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Mobile and Wireless Technology

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Q no 1

Ans

The selection of mobile and wireless technology for Axial requires a detailed study of location, medium as well as economic plan. Wireless technology should be chosen in such a way that Axial college will not receive any sort of protestations regarding their internet services. Therefore, considering physical location, number of users and all the requirements provided by CEO, the chosen technology for Axial College is WLAN (Wireless Local Area Network). As mentioned by the college CEO, the WLAN can be a solution as it wireless and provides powerful network connection.

Since each three floors are to be provided with wireless connection, we will need some fundamental hardwares in order to strengthen the network. As a network professional, the recommendation will be to implement hardware such as **repeaters** in order to extend the network signal to a larger area. The recommended repeater is TP-Link AC1900 Dual Band Wireless Repeater which has the exceptional range of about 30000 sq ft. And the data transfer rate of about 1950 Mbps.. Furthermore, Access Point is required which will provide wireless signals to the repeater to enlarge. For AP, the recommended one is TP-Link AC1750 Wireless Access Point, which is dual band, easy to install. Or, another option is to create a mesh network so that Access points can be used and wireless signals can be administered. Having all the required hardware such as routers, APs and repeaters, the GO-Wireless project in Axial can be successfully deployed.

Now, any five reasons to reinforce my decision of using WLAN are given below :

i) Cost Reduction :

With WLAN, the deployment cost declines to a certain level. Getting rid of cables and wires, the WLAN deployment is focused on virtualization which has far more options. Majority of costs will be during site survey, WLAN Infrastructures and hardware monitoring. Considering the reduction of hardware in WLAN (in comparison to wired network), the cost is automatically reduced and the technology is enhanced at the same time.

ii) Mobility :

As per the CEO of Axial College, system fading is something to be considered seriously. Mobility can be defined as process of maintaining a seamless alliance during the time when network user changes his location or Access Point. With WLAN, users are provided with real-time data and figures which allows them to roam anywhere around the particular area and still be connected to the network.

iii) Easy and Swift Installation :

The WLAN installation process is pretty easy compared to other technologies. Anyone with basic knowledge can install WLAN just by reading manuals or watching a video tutorials. This will help stakeholders of Axial college economically as there won't be massive requirement of networking labors (unlike wired and traditional technologies). Moreover, WLAN hardware such as routers and Access Points are self-configuring which makes user's life much easier than before.

iv) Range :

The area of network requirement in college might increase in sudden cases. During these occurrences, the WLAN can easily be extended as per the needed. Radio Frequency (RF) is used by most of LAN appliances because of the penetration of waves through inner windows or walls. If 802.11ac network is used, the band is 5GHz which is fast which will further be extended using Access Points or wireless repeater. This way, students and employees can use internet services anywhere at anytime.

v) Scalability and Future Enhancements

The configuration mechanism in WLAN network is built in such a way that it helps to meet user requirement as close as possible. Considering the scenario of Axial college, the number of students fluctuates every year, usually in upward trend. This means, scales and services might have to be modified depending upon the circumstances. WLAN offers that future expansion for new improvements or compatible to what most of the appliances supports.

Q no 2)

Ans

Video conferencing can be defined as a telecommunication or video-based convention that incorporates two or more than two participants at distinct location communicate to each other through video-authorized appliances or mechanism. Video conference, as per the scenario happens on regular basis as Axial College. As a Wireless Network executive, the wireless LAN technology for a high standard video streaming will be to use WiFi of IEEE 802.11ac taking into account the speed of about 5Gbps. Furthermore, selection of appropriate hardwares for WLAN deployment also plays a significant role in network quality. In terms of hardware, use of 'Asus ROG Rapture GT-AC53000' router in addition to 'Ubiquiti UniFi Pro 802.11ac' Access Point can be productive as both of them has 802.11ac specifications.

A college is a place that has furnitures, walls and other obstructions within its premises. One of the major reason to choose WiFi of IEEE 802.11ac standard is because it works exceptionally, even in in environment with numerous obstructions. The ability of 802.11ac WiFi radios to perceive signal route and communicating device to administer high amount of signal in exact same line makes this network superior to others. Likewise, the excellent MIMO service to enhance multi-user functioning also allows all those users to exchange data in a reliable network communication. Any five features of IEEE 802.11ac are :

i) Increased Bandwidth :

The comprehensive bandwidth of wireless medium is one of the consequential attribute of IEEE 802.11ac standard. The 802.11ac sustains channels like 20 MHz, 40 MHz and 80 MHz which offers diverse options to users who are planning to implement. This IEEE standard creates an supplementary space so that there is effectual passing of data to maintain network strength. Access points supporting 802.11ac also permits higher number of users to approach the network, even with multiple number of devices. What's crucial is, the IEEE standard 802.11ac uses 5 GHz band because 2.4 GHz band is suspected to attract interferences while 5 GHz avoids it to provide better video streaming in college premises, especially considering obstructions within the site.

