# *NETWORK INSPIRED IN THE FUTURISTIC ERA*

- *APPLICATION OF 5G IN SMART CAMPUS*
- *EMERGING TECHNOLOGY ON NETWORK INFRASTRUCTURE*
- *5G, WIFI6 AND EMERGING NETWORK TECHNOLOGIES (HUAWEI)*

## PROPOSED TO:

### DR AZURAH BINTI A SAMAH

## PROPOSED BY:

- MUHAMMAD IZAT BIN MD KAMIL A21EC0082
- NUR IMMAL HAYATI BINTI HASMI ANUAR A21EC0111
- AISYAH BINTI MOHD NADZRI A21EC0011
- THUVAARITHA SIVARAJAH A21EC0137
- LU QI YAN A21EC0049

BY LU QI YAN A21EC0049

# APPLICATION OF 5G IN SMART CAMPUS

## SMART CAMPUS

Smart campus is the basic or fundamental to build a smart city which smart campus is an area that we spend most of our time. Smart campus includes residential area, a shopping mall, a stadium and also a university campus. Since nowadays the world has been change into the digital world, new services and all the process have been transformed into digital process which used advanced technologies such as 5G, cloud computing and simulation. This transformation and building of a smart campus are to enhance the experiences of the user such as to increase the learning experiences of students in the colleges or university. Infrastructures and platforms in smart campus have been improve to increase the efficiency of works and tasks in the campus. In smart campus, 5G plays an important role as it helps in many aspects. I will talk about the application of 5G in Smart Campus which is provided high-speed mobile network in the below article.
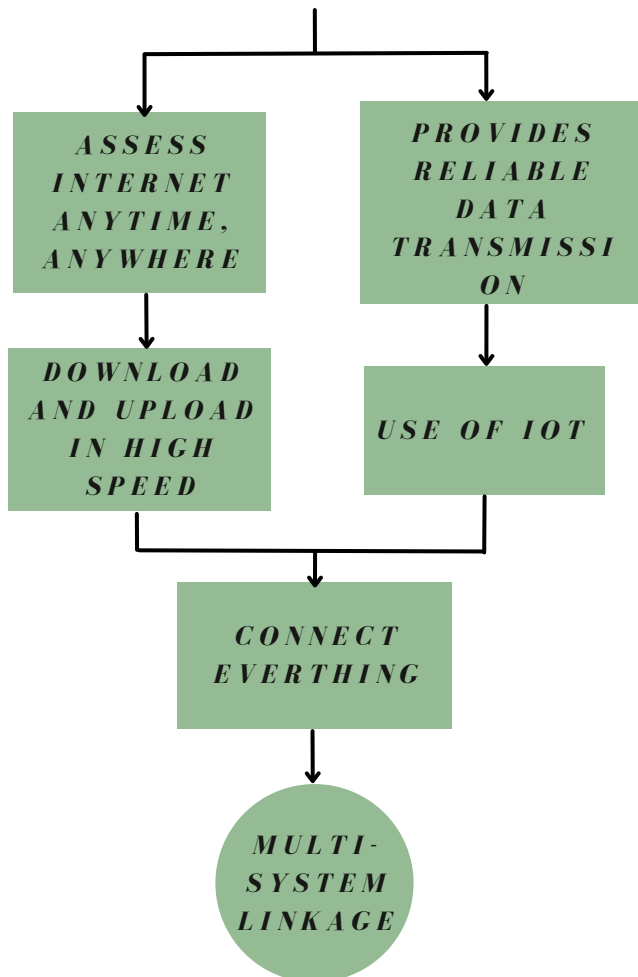
## EXAMPLE OF SMART CAMPUS

### 01

**COLLEGE/ UNIVERSITY**

### 02

**SHOPPING MALL**

### 03

**RESIDENTIAL AREA**

# HIHG-SPEED MOBILE NETWORK

## HIGH-SPEED MOBILE NETWORK

**ASSESS INTERNET ANYTIME, ANYWHERE**

**PROVIDES RELIABLE DATA TRANSMISSION**

**DOWNLOAD AND UPLOAD IN HIGH SPEED**

**USE OF IOT**

**CONNECT EVERTHING**

**MULTI-SYSTEM LINKAGE**

5G provides high-speed mobile network which enable people to assess internet and data anytime at anywhere which allow people to get connected with each other more convenient and faster. This high-speed mobile network also helps us to upload or download any document, video and photos easily and swiftly in high speed. It has connected everyone from all around the world and enable us to surf the internet without any limit which helps us to solve the problems, finish our task at the moment. The high-speed mobile network creates the highly connectivity of things and reliable data transmission enable the use of internet of things(IOT) in the smart campus which can increase the efficiency of works. Multi-system linkage occurs in the smart campus as the IOT connects everything in a secured way and this simplify many processes while the process and service become better and more convenient. For example, smart attendance, visitor management and fire extinguishing linkage in smart campus.

