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TREND OF NETWORK

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SMART CAMPUS

APPLICATION OF 5G IN SMART CAMPUS

Smart Facillity Management

Introduction

5G is 5th generation mobile network with feature of high transmitting speed, low latency and reliable. The invention facilitate the development of IOT in turn. Both of this make the realization and deploying of Smart Campus is not longer a dream. One of the important application in Smart Campus is Smart facility management system which can reducing the cost of management, data-driven decision making and enhancing the security in campus. What is smart facillity management system? Acoording Tony Khoo, President, Singapore International Facility Management Association (SIFMA), Smart Facillity System is about integrating technologies, people and processes to improve communications, lessen response time, reduce costs and manpower and more importantly, raise productivity." In brief, the data collected by the sensor could be utilised in varies aspect like autonomous and big data analysis

Benifit of Smart Facility Management System

Reducing Cost of Management

The electric and water bills was one of the majority expense of Campus. The system can enhance the efficiency of electric usage to reduce cost. It can detect how many people in a room that are gathering in a facility like classroom or accommodation by wifi and installing more sensors to HVAC systems to adjust the temperature and lighting to improving the energy saving. Besides, the facility management system also could help us saving the water usage. The real example is Arizona State University invest around $300 million which including camera, sensors to their football stadium which can send the data about water usage. Specifically, by comparing the water usage and the flow of people to a specific building, we even can find out unusual water usage which may be caused by pipe leakage, this is useful when campus is large enough. All of this rely on the real time transfer of 5G.

Data driven Decision Making

The 5G enable real time data transfer which is useful in analysis and decision making. These data including the security, classroom other facilities usage rate, student attendance or others. The classroom usage rate can help universities to rearrange their schedules for more efficiency. Besides, the bus stop usage rate also enable in optimizing transportation routes. Moreover, by analyzing the data, campuses can consider more reliable to increase the student experience in campus. For example, when a facility is always full of crowd, campuses could know the exact period to figure out the main reason for taking solution.

Enhancing security in Campus

Security of facilities always is the most concerned problem by campuses because this highly related with the reputation. The wireless sensor like motion detector for the moving of unusual opening of door or windows and safeguard device must be connected between each other and communicate in a high speed by 5G for to be triggered immediately. Besides, the smart IP video cameras allow to send high revolution recording and alerts by 5G.

Reflection

5G in Smart Campus play an important role for connecting the sensor and device together for fluency in communicating and work together for a specific task. The insight that I get from the technology is that really can save a lot of human resource, environment friendly and more reliable. By the sensor which installed in device and the real time information send to our front via 5G could easily detect the damage of infrastructure for repair and deploy workers efficiently to conduct regular maintenance and avoid the unnecesary human resource. Besides, the automatic adjusting light and temperature also is one of the strategy to reduce the tradeoff between convenience and environment friendly by adjusting the device according the real situation to avoid wastage. Other than that, the real time provided data via 5G also is a robust tool to analyze the problem to get an efficient approach because the data is a well representation of the real world. In short, smart campus is the trend of how our campus develop and is real applicable by the development of 5G.

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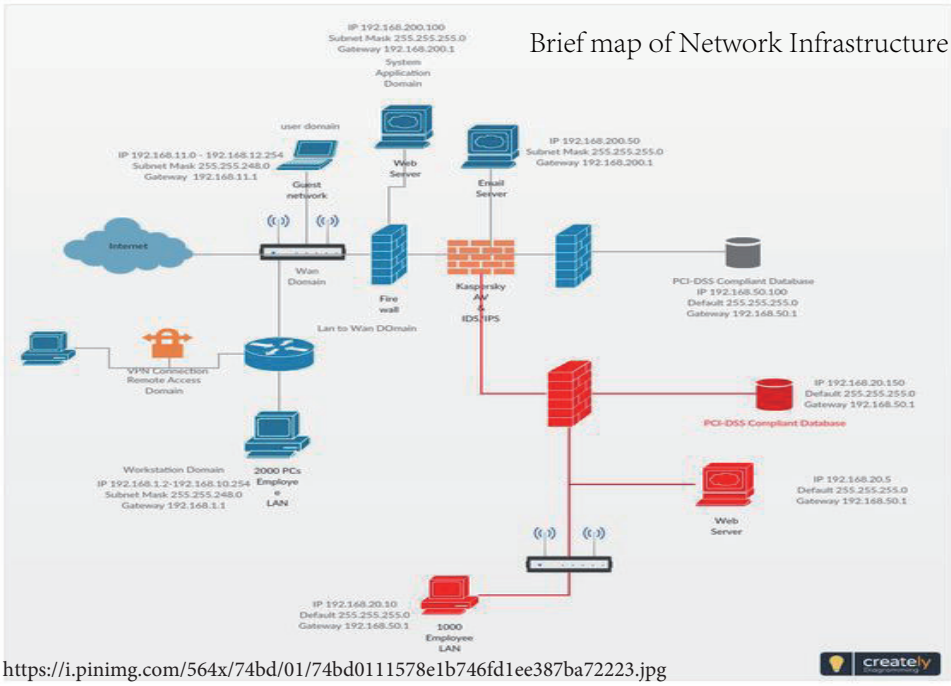
TECHNOLOGY ON
NETWORK INFRASTRUCTURE

