Group C -Technology Information System

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NETWORK TECHNOLOGY ISSUE

Wi-Fi 6 And 5G Is The Future • How Smart Campus Utilize 5G • • Problems Solved By Wi-Fi 6 Access Points Differences For Wi-Fi • Sustainable IoT Technologies With Wi-Fi 6

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SMART CAMPUS & 5G

APPLICATION OF 5G IN SMART CAMPUS

WI-FI 6 NETWORK INFRASTRUCTURE

HOW WI-FI 6 INTRODUCE NEW POSSIBILITIES

NEW NETWORK TECHNOLOGIES

5G TECHNOLOGY & USES EXPLAINED

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APPLICATION OF 5G IN SMART CAMPUS:

The invention of 5G has been a huge advancement in the technologies industry. With the intelligence of the human brain and the powerfulness of the 5G technologies, smart campus has been introduced in many country such as China and Canada.

What is smart campus

A smart campus is where a campus that is operated by a bunch of smart management applications with the help of 5G technologies to make the campus more convenient and reduce the needs of employees.

The usage of the application of 5G in smart campus has been a success. It not only reduces the needs of human resources, it also leads human towards a more advanced era where there are technologies involves in our daily basis.

Visitor Management Application

With the help of 5G smart application, visitors can visit campus with full-process self-service without being accompanied by campus employees. This can be done by visitors submit their application, personal and license plate information thru online. Hence, there are zero waiting time to waste if the visitors do it before visiting the campus.

Besides that, with e-pass technologies, the system will be able to identify the visitiors' license plate and let the vehicle pass if the vehicle is registered. Plus, the system can also be able to plan the route for the visitors make it easy for visitors by without getting help from others.

Last but not least, we also have facial recognition system which will be replacing the guard post as it will scan the visitors' face, the barrier gates will open if the face id is registered and recognized by the system.

9 December 2021

WIFI 6

- Wifi 6 is the next generation of wifi.
- It brings faster throughput speed, better battery life, and less bandwidth congestion than the previous wifi.

HOW WIFI 6 SOLVES REAL PROBLEMS?

OFDMA
- Increase efficiency of transfering datas

MU-MIMO
- Can communicate with multiple devices at a time

1024-QAM
- Increase peak throughput

BSS Colouring Technology
- Increase wifi performance/capacity

Wifi 6 Devices

- Playstation 5
- iPhone 11 & above
- Huawei P40 Pro
- Samsung Galaxy Fold
- Motorola Edge Plus

Internet of Things (IoT)

Benefits of implement of IoT solutions
- Cost reduction
- Enhance customer experiences
- Increase efficiency and productivity

Examples of IoT
- Smart locks
- Sensors
- CCTV

How does the Internet of Things (IoT) brings benefits in education?

With the Internet of Things that is equipped in a classroom, it can do many things. For example, with ***smart lighting*** in a classroom. A smart lighting will be turned on by itself automatically when a person enters the classroom. A smart lighting can also be turned on by command. This means that a person can turn on the lights with his/her commands through a device by connecting or pairing it with bluetooth. With that, electricity usage or consumption can be reduced as the lights will be turned off when it is not in used or no one is in the classroom. Hence, electricity bills will also be expected to be cheaper. Another example of Internet of Things that can be equipped in schools is a ***vape detection***. The function of a vape detection is that it can detect smokes with ease within the area. With that, whenever it detects a smoke, it will trigger an alarm in the school system.

WHAT IS A SMART CITY?

A ***Smart City*** places physical infrastructure on its ***network infrastructure***; creating situational awareness for new services, lower costs, and public city. It uses the Internet of Things to connect with buildings, vehicles, people, and things. Some examples of a smart city environment are: wifi provided in city, sensors, traffic lights, and many more.

Smart Campus

A ***Smart Campus*** is a combination of a smart city and a smart home. It is very critical to us, in order to attract and retain students while lowering the costs; giving a greater experience or chance to students in a campus. The ***benefits*** of a smart campus is that it will be able to provide a smart living, a smart learning, and a smart security.

Examples of Smart Living
- Smart ID cards
- Smart parking
- Internet Protocol Television (IPTV)

Examples of Smart Learning
- Virtual labs
- Online Distance Learning (ODL)
- Digital portal

Examples of Smart Security
- CCTV
- Connected entry (Entry Card)
- Sound & motion detection

Campus Safety with Internet of Things (IoT) Automation

When in a campus, we do not know when and where a security breach or incident may happen. Luckily, with the smart safety environments available in a campus, our safety will be safer and crimes can be prevented. One of the examples of a smart security in a campus is a connected entry. A connected entry is a security lock that requires a security safety in order to access a particular entrance. Examples of a security safety is a password, an entry card, touch ID's, and many more. With that, it will be harder and nearly impossible for a criminal to break into a campus.

Reflection

The ***Internet of Things*** (IoT), ***Wifi 6***, and ***Smart City*** have been a huge upgrade to the technology era of this world. These three have introduced a lot of new technologies to this world that would benefits us, especially Smart City; where it would give a more modern and safe environment towards us. With that, the future of the technology in this world is definitely bright and it could become more than we could ever imagine.

