

Technology Information System, **Emerging Network Technologies**



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APPLICATION OF 5G IN SMART CAMPUS



Introduction

Smart Campus

Smart campus refers to the purpose of promoting the integration of information technology on education and teaching, improving the effective of teaching and learning, using new technologies such as the Internet of Things, cloud computing, and big data analysis as core technologies to provide a comprehensive environment. Besides, it provides a smart learning environment that integrates teaching, scientific research, management and life services into a networked, collaborative manner and can provide insights and predictions on education, teaching as well as education management.

Application of 5G in Smart Campus

Campus Security

This application aims to improve campus security by using cloud computing, big data, artificial intelligence and other information technology. It provides the inspection and registration of the entrance and exit of the school, monitoring of time periods and all locations of the campus and timely warning of illegal external intrusions, providing safety guarantee for the teachers and students in the school.





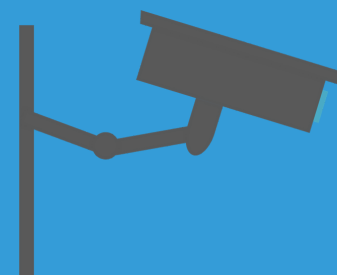
Campus access control

By using face detection and recognition technology to accurately identify identities and return identification results quickly, achieving higher throughput rates for access control and automated campus security management.



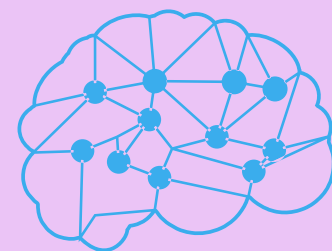
Area monitoring

Combined with AI and 5G, the controlled areas will be monitored in real time and it can detect illegal invasion if the person is making suspicious behavior. Guards can monitor all of the areas in the security room.



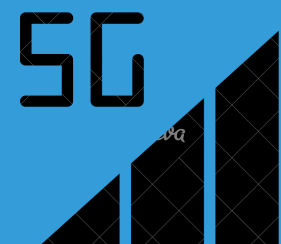
Accurate recognition

Artificial Intelligence provides a better recognition algorithm, it is able to recognize and analyze more complex scenes.



Low latency

5G provides ultra-low latency compared with the previous network. Face recognition can be done within milliseconds.



Reflection

Nowadays, smart campus plays a crucial role in the university environment. With the advent of the 5G era, most of all things are done through the network, because 5G is much faster than the previous network, even security is no exception. Normally this application will be used by universities it is because universities have a large area. If we use traditional methods such as patrols, it will cost a lot of manpower, and sometimes there will be some management negligence, allowing criminals to take advantage of it. By using this system, the security does not need to patrol everywhere every day or register for each visitor, because all of the jobs will be handled by smart campus. They just sit in the security room and they are able to observe the movement of the whole university. Next, students and staff can also use face recognition to pass the entrance guard, which saves a lot of time compared to before. Finally, the smart campus application provides a lot of benefits, changing the complex procedures in the past into simplification.

EMERGING TECHNOLOGY ON NETWORK INFRASTRUCTURE

Industrial talk by **COMMScope®**

*Devices used in
specific
technology*

Quick View

Pandemic has caused tons of people to work remotely and thus it's important for one company to manage its resources well by emerging latest technologies on their infrastructure. Technically not only employers, but everyone on the earth has learnt to cope with this pandemic period by adapting themselves into this rapid digital transforming world. In this talk, Mr. Goh has shared with us some of the technology highlights that we should know.

Control & Management



<https://support.ruckuswireless.com/products/77-smartzone-100-sz-100>

SmartZone is the high performing Wireless LAN controller for enterprises around the world. SmartZone network controllers simplify network management by strength security and reduce troubleshooting.

Switches



<https://www.commscope.com/product-type/enterprise-networking/ethernet-switches/>

The **RUCKUS ICX 7150** deliver high performance with SmartZone network controllers at entry-level price. The ICX 7150 series of switches are available in three formats: standard, Z-Series with multi-gigabit support, and compact.