ii) MU-MIMO

MU-MIMO is another captivating feature of our selected IEEE Standard. The MI-MIMO in 802.11ac passes manifold of packets concurrently, which allows users to convey data at the exemplary rate. If we compare spatial streams of 802.11ac to other network standards, it has 8 spatial streams which is twice the number of streams in 802.11n. With higher number of spatial streams, number of antennas also needs to be increased and that ultimately increases the data rate. These 8 spatial streams are uniformly distributed to four clients allowing each clients to be given with two spatial streams. In this way, MU-MIMO enhance network productivity while the latency is lessened with simultaneous data transmission in between users.

iii) Beamform and RTS/CTS :

Comparing to other IEEE standards, the 802.11ac provides higher efficiency among most of others. This is due to inclusion of features such as RTS/CTS. The use of wider channels might create barriers, causing repetitive collision. The intensified RTS/CTS offered in 802.11ac discern whether any channel is engaged by contrasting transmission. It basically acts as a mechanism to circumvent those frequent collisions and maintain efficient network. Likewise, 802.11ac supports explicit beamforming which if accurately utilized can emphasize network signals to specific direction. This distributes high standard signals to receiver which enable swift data interchange. Furthermore, interference is also brought down as signals won't be broadcasted when they're not in use.

iv) Higher Modulation :

802.11ac supports the use of 256QAM modulation which assists in conveying data across radio waves. Although standards such as 802.11n also offers Quadrature Amplitude Modulation (QAM), it only supports 64QAM which is mathematically four times lighter than the QAM which 802.11ac supports (i.e, 256QAM). It basically means, 802.11ac can transport four times more bits than what 802.11n can transport in a symbol. Wave consisting large amount of data means higher throughput benefit can be achieved with it. Nevertheless, this will require optimal positioning of device and must be placed adjacent to access points as well.

v) Backward Compatibility :

In some circumstances, users owning older version hardware have to buy a newer ones just because the older one isn't compatible anymore. Similar case can be seen in wireless deployment when a devices do not match network standards. However, with 802.11ac, backward compatibility is facilitated so the network can be of service to those clients who doesn't support 802.11ac but has 802.11n. Additionally, 802.11ac also supports rolling enhancement of network where Access Points of 802.11ac are mixed with other Access Points usually of previous generations. With backward compatibility, almost every deployment will turn out to be dual-band which grows network sustainability as well.

Q no 3)

Ans

For the invention of communication between two locations of Axial College (i.e, Kuala Lumpur and Malacca), larger scale of communication is required. So, studying multiple options and considering all odds, the chosen technology for this task is WiMax Technology. WiMax is a communication technology based on the network standard IEEE 802.16, that conveys swift internet amenities, especially for large scale areas.

Since CEO of Axial College wants connection to be strong and high speed, selection of WiMax makes sense as it offers swift speed especially for large scale areas like Axial college. Likewise, WiMax also has its monetary benefits as it costs less than wired DSL. This is because WiMax is wireless and does not require wire placements in the site. Likewise, WiMax also permits user to utilize limitless connectivity, further in data communication and video conferencing. There are several other advantages of WiMax which includes :

i) High Speed Connection :

As per provided data, the Axial college is of considerable area with roughly 5000 number of network users and 3 floors. Assuming each user to use at least 1 or 2 devices, about 8000-1000 devices are detected to be using the network. Not every technology backs this vast number of functioning devices at the same time. Likewise, connecting these technology will also require a reliable technology with high speed. WiMax offers few advanced technologies that provides high speed qualitative network attributes. Mechanizations like MIMO are used by WiMax, which provides users with multi path propagation and high data rate so that there is no complications in network speed. Similarly, use of OFDM (Orthogonal Frequency Division Multiplex) in WiMax makes network free from signal fading, which is a crucial prerequisite of Go-Wireless project.

ii) Multipurpose Functions:

The linkage of two WLAN connection requires a lot more that just a lucid network connection. Therefore, use of technology that furnishes the organization with supplementary functions will make things unexacting and meritorious. Using WiMax, the connection can be advantageous financially because it has other services such as data conversion, telephone amenities and video streaming as well. Furthermore, WiMax also facilitates its users with NLoS (Non-Line-of-Sight) which uses less frequency to link device antenna with WiMax tower while LoS (Line-of-Sight) uses influential range to provide steady and secured connection.

iii) Exemplary Network Coverage :