# REFLECTION

From the application of 5G in smart campus, we get to know that all the transformation and changes from traditional to smart campus are very crucial for us to create a better place and country. 5G benefits us with its high-speed mobile network while enhanced our experiences in the smart campus. More safety and more convenient process and service provides in the smart campus. With the presence of 5G, it can be more time efficiency, reduce cost and lots of task can be done in a moment as the multi-system linkage occurs. 5G is a necessary element for the build of smart campus as the 5G is one of the key to operate the digital world. Thus, the application of 5G is important and unable to be ignored nowadays.

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# EMERGING TECHNOLOGY ON NETWORK INFRASTRUCTURE

GOH BIH DER, SYSTEM ENGINEER OF COMMSCOPE MALAYSIA

29TH NOVEMBER 2021

3.00 TO 4.30 PM

**COMMSCOPE®**

## DESCRIPTION OF THE INFRASTRUCTURE DISCUSSED IN THE TALK

### MULTIGIGABIT TECHNOLOGY

- The Campus Core is under stress due to the rapid requirements of going wireless, the increase of Wi-Fi speed, the increase IoT devices in the market, more applications coming into the network and more video traffic in the network. Therefore, something was needed to improve or upgrade in the core network.
- Comparison between an existing campus and multigigabit infrastructure:

|  | Existing Campus Infrastructure | Multigigabit Infrastructure |
|---|---|---|
| Core | 10/40 GbE | 40/100 GbE |
| Aggregation | 1/10 GbE | 10/40 GbE |
| Access | 1 GbE | 2.5/5 GbE |

- By using the existing campus infrastructure, the bottleneck will be between the clients and the access point (802.11n) and has a speed of less than 1Gbps throughput. However nowadays, with a good access point (802.11ac) the speed will now be more than 1Gbps and by the time it gets more than 1Gbps there will exist a new bottleneck between the access point and the switch. By using the multigigabit switch, the speed will be 2.5GbE hence maximizing the performance on the multigigabit access point. In addition, there is an Access Point (802.11ax) which able to support up to 5Gbps thus improving the performance on the Access Point.

### WI-FI 6

- OFDMA: Improve and increase in efficiency in terms of delivering data as well as in terms of upload and download
- Multi-User MIMO Technology: Improve on how the access point communicate with wireless devices. Able to communicate with multiple devices instead of just focusing on a single device and this also helps with upload and download as well
- Power Efficiencies: Wi-Fi 6 has a technology called 'target wake-up time' which allowed devices to negotiate when and how often they will power up to send and receive data. Improve battery lives especially for IoT (Internet of Things) devices for instance smart locks
- 1024-QAM: Able to carry 10-bits instead of 8-bits. Hence, more bits peak throughput increase
- Long OFDM Symbol: Able to carry 10-bits instead of 8-bits. Hence, more bits peak throughput increase. The difference of Long OFDM Symbol and 1024-QAM is that it is outdoor reliability
- BSS Coloring: Access point will be able to ignore the neighboring Access point which is most likely meaning to network interference so that it can increase the Wi-Fi performance due to less network interference
- Don't Wi-Fi standards put all manufacturers on an even playing field? **No**, because the architecture inside the access points are all different.

**CLOUD ANALYTICS**

- When a problem arises and with analytics technology, the platform itself will be able to show you what happened to the network and what kind of recommendations actions for you to solve the network issue. Hence, no need to spend so much time google it out and find out what's the problem because the analytic platform will show and tell you everything there.
- In the future, there may be an analytical platform where the problem will be solved automatically.

**UNIFIED NETWORK MANAGEMENT**

SmartZone 6.0 Dashboard: Making it able to see the wired and wireless equipment as well as the list of the access point information and the list of switch information.

**Benefits of implement IoT solutions:**
- Cost reduction
- Enhance customer experiences
- Increase efficiency & productivity
- Increase business opportunities
- Education

**IoT**

**INTERNET OF THINGS**

**Challenges when deploy IoT solutions:**
- Connectivity
- Security
- Compatibility

**December 11 , 2021**

# SMART CAMPUS

## Smart City

- A Smart City places physical infrastructure on its network infrastructure.
- Create situational awareness for new services, lower costs & public safety.
- Using IoT to connect buildings, vehicles, people and things. For example, Wi-Fi divider, smart lining across streets and natural disaster sensors.

Smart Campus is basically a combination of Smart City and Smart Homes. These Smart Campuses are very critical in order to attract and retain students at the same time lowering costs.