TECHNOLOGY HIGHLIGHTS

Wifi & Access Point(AP)

Multigigabit Technology

Unified Network Management

IoT (Internet of Things)

Cloud Analytics

Access Point



<https://www.commscope.com/product-type/enterprise-networking/wireless-access-points/>

Access point is a device that cover an office or large building to create a wireless local area network (WLAN).



About Wifi 6 and Access Point



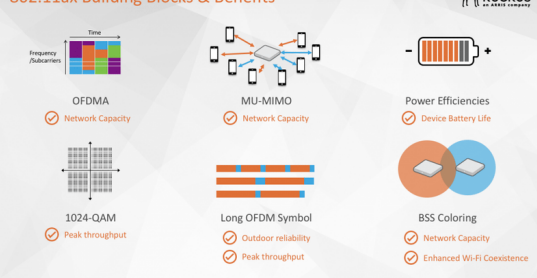
Source:
<https://www.bhphotovideo.com/explora/computers/tips-and-solutions/what-is-wi-fi-6>

Wi-Fi GENERATIONS

Wi-Fi Generation	Sample User Interface Icon	MULTI-DEVICE PERFORMANCE
Wi-Fi 6		
Wi-Fi 5		
Wi-Fi 4		

Wi-Fi 6 or 802.11ax provides higher speed and larger capacity, lower latency and finer traffic management, as well as higher spectrum efficiency, larger coverage, more energy-efficient access terminal power consumption requirements, and higher The reliability and security of Wi-Fi, as well as the ability to access data consumption and latency-sensitive applications, will greatly expand the application range and scenarios of Wi-Fi networks, from corporate office networks to corporate production networks.

802.11ax Building Blocks & Benefits



FEATURE OF WI-FI6

1. OFDMA is evolved from OFDM. Its data will occupy the entire channel, and its limited resources are seriously wasted. OFDMA technology divides the wireless channel into multiple sub-channels in the frequency domain, allowing multiple users reduce waiting time to transmit in parallel at the same time in each time period.
2. MU-MIMO allows multiple users to enter (input) and exit (output).
3. Power efficiencies enables a longer device battery life, it can save power and energy.
4. 1024-QAM doubles the effective bandwidth.
5. Long OFDM Symbol improve immunity to the propagation environment that prevents proliferation
6. BSS Coloring improves overall system performance and effective utilization of spectrum resources in densely deployed environments

Multigigabit Technology

Multi-Gigabit automatic variable speed network will automatically change the speed according to the serial device, no longer slow down due to unsupported switches, maintaining maximum performance.

Cisco multigigabit technology offers significant benefits for a diverse range of speeds, cable types, and Power Over Ethernet (POE) power. The benefits can be grouped into three different areas:

- Multiple speeds: Cisco multigigabit technology supports auto-negotiation of multiple speeds on switch ports. The supported speeds are 100 Mbps, 1 Gbps, 2.5 Gbps, and 5 Gbps on Cat 5e cable and up to 10 Gbps over Cat 6a cabling.
- Cable type: The technology supports a wide range of cable types including Cat 5e, Cat 6, and Cat 6a or above.
- POE power: The technology supports POE, POE+, and UPOE for all the supported speeds and cable types.



Source:
<https://www.cisco.com/c/en/us/solutions/enterprise-networks/catalyst-multigigabit-switching/index.html>

Unified Network Management

In traditional approach to on-premises, we need go to particular system to change it if we want to change our network password. What if we have one thousand password to change? We need to repeat a thousand time of the same thing, it is terribly tedious job. So, we centralize all the device by network controller.



We could use the SmartZone 6.0 dashboard of network controller to manage all the devices information. How network controllers solve today's IT challenges:

- Reduce operating costs
- Increase availability
- Improve agility
- Enhance security
- Accelerate adoption of intent-based networking

Source : <https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-a-network-controller.html#-faq>

Internet of Things (IoT)

In short, the Internet of Things refers to the rapidly growing network of connected objects that are able to collect and exchange data in real time using embedded sensors. Thermostats, cars, lights, refrigerators, and more appliances can all be connected to the IoT. Some of the examples are:

- Connected appliances
- Smart home security systems
- Biometric cybersecurity scanners

Anything that has a sensor attached to it and can transmit data from one object to another or to people with the help of internet is known as an IoT device. The IoT devices include wireless sensors, software, actuators, computer devices and more.



