

TECHNOLOGY



CHANGE THE WORLD

MUHAMMAD KHAIRIL AMAR BIN MOHD NAZRI

A21EC0085

MUHAMMAD DINNIEY SAUFEE BIN RAZALI

A21EC0204

MUHAMMAD RIYAAZ BIN KAMAL

A21EC0092

FIRHAD HAZIMI BIN JAMALUDIN

A21EC0175

ABDULRAHMAN OSAMA GALAL ALI

A21EC0244

ZIHAN IZHAR BIN AZAHIR

A21EC0241



Application of 5G in Smart Campus
Smart Campus: The Journey Starts
Here
(CommScope Malaysia)
5G, Wifi6 and Emerging Network
Technologies (HUAWEI)

Description

The fifth iteration of cellular network operations is known as 5G, or fifth-generation wireless technology. It differs from 4G, the most prevalent wireless technology, due to latency, the delay between sending and receiving information. 5G enables educational delivery to be faster, more dependable, and smoother due to its incredibly low latency rate. A 5G cell tower, for example, can hold and support nearly 10 times as many devices as a 4G cell tower. This is especially important in an educational setting because lower latency and more available bandwidth will allow for superior communication over greater distances. 5G can also increase video conferencing quality, add haptic response capabilities, enhance immersive learning experiences with virtual reality (VR) and augmented reality (AR), and personalise education. It could change how teachers and students interact with each other and their materials if the next generation of network power comes along. With a high-bandwidth, low-latency network like Verizon 5G Ultra Wideband, heavy processing and rendering could move away from a VR headset and into the cloud. This could give wearers longer battery life, lighter hardware, and lower costs, which could make these devices more accessible. With 5G, learning will come to life in extraordinary ways.

Reflection

Motivation

Imagine a future with no wires and unlimited access to virtual reality. 5G network integration into education delivery offers the potential to improve connection, streamline classroom logistics, and improve overall learning experience. 5G technology will empower teachers at all levels to deliver more interesting learning environments for their pupils. This is the motivation for using 5G in SmartCampus.

Insights

Students come from diverse backgrounds. As a result, their learning ability varies. Students may learn even when they are not in the classroom thanks to 5G technology, which provides the same responsiveness and speed on tablets, PCs, and smartphones as in the classroom. No matter where a student is on the college or university campus, they have access to the same modules, notes, essays, and other course resources.

Information

Earlier mobile network versions, such as 4G, can struggle to handle high numbers of devices. Other people have encountered this problem while trying to use their phones during crowded sporting events or concerts. By transmitting precise data to each device, 5G networks can manage up to one million devices per square kilometre. This precision reduces 5G noise, making it easier to connect many devices. Because the number of networked devices is rapidly increasing, the ability to connect more devices is critical. The number of networked devices increases by roughly 25% per year.

APPLICATION 5G IN SMART CAMPUS

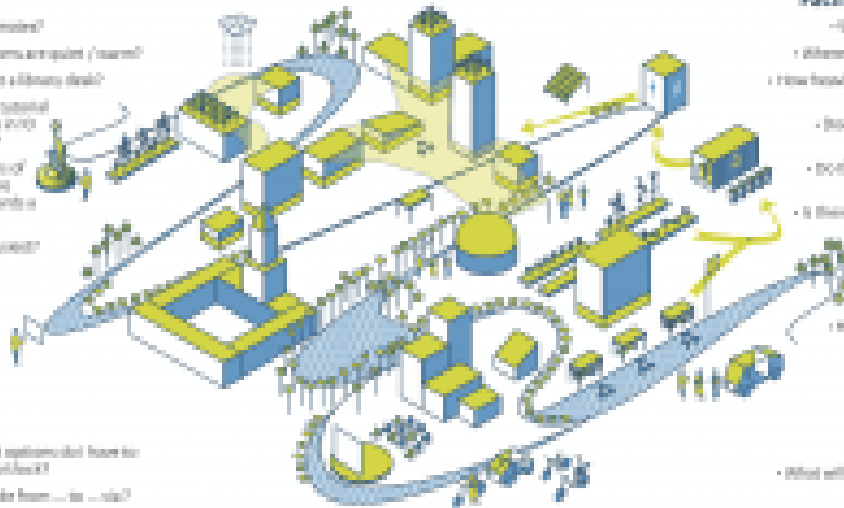


Smart Campus



Personal

- Where are my notes?
- What study rooms are quiet / noisy?
- Where can I get a library desk?
- Where can my personal group meet up in 10 minutes' time?
- Are the contents of work and lessons taking me towards a good degree?
- Which door is best?