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5G AND WIFI 6 by Huawei 2 Dec 2021

-EXTRA-

WHY 5G IS BETTER

- 5G devices are lower latency, enabling faster transmission of larger data streams.
- 5G devices are more reliable, enabling better transmission of data in extreme conditions
- 5G is more flexible than Wi-Fi and can support a wider range of devices, sensors and wearables.

BENEFIT OF 5G

- Tourist able to live-stream their experiences in 4k resolution anytime via 5G network and help to develop local tourism.
- Equip the high-tech park with a fully connected and intelligent 5G industrial park platform, attract high-tech investors through the development of high-tech industries, diversify the economy, and create job opportunities for the new generation.
- Support virtual education based on AR and VR.

5G APPLICATION SCENARIO

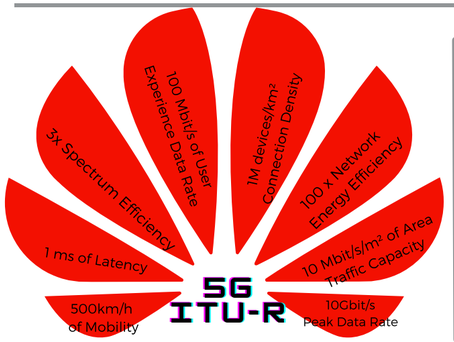
Major application scenario defined by ITU

- Enhanced Mobile Broadband
- Massive Machine Type Communication (mMTC) Smart City, Smart Home and Smart Building)
- Ultra-reliable and Low-latency Communication (uRLLC) 3D Video UHD Screen, Work and play in the cloud, Augment Reality, Industry automation, Self-driving car)

-5G->

WHAT IS 5G

5G is the next generation of wireless technology systems. It provide speeds faster than any previous generation, comparable to those delivered via fiber-optic cables. 700 - 3025 Mbps of real-world speeds has been shown in the early test of 5G. One of the example is movies that took minutes to download with 4G will take second in 5G.



5G Future Use

- Augment Reality
- Virtual Reality
- Driver Infomation
- Entertainmen in Vehicle
- Automation in Vehicle
- Smart Grid
- Delivery Drone

-VR->

WHY VR NEED 5G

Because VR have **5037 x 5037 resolution** for retina experience per eye and also **6 angles** for full-view panoramic video mosaics. There are 3 quality of retina experience of VR which is **Quasi, Basic and Ultra.** The difference between these 3 qualities are frame rate, Bit-per-pixel, 1/2 screen and 3D+panorama (2*6), the lowest quality which is the **quasi** require **70Mbps for 1/2 Screen** and **840Mbps for 3D+ panorama** to **produce 25-30 fps** and **8 bpp**. The highest quality which is the **ultra**, require **350Mbps for 1/2 Screen** and **4.2Gbps for 3D+ panorama** to **produce 100-120 fps** and **12 bpp**. VR need 5G because 5G can provide **high throughput** for Retina Experience VR and the **low latency** of 5G also can avoid **motion sickness** by control the **MTP Delay smaller than 20ms** and make the **Network RTT smaller than 7 ms.**

Industry talk 6

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-EXTRA-

Huawei expert was elected chairman of the Wi-Fi 6 standrads working group and Huawei also submitted 240 new proposals, accounting for 15% of the total number of proposals

What Wi-Fi 6 can do

- Multi-screen IPTV - Watch 4k in multiple divice at the same time.
- HD video teaching
- Cloud VR interaction
- E-sport acceleration

Download/ Upload Experience with and actual rate over 1 Gbit/s

Wi-Fi 5 take **7 minutes** (30 Mbit/s) to **download a 1.6GB** file and **8 hours**(30 Mbit/s) to **upload a 120GB** photo and video backup. However, **Wi-Fi 6** take **20 second** and **20 minutes** to **download and upload** the same file.

SUMMARY WI-FI 6 VS WI-FI 5

- **Large Bandwidth**
  Up to 9.6 Gbit/s rate, 4x bandwidth
- **High Concurrency**
  Number of terminals on a single AP is 1024, 4x the number of concurent users
- **Low Latency**
  Service latency reduced to 20ms, Average latency = 50%
- **Low Power Consumption**
  TWT mechanism,
  Terminal power consumption = 30%

-WI-FI 6->

WHAT IS WI-FI 6

WI-FI 6 or we can call it as 802.11ax. It is the latest Wi-Fi standard after Wi-Fi 5. It is expected to provide faster speeds and better connectivity and increase support for multiple high-bandwidth devices. It operates between the 1 and 6 GHz band. The max rate can support by Wi-Fi 6 is 82% higher than previous version which is 802.ac (Wi-Fi 5), the 2T2R speed of Wi-Fi 6 is 1.534 Gbps higher than Wi-Fi 5. The next improvement is the number of spectrum, Wi-Fi 5 only have 1 spectrum which is 5Ghz but the 1st release of Wi-Fi 6 have 2 spectrum which is 2.4Ghz & 5Ghz and 2nd release of Wi-Fi 6 or we call as Wi-Fi 6E will have another 6Ghz spectrum.