## Smart Learning benefits

- Flexible Learning Spaces
- Virtual Labs
- Lecture Capture
- Digital Portals
- Distance Learning
- Library of the Future
- With IoT implementation in the network, students can use the IoT equipments and create an app to help with an assignments and what not and also to help the campus in general for example by creating an app to check the air quality or to check the traffic flow or to see if there is any parking available.

Smart Campus have a few benefits which includes, Smart Living, Learning and Security.

## Smart Living benefits

Smart ID cards: in order to purchase foods, use it as an identification badge and access buildings

- In-building LTE
- Smart Parking/Transit
- Personal Networks
- Smart Lighting
- Wayfinding
- IPTV

## Smart Security benefits

- CCTV & VMS
- Connected Entry
- Tracking Assets
- Sound Detection
- Motion Detection
- Campus safety with IoT automation will track motion for any suspicious activity and will engage smart locks as well as turning on the LED lights and activate the CCTV cameras.

These benefits will be able to attract and retain students and bring a greater student experience and in terms of operating wise, it will be greatly increased as well.

## DEVICES USED

**Indoor Wireless Access Point**
- RUCKUS H550
- RUCKUS R550
- RUCKUS R650
- RUCKUS R750
- RUCKUS R850

**Outdoor Wireless Access Point**
- RUCKUS T350c
- RUCKUS T350d
- RUCKUS T750

**Fixed Switches**
- ICX 7150: Entry-level Access
- ICX 7250: Access
- ICX 7550: Access-Aggregation
- ICX 7650: Premium Access-Aggregation
- ICX 7750: Aggregation-Core
- ICX 7850: Aggregation-Core Data Center

## DOMAIN INVOLVED

- telkonet
- OSRAM
- SOTER
- Aqara
- TraknProtect
- ASSA ABLOY
- SmartThings
- AXIS COMMUNICATIONS

## REFLECTION

This 5th Industrial Talk feed us with more than enough information regarding Network Infrastructure. For instance, we now know the importance of Wi-Fi 6 and the myriad of upside it came with it. Wi-Fi 6 increases the access point capacity in support of IoT and mobile devices. This provides teachers a broader teaching abilities. It also helps teachers & student acheive better communication. Luckily, Wi-Fi 6 makes expanded AP capacity achievable and its ability to provide a level of usability for users without experiencing any inconvenience on learning & teaching devices.

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# 5G & WIFI6

The talk was given by the invited speaker , **Mr. Nicholas Yong** , the Executive Industry Solution Manager for Asia Pacific Region ⚡ HUAWEI on **2nd December 2021.**

He is also an experienced person that have been in ICT industry for about more than 17 years. The main topic that be discussed were the **5G transformation and Wifi6 technology.**

## 5 G

5G is the next generation of wireless technology systems that has high bandwidth with low latency

**Once 5G becomes widespread, the effect on these industries could be transformative for 3 main reasons :**

- 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.
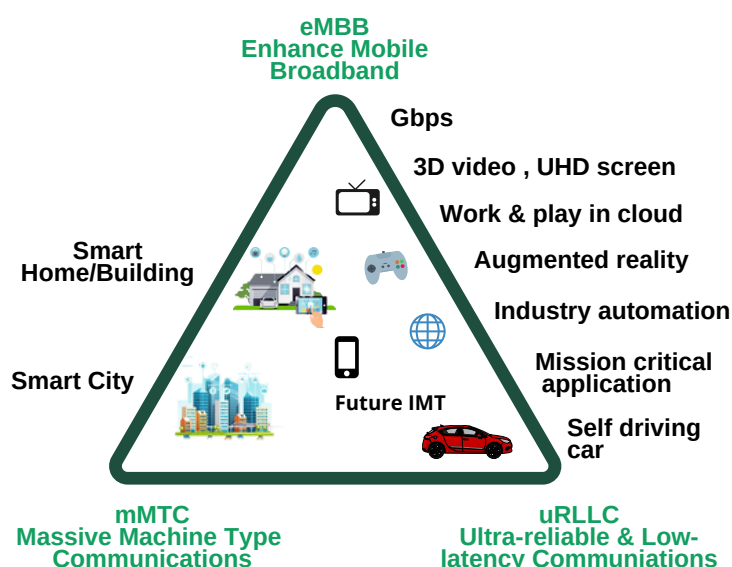- 5G is more flexible than Wi-Fi and can support a wider range of devices, sensors and wearables.