Facilities Management

- Where are my notes/assignments?
- Where can I find a parking space?
- How frequently are rooms in the building / school utilized?
- How much lecture / meeting room is more available?
- Are the lights continued to be on when not in use?
- Is there a location event / issue?
- Can I be heading for a good job?
- Is it advisable staying (by / during time)?
- How much time is left to the bus / other things?

Music

- What transport options could be used to get to ... by ... at ... time?
- Who wants a ride from ... to ... via ...?
- How do I get to ... by bus / train / wheelchair ...?
- What (development) approach would fit with my preference type?

Weather

- Is it sunny / raining / sunny / cloudy?
- Is there a high risk of flooding?
- Is the car park full?

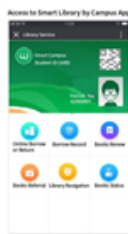
Engagement

- What's around my class / subject / department?
- What's the latest news?

Privacy

- What safety security problems exist about this? And to whom?
- What will Smart Campus reveal, and to whom, about:
 - Students / Staff / Visitors
 - The Infrastructure / Services

Dormitory- Personalized Learning



Flipping the classroom

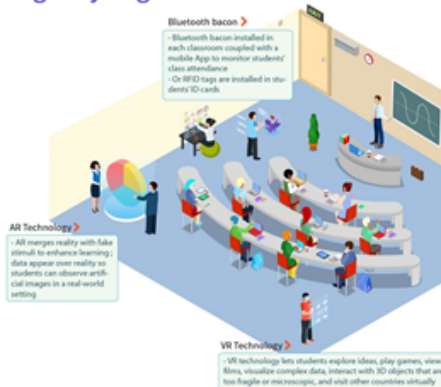
- Students watch pre-recorded lectures, do readings, and take quizzes at home, then do activities and assignments during class time
- Use resources of smart libraries to conduct research, which pre-recorded lectures that utilize SMARTboard technology, and check their understanding with short answer quizzes graded by AI technology

E-Learning and Virtual Classroom

- Students can virtually contact their academic advisors, and can learn individually in online courses or participate in virtual classrooms



Lecture Hall- Digitally Augmented



Bluetooth beacons

- Bluetooth beacons installed in each classroom coupled with a mobile App to monitor students' class attendance
- Or RFID tags are installed in students' ID cards

AR Technology

- All merges reality with fake stimuli to enhance learning; data appear over reality so students can observe artificial images in a real-world setting

VR Technology

- VR technology lets students explore ideas, play games, view files, visualize complex data, interact with 3D objects that are too fragile or microscopic, and visit other countries virtually

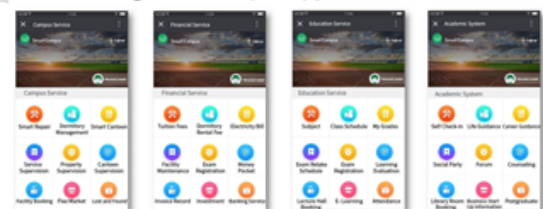
SMARTboard

- Can replace overhead projectors and allow teachers to enhance their lessons by integrating computers, video cameras, microscopes, and online resources with the board

Cloud-sourced customized curriculums

- Teachers could share their syllabus, lecture notes, or even past exams with a network of teachers from different institutions
- Teachers could borrow the best ideas and adapt successful lesson plans into their own courses

WeChat integration Campus App



*WeChat integration that allow teachers, students, administrators to communicate and accomplish campus-related tasks all in one app

DESCRIPTION & DEVICES USED

Wifi and Access Point

As 2021, the global values of Wi-Fi is \$3.3 trillion USD and it will rise up to \$4.9 trillion USD by the year 2025. As the world moving fast, we have now called the Wi-Fi 6 which improved from battery efficiency, network capacity, increase of peak throughput and reliable in outdoor. There are few devices using Wi-Fi 6 such as Iphone 11 series, Huawei p40, PS5 and many more.