MR Goh Bih Der (COMMSCOPE)

Description of Infrastructure



Brief map of Network Infrastructure

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Example in Domain

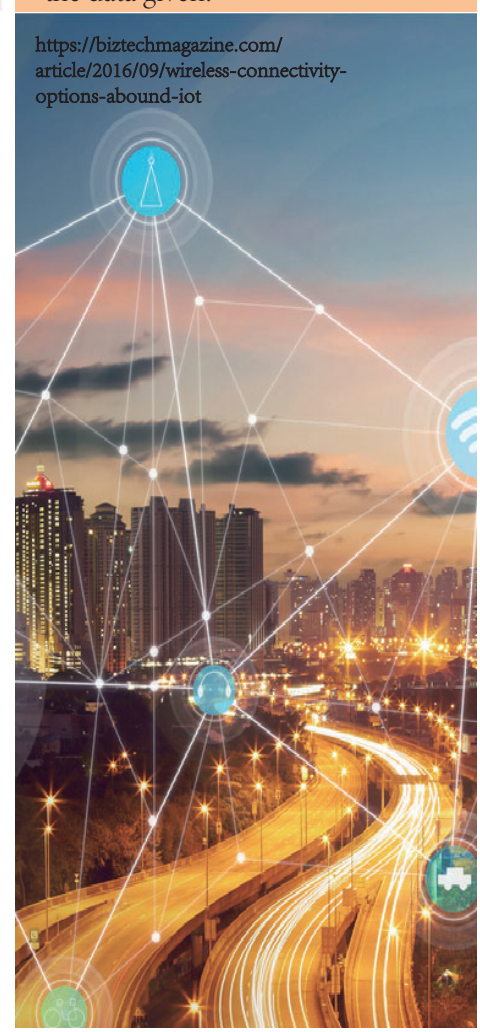
In this modern-day and age, the development of the world is advancing day by day and step by day. For example, Seoul, the capital city of South Korea, is the world's first smart city. In this world's first smart city, they manage and measure the city's data such as air quality and traffic flow and speed with sensors and CCTV deployed all around the city. On the other hand, it can also detect abnormal movement, temperature, humidity and lighting. With the help of Artificial Intelligence (AI), it can detect potential crime patterns by using the data given.

Based on the industrial talk by Mr Goh Bih Der from Commscope, vital infrastructure is highlighted in the talk: network infrastructure. Network infrastructure is becoming the cornerstone of our daily life in today's modern world, and we are intensely reliant on it. Network infrastructure provides completed and well-function network services that allow devices to connect and communicate.

In brief, network infrastructure builds hardware, software, services, and facilities. There is hardware such as wireless access points, switches, core switches and cables that connect the devices. Networking software like operating systems, firewalls and network security applications are usually included in the network infrastructure. In addition, network services such as satellite, wireless protocols, IP addressing and so forth. There are also facilities like data centers that connect servers to end-user locations.

Based on the Gigamon blog, network infrastructure is all of the resources of a network that make network or internet connectivity, management,business operations and communication possible. Network infrastructure comprises hardware and software, systems and devices, enabling computing and communication between users, services, applications and processes. Anything involved in the network, from servers to wireless routers, comes together to make up a system's network infrastructure. Network infrastructure allows effective com munication and service between users, applications,services,devices.

https://blog.gigamon.com/2019/03/06/what-is-network-infrastructure/



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Device used

To make the network infrastructure work perfectly, the speaker had introduced us to the devices used in this network infrastructure scenario. The devices used are Wi-Fi 6 TEchnology, Multigigabit Technology, Unified Network Management and Internet of Things (IoT).

