3025 Mbps (3.025 Gbps), which consumers may experience once 5G becomes commercially available. Movies that took minutes to download with 4G will take seconds with 5G. Once 5G becomes widespread, the effect on these industries could be transformative for 3 main reasons which are 5G devices are low latency, enabling better transmission of larger data streams, 5G devices are more reliable, enabling better transmission of data in extreme conditions, and 5G is more flexible than Wi-Fi and can support a wider range of devices, sensors, and wearables.

The International Telecommunication Union(ITU) formally adopt the term "IMT-2020" as 5G, which follows the footsteps of IMT-2000(3G) and IMT-Advanced(4G). 5G requirements will support more applications because 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 kilometer. Next, 5G application scenarios defined by ITU from people to vertical and IoT which are enhanced mobile broadband like Gpbs and UHD screen, massive machine-type communications like Smart City/Home, and ultra-reliable and low-latency communications such as self-driving cars. Besides that, the future use cases of 5G for business impact and 5G essentials are augmented reality, virtual reality, driver information, entertainment in the vehicle, automation in the vehicle, Smart Grid, and delivery drone in which the key relevant use cases among these are augmented reality, virtual reality, automation in the vehicle, and Smart Grid.

VR will be a killer application in 5G because of the gradually found industry chain such as chipset where Qualcomm Snapdragon 820 with VR optimization is used, VR terminal where the HTC live/Oculus Rift 2, Sony PSVR, and Gear VR/ Huawei VR is used, for example, content producer in where Facebook Surround 360, Google Jump, and Nokia OZO is used, and finally, the broadcast platforms where Facebook and Youtube VR platform is used. Moreover, VR needs 5G because of the high throughput for retina experience VR and low latency to avoid motion sickness like where the motion-to-photon will be less than 20ms and Network RTT will be less than 7ms. Besides VR applications, there are also top potential industrial applications that will benefit society in the future. The examples are 5G Smart Medical, 5G Smart Education, 5G Smart Port, 5G Smart Mine-Underground Mining, 5G Smart Power Grid, 5g Smart Manufacturing-Airplane Manufacture, etc.

Next, the opportunities and benefits of 5G. Firstly, next-generation Smart Tourism requires new technology applications for tourists to be able to live-stream their experiences anytime via 5G network. Besides that, enhancing the tourist-guide mobile App experience will also enhance the visitors' experience via next-generation AR and VR applications. Secondly, advanced 5G industrial park encourage Hi-Tech industry establishment to create local job opportunities. This can be done by equipping Hi-Tech Parks with a fully connected intelligent 5G industrial park platform to Hi-Tech investors to diversify the economy through High-Tech industrial development and create job opportunities for younger generations. Thirdly, 5G enables AR/VR based virtual education which helps students with excellent resources all over the country/world. This allows students to use VR to find better ways to know how certain experiments of theory works and also enables them to use VR for remote class learning.



WI-FI 6

Wi-Fi 6 is an indoor high-speed coverage with indoor ultra-high-density building/house that has been verified for more than 3 years. The standard evolution of the Wi-Fi industry chain following the 802.11 standards evolution process and WFA-name Wi-Fi generations is from 801.11n which is Wi-Fi 4 to 802.11ac wave 1 & 802.11ac wave 2 which is Wi-Fi 5 to 802.11ax which is Wi-Fi 6. The first release of Wi-Fi 6 terminals in 2019 are for example the iPhone 11 series, the Huawei P40 series, and massive Wi-Fi 6 terminals. Next, the evolution path of Wi-Fi technology started in October 2018 where the Wi-Fi Alliance specified a new name for different Wi-Fi standards. 802.11ax was named Wi-Fi 6 which is a revolutionary new technology. The new Wi-Fi 6(802.11ax) standards were empowering enterprises' digital transformation by providing large bandwidth, low latency, IoT-oriented Energy Saving and Anti-interference. In addition to that, the base technologies for Wi-Fi 6 are 1024-QAM, OFDMA, UL/DL MU-MIMO, BSS Coloring and TWT.

Wi-Fi 6 supports gigabit broadband promotion which is 1 Gbit/s to mobile phones/PCs, fast download/Cloud backup experience. It has improved bandwidth by 2.8 times, the rate of each spatial stream increases by 5.2%, a higher number of subcarriers and higher speed uplink and downlink experience compared to Wi-Fi 5. Besides that, Wi-Fi 6 chip RF optimization improves the TX power and sensitivity under the same signal quality and a dedicated algorithm, improving performance and omnidirectional coverage compared to when connecting to traditional Wi-Fi 5 STAs. Furthermore, by using Wi-Fi 6 OFDMA which uses multi-user sequential scheduling, it provides lower latency than Wi-Fi 5 OFDM which only uses multi-user disorder competition. Besides that, BSS Coloring in Wi-Fi 6 has a lower interference rate than CCA power adjustment in Wi-Fi 5 because in BSS Coloring data can be transmitted at the same channel simultaneously, because different colors are used for different users. These support the evolution of home value-added services such as Multi-screen IPTV, HD video teaching, Cloud VR interaction and E-sports acceleration. Next, it also supports a better multi-user experience where more than 100 terminals are connected and the power consumption of terminals is reduced by 30%. This is made possible by the use of TWT (Target Wakeup Time), terminal wake-up on-demand and examples of devices are Smart TVs, Smart Fridge and Smart Washing Machine. In addition, it also enhances the positioning of gateways as the control centers of Smart Home.

EMERGING NETWORK TECHNOLOGIES

Huawei AirEngine Wi-Fi 6 and 5G Technologies has the highest performance (16x16 MU-MIMO) which means it also has a better speed compared to the industry terminals. Besides that, it has the most stable experience because the smart antenna improves SNR, expanding the coverage radius by 20% compared to smart antenna in industry and Smart Radio radio calibration algorithm which enables 10ms Ultra-Low Latency using Dynamic Turbo where multi-queue packet scheduling acceleration algorithm can prioritize application latency and lossless roaming where zero packet loss in service roaming. Besides that, it has the most comprehensive IoT Apps in which two built-in slots for IoT module, IoT expansion through the USB port and IoT chip ready helps safe space, cables and increase capability. Lastly, it is the most secure because of the independent radio for scanning, hardware encryption and dual-signature boot.

REFLECTION

Through the talk, I was enlightened by the fact that 5G and Wi-Fi 6 can be and is already very beneficial to human life. This is because with the high-speed data transfer with less interference compared to their own previous features, critical information can be distributed quicker such as a patients medical record can be sent from one hospital to another in a matter of seconds which enables them to prepare for an important surgery even before the patient arrives or the use of self-driving cars may help prevent accidents and reduce one of the highest causes of death in our current society which is death through car accidents. These are just fractions of what these technologies can aid human life with and I hope that more countries will be able to adopt these technologies and use them in ways that will benefit everyone.