Multigigabit Technology

Wireless devices are driving the demand for increased network capacity, thanks to the massive expansion of 802.11ac and new wireless applications. As a result, a solution that enables rates greater than 1 Gbps on all cabling infrastructure is required. For better performance, an increasing number of users, each with a device such as a laptop, tablet, or phone, are adopting the latest Wi-Fi standards. 802.11 (A, B, G, and N) APs could only manage roughly 600 megabits in previous Wi-Fi generations. 2.5/5 GbE access established in Wi-Fi 6 compared to existing 1GbE access. Bottleneck now is between the access point and the switch. This is why there is a demand for connections between access points and switches that are faster than one gigabit per second.

Unified Network Management

The administration of both wired and wireless networks through a single interface is known as unified network management. Through a unified interface, SmartZone 6.0 network controllers ease the complexity of scaling and maintaining wired switches and wireless access points. Network configuration, troubleshooting, performance management, and reporting are all supported by all SmartZone appliances, both physical and virtual. SmartZone's single, easy-to-use web interface manages network visibility from the wireless access point.

Internet of Things

Network has evolved from wired devices in 1970s to wireless in 1990s and now IoT devices in 2010s. By year 2025, smart building market will grow up to \$108B and 50 billion devices expected to be connected with IoT. Implement of IoT gives us many benefits such as cost reduction and enhance customer experiences but the downside of IoT is connectivity, security and compability. Devices or endpoint used in IoTs are for example CCTV, smart home with bulbs, bell all connected with Wifi or Bluetooth. While for education, IoT can be useful for vape detection, smart lighting and automated locks.

Cloud Analytics

new cloud service that provides network analytics and simplifies service assurance, allowing enterprises with complex networks to improve their users' experience proactively. The new service, which is based on machine learning and artificial intelligence foundation, speeds up troubleshooting, provides comprehensive network visibility, automatically identifies service-affecting issues, and—uniquely in the networking industry—classifies them according to severity.



Example of any domain

The example of a domain from the talk is " What is Smart Campus ? ". The definition of Smart Campus is the same as Smart City but in aspect of the campus. So, what is Smart Campus ? A Smart Campus places physical infrastructure on it's network infrastructure. It's create situational awareness for new services, lower costs and public safety. Its also using IoT to connect building, vehicles, peoples and things.

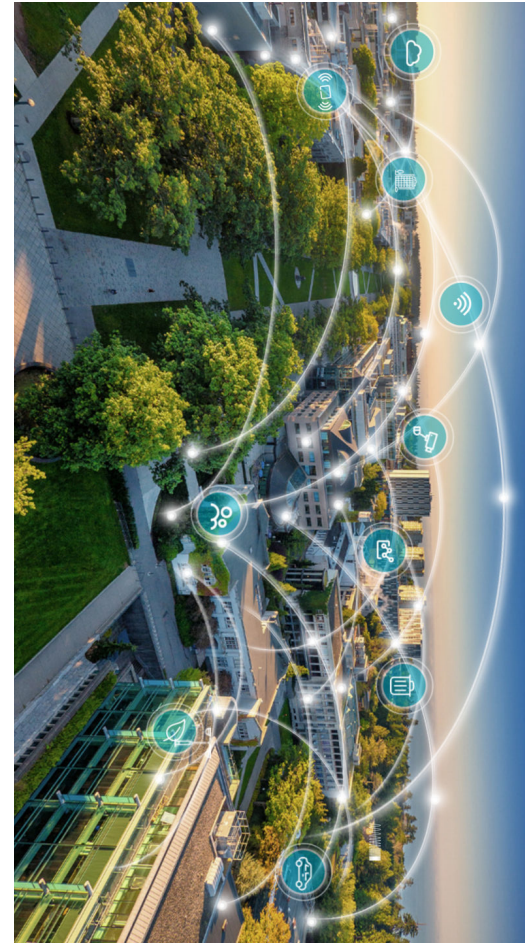
Smart Campus is the new frontier in higher education. To build a Smart Campus , 3 factors must be fulfilled in building automation and operational efficiencies.