**5G requirements that will support more applications :**

- Peak Data Rate (10Gbps)
- User Experienced Data Rate (10Mbps)
- Spectrum Efficiency (3x)
- Mobility (500km/h)
- Latency (1ms)
- Connection Density (1Mdevices/km2)
- Network Energy Efficiency (100x)
- Area Traffic Capacity (10Mbps/m2)

## 5G Application Scenario : From People to Vertical and IOT

**eMBB**
**Enhance Mobile Broadband**

Gbps

3D video , UHD screen

Work & play in cloud

Augmented reality

Industry automation

Mission critical application

Self driving car

Smart Home/Building

Smart City

Future IMT

**mMTC**
**Massive Machine Type Communications**

**uRLLC**
**Ultra-reliable & Low-latency Communiations**

## 5G Top Potential Industrial Application :

- 5G Smart Mine (Open-pit Mining)
- 5G Smart Manufacturing (Airplane Manufacture
- 5G Smart Mine (Underground Mining)
- 5G Cement
- 5G Smart Power Grid
- 5G Public Safety
- 5G Petrol Station
- 5G Smart Education
- 5G Smart Medical
- 5G Live Broadcast
- 5G Smart Port

**All these are important :**
- For outdoor wireless transmission via telecommunication
- Due to the capability to transmit high information from this bandwidth & low latency bandwidth

## 5G Future Cases Evaluation & Prioritization

| Virtual Reality | Driver Information |
|---|---|
| Smart Grid | Automation in Vehicle |
| Augmented Reality | Delivery Drone |
| Entertainment in Vehicle | |

## New Opportunities and Benefits from 5G :

**Next Generation Smart Tourism**
- Live-stream & tourist-guide application

**Hi-tech Industry Establishment**
- **A**ttract Hi-tech investors & create job opportunites

**Enables AR/VR based on Virtual Education**
- Better way to understand
- Remote Class Learning

# WI-FI 6

Wi-Fi 6 is the next generation of Wi-Fi with a bunch of additional technologies to make that happen more efficiently, speeding up connections in the process.

## Standard Evolution, Mature Wi-fi 6 Industry Chain

| 2011-2015 | 2015-2019 | 2019-2021 |
|-----------|-----------|-----------|
| **Wi-Fi 4** | **Wi-Fi 5** | **Wi-Fi 6** |

## New Wi-Fi 6 Standards, Empowering Enterprises Digital Transformation :

- Large Bandwidth
- Low Latency
- IoT-oriented Energy Saving
- Anti-Interference
- 1024-QAM
- OFDMA
- UL/DL MU-MIMO
- BSS Coloring
- TWT

## Wi-Fi 6 supports Gigabit Broadband Promotion which is 1Gbps to Mobile Phones or Pcs, Fast Download and Cloud Backup Experience

High-speed uplink and downlink experience with an actual rate of over 1Gbps

- 128 GB photo and video backup
- 8 hours(30Mbps) - 20 minutes(1000Mbps)

## How does Wi-Fi 6 improve bandwidth?

|  | Wi-Fi 5 |  | Wi-Fi 6 |
|--|---------|--|---------|
| **Spatial stream** | 4T4R | → | 8T8R |
| **Sub-carrier quantity** | 234 sub-carriers | → | 980 sub-carriers |
| **Coding mode** | 256-QAM coding | → | 1024-QAM coding |
| **Transmission Time** | 3.2 us per terminal | → | 12.8 us per terminal |

**Wi-Fi 6 supports better multi-user experience** which improved the multi-user experience by reducing terminal power consumption by 30% and enhancing gateway positioning as the control centre of smart homes.

### WIFI-6
- **Smartphone**
- **Laptops**
- **Tablets**

### Devices used

### 5G
- **Samsung Galaxy Note 10 5G**
- **LG V50 Thin**
- **Huawei Mate X**

## Huawei Air-Engine Wi-Fi 6 Technologies

### 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

### Most Secure
- Independent radio for scanning
- Hardware encryption
- Dual-signature boot

## Core Technologies of Wi-Fi 6 (vs Wi-Fi 5)

- Large Bandwidth (1024-QAM & 8x8 MU-MIMO)
- High Concurrency (UL/DL OFDMA & UL/DL MU-MIMO)
- Low Latency (OFDMA & Spatial Reuse)
- Low Power Consumption (TWT & 20MHz only)

| WI-FI 6 | 5G |
|---------|-----|
| Indoor ultra-high density | Outdoor wide coverage |
| Indoor high-speed coverage | Outdoor internet access |
| Examples :<br>- Home Network<br>- Supermarket/Mall<br>- Universities<br>- Classroom | Examples :<br>- Urban Coverage<br>- Street/Plaza<br>- Commercial Street<br>- Highway |

## REFLECTION

From this industrial talk , Mr.Nicolas emphasized on the effects and benefits of 5G as well as Wi-Fi 6 in form of transformation of technology. We gained a lot of information about 5G potential industrial application, core technologies of Wi-Fi 6 and Huawei Air-Engine Wi-Fi 6 Technologies that lead us into a new era of technology.The differences between 5G and Wifi 6 also gave us a clear view on how they work with their own way.

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