Smart Campus as part a of domain in emerging technology

School as a place which for student to gain knowledge and provide a good environment to student as protect their security so that they would not been injured or scamming by people who are rude in the dark. As a result, school like smart campus have used the network technology to increase preventive ability such as IoT, Cloud Analytics, Unified Network Management and other.

For example, if an unfriendly people try to break in the Smart Campus, he needs to access the password of the electronic lock. As he enters the wrong password or attempt to break down the system, the light bar and siren will automatically running the system since the infrastructures is connecting the internet with a high speed transmission. At the meantime, the video from CCTV camera catches his face and his real-time location will be save in the cloud data then sending to the security house. The anti-theft system will strengthen the security system until the man have been caught.

Cloud Analytics

People face problems of network professionals spend too much time troubleshooting and problems of network professionals cannot proactively identify network performance issues. Examples of cloud analytics can be software-as-a-service business intelligence (SaaS BI), perform to host data warehouses, and cloud-based social media analytics. The benefits are:

- Scalability
- Simplify operations
- Easy access and collaboration
- Reduce costs

Reflection

Attending this talk had us realizing how powerful are these technologies on creating a massive impact to the world. Its a common thing that majority enterprises switch to cloud computing in terms of storing databases and computing storage during this period. In order to lower latency and support a larger data transmission for digital business transformation, more advanced technologies must be adapted to boost the performance of the companies. We're so excited about the soon launching of Wifi-6 in our country, which means that the Internet speed can be even faster compared to the existing one. As the generation who hold the future of Malaysia, we hope that we can contribute our parts to make this country a better one, to make Malaysians proud of what our technology field achieves in the near future.



5G, Wifi6 and Emerging Network Technologies

Industrial talk by Huawei

5G or also known as IMT-2020 by International Telecommunication Union (ITU) is the fifth generation of wireless technology systems. It provides speeds faster than the previous generation and is comparable to those delivered via fiber optic. The early testing of 5G shows that the speeds can achieve 700Mbps to 3.025 Gbps. This can let consumers have a better experience such as downloading a movie in just a few seconds compared to 4G which takes a few minutes.

5G brings a transformative effect because of 3 main reasons. Firstly, 5G devices are lower latency which enables faster transmission of larger data streams. Secondly, 5G devices are more reliable because it enables better transmission of data in extreme conditions. Lastly, 5G is more flexible than Wi-Fi and supports a wider range of devices, sensors, and wearables such as connecting up to millions of devices into a single point.

5G supports 1ms of end-to-end latency, 10Gbps peak data rate, and 1 million connections within 1 km square. Hence, the user experience will be better. For instance, 5G allows users to stream 4k or even 8k video without lagging.



<https://www.forbes.com/sites/bernardmarr/2019/10/25/what-is-5g-technology-and-how-must-businesses-prepare-for-it/?sh=57d6d6401758>

5G devices example:

- Xiaomi Mi 10 5G
- Samsung Galaxy Z Fold2 5G
- OPPO Find X2 5G
- Huawei P40 5G
- Huawei 5G router such as Huawei 5G CPE Pro 2 H122-373

Source: <https://www.router-switch.com/5g-devices.html>

Domain that implements 5G

5G has many use cases included Augmented Reality, Virtual reality, Driver Information, Entertainment in the Vehicle, Automation in the vehicle, Smart Grid, and Delivery Drone.

5G is important in VR because it provides high throughput for retina experience VR and low latency to avoid motion sickness so that the users will have a better experience in VR. For instance, 5G enables high resolutions for a better retina experience and provides a high data transfer rate to meet the requirement of 3D and panorama in VR.