Firstly is Smart Living. The infrastructures provide by Smart Living are smart ID cards, in-building LTE, smart lighting, smart packing/transit, wayfinding, personal networks and IPTV. For example in campus situation is when student want to borrow book from library, student must use smart ID card . Student only have to scan the ID card and the data of the loan will be updated in the library data. It will ease the burden of students.

Secondly, the Smart Learning . The infrastructures of Smart Learning are Flexible Learning Spaces, Digital Portals, Virtual Labs, Distance Learning, Lecture Capture and Library of the future. From what we experience in Universiti Teknologi Malaysia (UTM) , we can relate from Digital Portals is UTM e-learning portal which is created for student and lecturers of UTM to ease the burden of them to make them easy to search the notes uploaded by lecturer in the portal.

Lastly, is Smart Safety. The infrastructures of Smart Safety are CCTV & VMS, Connected Entry, Tracking Assets, Sound Detection and Motion Detection. The use of CCTV & VMS to monitor the circumstances in the campus. For example, the security guard only have to watch the screen in the guard house which connected wireless to the CCTV in the campus.

With these three factors, students will gain greater experience.



Reflection

From the talk by System Engineer in COMMSCOPE , Mr. Goh Bih Der, we have gained many knowledge about Smart Campus and more about technology. For example, the pandemic impact to IT world. The new normal have been used last 24 months with Covid 19 such as remote working and Cloud & Mobile Computing. Beside that, we also gain information about COMMSCOPE RUCKUS. They provides Indoor & Outdoor Wireless Access Point. From this talk, we can use these knowledges to expand our thinking.



5G,WIFI6 and EMERGING NETWORK TECHNOLOGIES

2nd December 2021

Description

5G

From the talk, the topic discussed firstly are 5G, 5G is the next and fifth generation of wireless tech system. It provided faster speed compared to previous generation. Early testing of this tech shows real speed of 700-3025 mbps. Movies that took minutes to download in 4G will take seconds with 5G. 5G will transform the industry as 5G are lower latency, enabling faster transmission of larger data stream. 5G is also more flexible and can support wider range of devices, sensors, and wearables.

5G requirement will support more application and more people will be able to go stream higher resolution video. WIFI 6 has been verified for more than 3 year.

WIFI 6

Huawei Wifi 6 first introduced on 2016 in form of wifi chipset. In 2019 WIFI alliance initiative WIFI 6 certification to indicate WIFI 6 has reached commercial usage. WIFI 6 is revolutionary because of the speed jump between 1.73Gbps to 9.6Gbps in between of 6 year.

WIFI 6 support gigabit broadband promotion: 1Gbits to mobile phones/Pcs, Fast download/Cloud backup Experience. The bandwidth are improve by 2.8 times allowing higher speed uplink and downlink experience with an actual rate of 1Gbit/s. WIFI 6 improve bandwidth by 3 factor which are spatial stream, sub carrier quantity, symbol duration and coding mode. WIFI 6 improve coverage by full house coverage of 5Ghz Signal. WIFI 6 chip RF optimization improve the TX power and sensitivity under the same signal quality. Dedicated algorithm, improving performance and omnidirectional coverage when connecting to traditional WiFi 5 STAs. WIFI 6 big advantages are are bandwidth improved by 2.8 times, coverage range improve by 40%, network capacity and efficiency improve by maximum of 128 user supported and the power consumption of STAs reduced by 30%

EMERGING NETWORK TECHNOLOGY

Smart antenna improves SNR expanding coverage radius by 20%. The beam technology help to reduce network instability. Network get overwhe when user move between different access point causing poor network experience.. Smart antenna help to transmit stable network signal.