Wi-Fi 6 Technology

In the prediction, Wi-Fi 6 can provide up to 9.6 Gbps compared to the 3.5 Gbps of Wi-Fi 5. Firstly, Wi-Fi 6 used Orthogonal Frequency Division Multiple Access (OFDMA) to deliver higher aggregate throughputs with lower latencies. In addition, Wi-Fi 6 introduces the more extended OFDM symbol that provides broader coverage of signal and enhances the efficiency of data transmitting. Furthermore, Multi-User Multiple-Input Multiple-Output (MU-MIMO) enables the wireless access points to communicate with multiple devices simultaneously. Besides, Target Wake Time (TWT) enhances the power efficiency by increasing its low power sleep times and waking up more efficiently. Wi-Fi 6 also supports 1024 QAM with 10 bits per symbol with more bits could carry more data, leading to the efficiency of the payload data delivery and increasing peak throughput. Lastly, Basic Service Set Coloring (BSS Coloring) help to enhance the coexistence.

Multigigabit Technology

Multigigabit Technology provides a port that allows devices that require more than one gig of throughput to connect. It able to attain equal high speed and connectivity with lesser capital expenditure because it consumes lower costs without using existing cabling infrastructure. In addition, this technology provides multiple connectivity speeds based on the devices' needs..

Unified Network Management

Unified Network Management can help us manage the network infrastructure to complete the heavy tasks of new devices and applications. In addition, it used a network controller to centralise control of all the access points and switched in one. Besides, Unified Network Management enables us to manage multiple technology domains through a single platform. Furthermore, the unified user interface is simple and easy to use for most people who improve user experiences. It allows us to manage the information of access points and switches through the SmartZone 6.0 platform only.

Internet of Things (IoT)

Based on Oracle, the Internet of Things (IoT) describes the network of physical objects things hat are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet. It can reduce and save costs in many aspects. Other than that, we can achieve a better customer experience with all that fabulous IoT devices. The opportunities on the business also will be enlarged and increased widely. Back in manufacturing, efficiency and productivity also can be improved.There are three main fields.:

1. Smart City refers to a physical infrastructure placed on the completed network infrastructure. The smart city uses ICT to boost operational efficiency, communicate and exchange information with the public, improve government service and citizen welfare. It provide new services, lower living costs, and better public safety.

2.The Smart Home is a home that allows people to control the appliance and other devices automatically through a wireless or wired internet connection. This can work well with IoT devices such as smart security systems, doorbells, and other smart appliances to reduce the costs and provide convenient and safe life.

3.The Smart Campus utilise advanced network infrastructure and internet-connected equipment to connects people, devices, and applications, allowing universities improve the smart living, smart learning, smart safety, and security .

Reflection

Based on the valuable talk by Mr Goh Bih Der from Commscope on 29th November 2021, we have found out that the presence of network infrastructure becoming more and more crucial. When we talk about network infrastructure, the smart campus always comes to our minds as students. This talk motivated us to how smart campus innovation will help human life in education.

In this rapid development information age, technology plays an important role in human life, including campus students. The concept of a smart campus will provide smart living, smart learning, and smart security. First and foremost, a smart campus can enhance campus security and safety with the help of IoT devices such as smart sensors, smart locks, and other equipment. Other than that, everything on the campus can work automatically, like smart lighting to reduce operational costs. Furthermore, students can access their study materials anywhere with the digital portals and better learning experiences with technology such as Internet Protocol television (IPTV).

In sum, the innovation of smart campuses provides more convenient, safe and cost-saving learning and living in-campus experiences to the student and other people. We hope and believe that this innovation will be applied sooner to most universities or colleges campus.

5G, Wifi6 and Emerging Network Technologies

MR Nicholas Yang (HUAWEI)

Description of Infrastructure

We discussed the information and communications technology (ICT) infrastructure concerning Mr Nicholas Yong's industrial presentation from HUAWEI. The term "ICT infrastructure" refers to the collection of devices, networking components, systems, and applications that enable organisations and individuals to interact with and connect to the digital world. The ICT infrastructure includes digital telephone networks, mobile phones, internet capability, procedures, protocols, and other telecommunications or information technology technologies.

The ICT infrastructure will connect every person, home, and organisation to the digital world, enabling a fully connected and intelligent world. The flow of ICT infrastructure in an intelligent world includes information transmission, information processing and storage, information learning and inference, and information distribution and interaction. To complete the ICT infrastructure in this world, it used devices, intelligent automotive components, connectivity and computing, and a robust cloud connection.