In terms of tourism, tourists can live-stream to share their travel experiences via 5G network anywhere and anytime without worrying about the speed and the coverage of the internet. In addition, applications of next-generation AR and VR also can enhance visitors' experience as 5G enables the functions provided by AR and VR to be more advanced.

In terms of industry, 5G Industrial Park encourages Hi-tech industry establishment and creates job opportunities.

In terms of education, 5G enables AR/VR-based Virtual Education which makes learning more attractive. Besides that, 5G provides high-speed internet which lets remote class learning become easier and increases the efficiency of learning.



Source: <https://learn.g2.com/virtual-reality>



Source: <https://globetrender.com/2020/06/07/live-stream-virtual-travel-experiences/>



Source: <https://www.hp.com/gb-en/shop/tech-takes/10-remote-learning-best-practices-for-teachers>

WI-FI 6 (802.11 ax)



In September 2019, the WI-FI Alliance has initiated the WI-FI 6 or know as 802.11ax has entered the mature commercial use phase. From its revolution, there are great leaps from a 1.73 Gbps to 9.6 Gbps of maximum transfer rate and 866 Mbps to 2.4 Gbps of 2T2R.

In terms of its core technology, WI-FI 6 can provide us 2.8 times higher in bandwidth, 40% wider in coverage range, approximately 50% lower in average latency, and 30% lower in terminal power consumption. With the increase of the number of subcarriers from 234 to 940, the rate of spacial streams is increased by 4.3% and thus contributes in part of the faster data transmission. Not only that, with the implementation of TWT (Target Wakeup Time) in WI-FI 6, our terminal will wake up on demand instead of staying awake all the time and drain its power faster.

Reflection

The technology is constantly evolving, and the 5G and Wi-Fi 6 are the best examples of the results of the evolution of technology. From this industrial talk, it shows that 5G is the latest generation of wireless technology systems which has made great leaps in many aspects compared to the previous one. For instance, 5G can achieve greater devices courage and lower latency. Besides that, Wi-Fi 6 also provides a larger bandwidth and lower latency compared to Wi-Fi 5. These technologies will enhance the user experience in the usage of the internet and also allow more technologies to be developed and implemented. The evolution of technology is inseparable from peoples' efforts. Hence, we must study hard so that we can make some contribution to the technology advancement in order to make our life easier and improve our quality of life.



Source: <https://e.huawei.com/uk/products/enterprise-networking/wlan/wifi-6>

Huawei AirEngine WI-FI 6

is a product from Huawei that is compliant with the WI-FI 6 standards and claims to provide us the world's first 10 Gbit/s of seamless WI-FI experience. In this remarkable innovation by Huawei, they are acclaimed for their Smart Antenna, SmartRadio, and Continuous Self-Organizing Networking.

By using 16 built-in Smart Antennas and the 5G-powered beamforming algorithm, it can achieve 20% wider coverage and free from blind spots.

With the implementation of SmartRadio, AirEngine WI-FI 6 can reduce roaming latency of WI-FI 6 from 50ms to 10ms and hence deliver a smooth experience for video-conferencing and voice call with almost zero packet loss. Nonetheless, it comes with the AI-powered intelligent radio calibration that will enable greater precision in detecting the environmental changes to optimize the net-work wide experience by up to 58%.

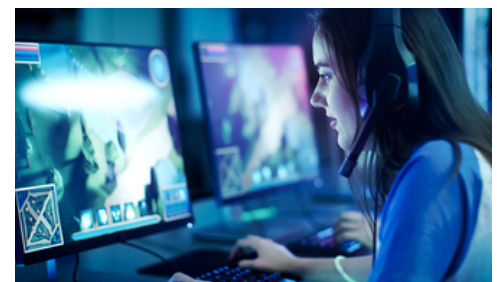
Example of domains



Source: <https://www.istockphoto.com/videos/teacher>

HD video online teaching

- 20-50 Mbps
- 0 packet loss within 45 minutes



Source: https://www.nyit.edu/medicine/center_for_esports_medicine

E-sport acceleration

- Less than 10ms latency