As discussed before, the connection is to be done in between two different location. This requires a technology that can cover large area geographically. The WiMax Wireless technology, with the frequency band of up to 11 GHz provides excellent coverage that ranges from 40 km to 60 km with round about 40 Mbit/s. This is much better than other options such as Wi-Fi that might not cover huge area and number of devices of Axial college. Taking measurements relevant to wireless network coverage, the net alters in between RSS 11-18 dBm while DTR 510-1.7Mbps. Moreover, path loss within the college premises is expected to be about 0.6-1 with antenna being placed a bit higher than recommended height for superior network strength.

iv) High Bandwidth and Data Rates :

The WiMax technology has remarkable data-transfer scale ranging from 60 to 80 Mbps. The adjustable channel bandwidth ranges from 1.2 to 20 MHz while the bandwidth productivity is about 5 bps/Hz. This allows employees and students of college to exchange information without lagging or being disconnected from the network. Similarly the high data rates of WiMax gives users the freedom to utilizing network. CEO who wants immediate content downloading can do it without waiting for a long time while users connected to smartphones can also get exceptional data rate of about 70 Mbits per second.

v) Scalability :

Scalability is one of the major reason to choose WiMax for Axial college. The number of students in college fluctuates every year. This might need occasional modifications in wireless network so that network strength remains effective. With WiMax, there is always an choice to ameliorate system architecture so that elements like channel bandwidth and data rate are scaled. Considering an example matching our scenario, lets us assume that a WiMax system used FFTs of 128 or 1048 bits. Now, bearing in mind the channel bandwidth (i.e, 1,25MHz and 10MHz), the high-powered scaling can be done so that it holds up roaming users with both bandwidth allotments.

Q no. 4)

Ans

IoT (Internet of Things) make reference to network of inter-associated physical devices, that can interchange and share data over a wireless network. The IoT technology required in Axial College should be able to transfer the data of a distant location, so that CSO can monitor and study college incidents. For this, the chosen wireless technology is '**LPWAN Technology**'. The Low Power Wide Area Network can be seen as a wireless technology that provides solution to IoT, IIoT as well as M2M of considerable range and stubby power. LWPAN have been one of

the finest tech solutions because of its captivating characteristics like prolonged coverage, giant potentiality as well as economical advantages. Under LPWAN, the chosen operator is **Sigfox**, which is a LPWAN network that provides end-to-end connections even in long range. Some of the features of Sigfox LPWAN are :

i) Extensive Range

LPWAN provides an exceptional range of recipient sensitivity extending up to -130 dBm. Since the signal bandwidth is brought down significantly, the knowledgeable noise status falls down to inferior data rates. Similarly, instead of using 2.4GHz band, if sub-GHz frequency bands are used, it can boost the perforation potential as well as network range. Since two Axial colleges have considerable distance in between them, use of Sigfox will need low number of base stations while it overlays large area. The range of Sigfox depends upon the interference of a certain geographical location. For instance, a location with low interference offers range of about 55km and declines up to 10 - 20 km with increase on interference.

ii) High Energy Competence

Sigfox hardware (eg. Sigfox semiconductors) are built in such a way that they consume minimal amount of power. Sigfox semiconductors only permits data transmission when there is a current range of 10mA to 50mA. Unless the data is transmitted successfully, there is no exchange of information between base station and devices. This particular process denies possible pairing and eventually holds long battery life. This is one of the main reason behind Sigfox's impression on market by offering low power consumption methodologies.

iii) Flexibility to Interference

Sigfox offers a eccentric anti-jamming attribute which is formed when 192KHz UNB is unified to spatial diversity. The Ultra Narrow Band (UNB) impede spectrum indications which Sigfox uses, and is basically set to employ in the called Industrial, Scientific & Medical (ISM). With optimal flexibility to interference, transmission beneath jamming signals is enabled while Sigfox can be in action effectually in ISM band.

iv) High Network Capacity

Sigfox network offers outstanding network capacity which allows it to extent millions or even billions of entities within its coverage. Network cells are overlapped which originates some particular kind of variety. The ultra-narrow band modulation in Sigfox adjust flexibility to intrusions and hostility to enable scaling all those high objects. Likewise, establishment of time and frequency is done by an access which emerges Sigfox's capacity rise to maximum level.

v) Formidable Architecture and Security

Sigfox has a double layered architecture among which the first one comprise network tools while second one depicts support system. The network layer collects messages and signals from IoT devices, which is further sent to the support system. Once the message reached second layer, they are exercised and transmitted to clients system. Similarly, in terms of security, Sigfox consist of an built-in firewall which guards IoT objects from any sort of online threats. In this way, the architecture offers a mechanism which ensures data protection within it.

Apart from these, some of the utmost and absorbing features of Sigfox includes :

- Remote access and supervising
- Tracking of stocks and individuals
- Sharp metering transmission