WHY

WHY WE CHOOSE WI-FI 6

Larger Bandwidth

1K QAM/160M/frame length/subcarrier optimization, improving bandwidth by 2.8 times by using Wi-Fi 6. The Peak performance of Wi-Fi 5 increased 33% compared to Wi-Fi 4. The peak performance of Wi-Fi 6 increased by 25% compared to Wi-Fi 5 and the Transmission Time for Wi-Fi 5 is 3.5 us/time and it increase to 12.8 us/time.

How Wi-Fi 6 increase Bandwidth

- Increase number of Spatial Stream to 8T8R
- Increase the sub-carrier quantity from 234 sub-carriers in Wi-Fi 5 to 980 sub-carriers in Wi-Fi 6.
- Increase the transmission time form 3.2us per terminal at each time to 12.8us per terminal in Wi-Fi 6
- Update coding mode form 256-QAM coding in Wi-Fi 5 tp 1024-QAM coding in Wi-Fi 6.

Wi-Fi 6 have a larger coverage

The **Wi-Fi 6 chip** radio frequency optimization **improves power and sensitivity** under the same signal quality. When connecting to traditional Wi-Fi 5 STA, a **dedicated algorithm can improve performance and omnidirectional coverage.** As a example when we stand in same place the speed of the network of device that support Wi-Fi 6 will faster than device that not support Wi-Fi 6.

OFDMA and BBS coloring

We can define OFDMA as multi-lane with traffic lights, that is, multi-user sequential scheduling, which is conducive to anti-interference.

For BSS coloring, because different users use different colors, data can be transmitted on the same channel at the same time. BSS helps reduce latency.

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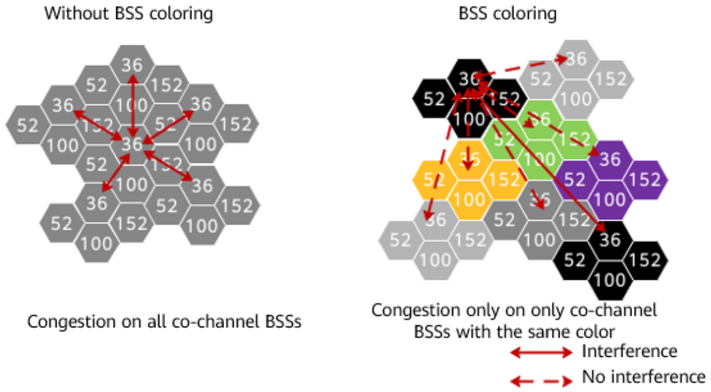
-CONT'->

WHAT WI-FI 6 CAN DO WITH OFDMA AND BSS COLORING

- MULTI-SCREEN IPTV - WATCH 4K IN MULTIPLE DIVICE AT THE SAME TIME.
- HD VIDEO TEACHING
- CLOUD VR INTERACTION
- E-SPORT ACCELERATION



BREDUCING TERMINAL POWER CONSUMPTION BY 30% USING TWT(TARGET WAKE TIME)

The existing Wi-Fi client energy-saving mechanism has been used since 802.11b. The client device sleeps between AP beacons or multiple beacons, and wakes up only when there is data to transmit (they can transmit at any time because the AP is not asleep), including the transmission stream indicator map (DTIM) and bitmap indicator AP has buffered downlink traffic for transmission to specific clients

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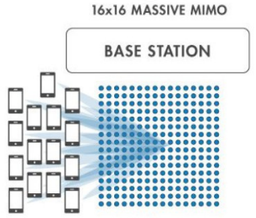
NEW TECH

HUAWEI

AirEngine Wi-Fi 6



Highest Performance
- 16 x 16 MU-MIMO

Most Stable Experience
- Smart antenna
- Dynamic Turbo
- Lossless roaming
- SmartRadio, radio calibration algorithm
- Joint scheduling through MU-MIMO and OFDMA

Most Comprehensive IoT Apps
- 2 built-in slots for IoT module
- IoT expansion through the USB port
- IoT chip ready

Fastest Wi-Fi 6 AP
- 2x Speed vs industry Wi-Fi 6
- 8.37 Gbps Real-Time performance
- 10.75 Gbps PHY rate

Most secure
- Independent radio for scanning
- Hardware encryption
- Dual-Signature boot

Summery of 5G and Wi-Fi 6

Wi-Fi 6 is more suitable for indoor use. For example Home Network, Supermarket Universities, Classroom and stadium. However 5G is more suitable for outdoor use for example when you are in City, Highway, Scenic Area, Commercial street and etc.

Reflection - 5G and Wi-Fi 6 both are a big step of human in IR4.0 and the progress of science and technology. 2 of these bring us a main benefit which is reduce the waste of time. These can also help us develop virtual worlds and make our future lives more convenient. One of the example is Metaverse.