Smart radio enables 10ms Ultra low latency and lossless roaming to able user to transmit information faster. Lossless roaming is important to ensure continuous roaming experience



Example of domain

5G

Example of domain are in industry. 5G will help industry especially technologies and manufacturing by enabling higher data transmission and allowing data to be used to improve the productivity of the industries. 5G able user to stream 4K video effortlessly without any lagging allowing user to enjoy high resolution video like movies, football games and much more as 5G help increase data transmission. 5G is used in augmented reality, virtual reality, driver information, entertainment in vehicle, automation in the vehicle, smart grid, delivery drone and many more. In virtual reality (VR), VR will be killer application because high throughput for retina experience VR. Low latency are required to avoid motion sickness. All these require fast data transmission thus 5G will enable user to enjoy Virtual Reality experience. In industrial application example of 5G implementation are 5G smartport, 5G smart manufacturing, 5G smart education, 5G smart medical, 5G private line, 5G smart transportation and many more

WIFI 6 example of domain:

For user it help in dense environment by improving average throughy per user by at least 4 times in dense or congested environment. Wifi 6 help to increase network efficiency. Wifi 6 can be used in online education, multiscreen IPTV, VR and Esports. Wifi 6 support better multi user experience for user and power are reduced by 30% especially for gamer Smart antenna help user to increase internet efficiency . Smart radio in industry require lossless roaming so that there are continuous roaming experience especially smart manufacturing

Reflection

From the talk given by Mr Nicholas Young, students are able to garner knowledge about Huawei and its role and contributions in developing or leveraging 5G technology, Wifi 6 and other network technologies that bring forth new technologies that can revolutionize toda digital world. Student had able to gain exposure on these topic as well as obtaining new information on the industry that are given by HUAWEI. Hopefully, this talk help student to understand more on the fundamental of these technologies and its application whether for user, home or organization as a whole. Student that are aboe to use well the information gained will have a better chance in thriving in the technology industry after university.

wei AirEngine Wi-Fi 6 Technologies At-A-Glance

Highest Performance



- 16x16 MU-MIMO

Most Stable Experience



- Smart antenna
- Dynamic Turbo
- Lossless roaming @office@AGV
- SmartRadio radio calibration algorithm
- Joint scheduling through MU-MIMO and OFDMA

Most Comprehensive IoT Apps



- Two built-in slots for IoT module
- IoT expansion through the USB port
- IoT chip ready

Huawei Confidential

Devices used

As the talk was given by Huawei representative, most of the devices are developed and created by Huawei. Huawei created smartphones, wearables, smart home devices. Huawei does not only focus on user only but Huawei also develop technologies for organization. Huawei also develop intelligent automotive component like autonomy driving, intelligent sensing, intelligent vehicle cloud service that require implementation of 5G to work effectively. Huawei also develop connectivity like wireless network, data communication, transport network that can be improved further using WIFI 6. In term of component 5G use wireless technology system that are faster than speed provide by fiber optic cables. In VR the chipset needed Qualcomm snapdragon 820 VR optimization that can run smoothly using 5G. The component used in WIFI 6 1024 QAM, OFDMA, UL/DL MU-MIMO, BSS COLORING and TWT. Devices that can benefit from WIFI 6 are smartphones, wearables, automation, manufacturing warehouse and many more.. Smart antenna used antenna as much as 16 to improve coverage radius.

Wi-Fi 6 Provides High Bandwidth, Wide Coverage, Anti-interference/Low Latency, And Multi-user Access

Wi-Fi 6 Advantages	Improvements	Wi-Fi 5	Benefits
Bandwidth improved by 2.8 times	802.11ax for 2.4 GHz	The 2.4 GHz frequency band does not support 802.11ac	2.4G performance improvement
	1024QAM	Only 256QAM	Peak performance improved by 25%
	4 x longer OFDM symbols (12.8 us)	3.2 us	Peak performance improved by 5.2%
	The ratio of subcarriers carrying carriers increases by 95.7%	91.4%	Peak performance improved by 4.3%
Coverage range improvement, Increased by 40%	Dual carrier modulation (DCM)	None	The receive SNR increases by 3 dB
	OFDMA (Smaller BW RU)	None	Theoretically, the receive SNR increases maximum of 9 dB
Network capacity and efficiency improvement A maximum of 128 users are supported	OFDMA	OFDM	Multi-user small-packet performance improvement
	Spatial Reuse	None	Multiple APs share spectrum resource, improving spectral efficiency
	UL MU-MIMO	Only DL MU-MIMO	Uplink multi-user concurrency, improving network capacity
	Preamble puncturing	None	Improved spectrum utilization under interference
The power consumption of STAs is reduced by 30%	Target Wake Time (TWT)	None	The power consumption is reduced when STA (Station) is in sleep mode