Device Used

5G In the modern era, wireless networks such as the 4G network are becoming increasingly important in human life, and the 5G network is about to revolutionise the industry. 5G, also referred to as the fifth generation of mobile networks, is the most recent generation of wireless technology following 1G, 2G, 3G, and 4G networks. Compared to the previous generation, 5G can deliver faster data speeds with lower latency, on par with most fibre-optic cable-delivered networks.Lower latency can reduced delay enables the transmission of more extensive data streams at a faster rate. 5G also enables the connection of more devices and supports a broader range of devices, sensors, wearables, and other internet-connected devices for more flexible. Besides, the data transmission is improved, faster, and smoother when performing a heavy task.

Virtual Reality (VR) is a simulation technology that creates an artificial environment. Through this VR technology, individuals can interact with the three-dimensional world. Several examples of virtual reality equipment are available on the market, including the Playstation VR and HTC Vive Pro Eye.

Apart from that, the rising popularity and development of VR are inextricably linked to 5G. 5G can provide the necessary throughput for a retinal VR experience. It enables up to 5037x5707 resolution for the entire retinal experience per eye with the help of 5G. Additionally, 5G can achieve six angles for full-view panoramic video mosaics, providing the user with a near-reality and fully 3D environment. Additionally, the low latency provided by 5G will aid in avoiding motion sickness when using VR. The latency can be kept to less than 20ms, and the user will receive feedback in real-time in virtual world.

Example of Domain

https://www.nicepng.com/maxp/u2q8t4u2a9y3i1t4/

Liverpool logo

Liverpool 5G Create was launched in the United Kingdom's Liverpool. The primary objective of this project is to complete the installation of a 5G network in this city. Additionally, this multimillion-dollar project will benefit majori of the public and private sectors, particularly health and social care.

Liverpool 5G Create, based on the UK5G website, is developing a private, independent network for the delivery of public health, social care, and education. The project will alleviate digital poverty by providing secure, free, and accessible connectivity to health, social care, and education services for those in need. This work expands on the previous 5G Health and Social Care Testbed by expanding the coverage area, modernising the network technology, and evaluating new use cases.

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Device Used

Wi-Fi 6, alternatively referred to as 802.11ax, is the next and most advanced generation of Wi-Fi technology. Wi-Fi 6 is a revolution compared to its predecessors, including 802.11, 802.11a/b, 802.11g, Wi-Fi 4 (802.11n), and Wi-Fi 5. (802.11ac). It offers increased bandwidth, lower latency, energy-saving features, and anti-interference capabilities.

Optimising subcarrier or frame length and utilising 1024QAM increases Wi-Fi 6's bandwidth by 2.8 times over Wi-Fi 5. As a result, the transmission time increases from 3.2 to 12.8 milliseconds per second. Additionally, Wi-Fi 6 can deliver uplink and downlink speeds of up to 1 Gigabit/s. Apart from that, Wi-Fi 6 provides superior coverage for its wireless internet connection, as Wi-Fi 5 operates exclusively on the 5GHz frequency band. In contrast, Wi-Fi 6 operates on both the 5GHz and 2.4GHz bands. Additionally, Wi-Fi 6 uses an optimised RF chip that increases TX power and sensitivity while maintaining the signal quality.

Additionally, the orthogonal frequency-division multiple access (OFDMA) capability of Wi-Fi 6 can reduce latency to less than ten milliseconds. Wi-Fi 6's Basic Service Set (BSS) colouring also enables simultaneous data transmission on the same channel. Target Wakeup Time (TWT) can reduce terminal power consumption by 30% with terminal wake up on demand. Wi-Fi 6 enables people to enjoy better new video services such as multi-screen IPTV, online video instruction, virtual reality (VR), and eSports acceleration.

Reflection

We gained a clear picture of how far 5G and Wi-Fi 6 technologies will develop in the future due to Mr Nicholas Yong's informative presentation. We were motivated that 5G will be a game-changer for all humans in virtual reality development and advancement (VR). As we all know, virtual reality is a game-changer in the modern era due to the immersive and three-dimensional experience it provides. Thus, VR is critical in the development of the metaverse concept. 5G can help virtual reality users avoid motion sickness due to the low and unstable latency, as low as 20 milliseconds. 5G will enable high-speed and Retina-quality virtual reality experiences with up to 5037x5707 pixel resolution. For full-view panoramic video mosaics, six angles will be available.

To summarise, we hope that 5G will achieve global coverage, particularly in rural areas, and eventually pervade every aspect of our lives. 5G will significantly improve the convenience and practicality of human life. Thus, we can use VR to enter the unknown world of the metaverse and explore the unknown.