COMP2250 Proposal

Executive Summary

Intro

The objective when making business and technical decisions should not focussed on the quality of the outcome,

## Wireless Network (Warehouse)

Many external factors need to be considered when designing and configuring a wireless networking solution. Business requirements, technical requirements, and any constraints caused by the network’s expected physical environmental must first be investigated. From this information, the wireless solution can be designed within the bounds of the constraints whilst meeting all of the identified requirements as accurately as possible.

### Business requirements

Through use of this methodology, Bancroft Systems have clearly stated the following business requirements. Strong wireless coverage is required throughout the entire area of the warehouse so that workers are able to use scanning equipment from any position to update an existing warehouse stock database, a crucial aspect of the warehouse. The use of the network will be limited and will only be utilised by a few workers at a time. Finally, there is a low bandwidth requirement, and the tasks that will be performed using the network are not bandwidth intensive.

### Network constraints

Now that the requirements have been clearly identified, constraints must also be investigated to understand the bounds of the potential solution. Bancroft Systems have only stated the size of the warehouse, which is 100 meters in length, 40 meters in width and 15 meters in height. However, it would also be valuable to understand the material of the walls and roof, any existing electromagnetic interference within the area, and the number, size, and material of the physical obstacles and objects used within the warehouse area. Given that these critical details have not been provided, multiple solutions should be conceived so that a best fit solution can be chosen based on each solution’s advantages and disadvantages.

### 802.11x Technology

There are many different variants of wireless networking technologies. 802.11 refers to the family of wireless LAN (WLAN) standards developed by the IEEE. The sequence of characters that follow, such as “n”, “ac”, “ax”, etc, refers to the generation within that family. WLAN hardware, such as an access point (AP), will implement at least one of these 802.11 generations. It can also be assumed that each subsequent generation of 802.11x will be more expensive than its predecessor. For example, an access point (AP) using the 802.11ac standard will often be more expensive than an AP using the 802.11n standard. Using these standards, we can benchmark the expected performance of different hardware to make more informed decisions.

The most common method of wireless communication makes use of the electromagnetic spectrum, commonly referred to as radio waves. Data is encoded and used to manipulate the waves which are transmitted over-the-air. A key aspect of this technology is the use of frequency bands to allow for more efficient use of the electromagnetic spectrum. This means that electromagnetic spectrum has been divided up and its use has been categorised. For example, in Australia, the 2.4GHz radio frequency range for “Low Interference Potential Devices” is between 2400 and 2483.5 MHz ([src](https://r-spectrum.com.au/resources/countries-nations/australia/wireless-bands/2400-24835-mhz-4-w)), commonly used with WLAN devices. Sending and receiving devices will operate within this frequency range and will ignore waves of other frequencies.

The two most common frequency bands used for WLAN are the 2.4 GHz and 5 GHz range. These different values represent their wave frequency in the electromagnetic spectrum. An electromagnetic wave has different physics properties depending on its length. A longer wavelength will travel further and penetrate solid objects more effectively and shorter wavelengths do not penetrate solid objects as well and do not travel as far. However, the 5 GHz frequency band has a much higher total frequency width ([src](https://help.datto.com/s/article/KB115005589863)), allowing for either larger sized channels, massively increasing bandwidth, or reducing interference. Given these details, a 2.4GHz WLAN solution is a more suitable choice for Bancroft Systems due to the size of the warehouse, low bandwidth requirement, and the potential for many physical obstacles.

WLAN technologies implement similar techniques, allowing for multiple channels across the frequency bands they operate in. The 2.4 GHz band is dissected into a total of 14 channels to allow for efficient use of the allowable radio frequency range. These values are determined by the country of which the network is in, as each nation has set their own radio frequency regulations. For example, the 2.4GHz frequency band consists of a total width of 83.5MHz in Australia, further broken down into 13 channels of 20 MHz width. Given that 13 channels with a width of 20 MHz equals a total of 160 MHz, channels must overlap one another to fit within the 83.5 MHz requirement.

Radio waves are a half-duplex networking medium, meaning that data can only flow in a single direction cannot be both sent and received at the same time. To alleviate the issues of lost data, like the Ethernet protocol, 802.11x implements Carrier-Sense Multiple Access (CSMA) and Collision Avoidance (CA) to manage the network when collisions do occur. This is important to understand as CSMA/CA protocols consume most of the bandwidth. In a best-case scenario, and whilst controlling all possible variables, real world bandwidth speeds can only reach 50% of the theoretical maximum. These inefficiencies cause by CSMA/CA protocols only become worse as the number of users increase.

When designing a WLAN solution, overlapping channels are undesirable and increases the probability of wave collision. Within the usable channels 13 usable channels of 2.4 GHz, channels 1, 6 and 11 with a width of 20 MHz do not overlap. This reducing wave collision risks and improving the efficiency of the network. When positioning the wireless access points (WAPs) around the warehouse to achieve strong and complete coverage, these channels can be used to minimise collisions between each other. With a typical AP using the 802.11n standard, a range of 50 meters can be expected indoors. This range value can be impacted by the size, number, and material of the physical obstacles. Below is a concept diagram of WAP placements around the warehouse, including each WAP’s frequency channel to best manage wave collision and maximise the wireless network’s efficiency. The yellow circles represent the position of an access point, the broader blue circles and blue area represents the coverage with an assumed 40-meter range, and the red number represents the channel of the access point.

### Diagram, venn diagram, funnel chart Description automatically generated with medium confidence

### Chosen Solution

Through careful consideration of Bancroft Systems’ business requirements and our understanding of the physical constraints of the warehouse, the most appropriate solution would be the use of six wireless access points strategically positions around the warehouse. This will ensure that the Bancroft Systems’ warehouse staff have strong signal at all locations of the warehouse. Each of these access points should implement the 802.11n standard as this best meet the business requirements whilst keeping costs to a minimum, maximising Bancroft Systems’ return on investment. These access points should be positioned in such a way that it matches the previous diagram of this report, which have been carefully placed to maximise wireless coverage of the warehouse. The access points should be configured to use the 2.4 GHz frequency band as this will maximise their reach and allow them to penetrate any unplanned physical obstacles as best as possible, minimising wireless blackspots and inefficiencies for the staff. Each of the access points should be configured to match the appropriate frequency channels as per the above diagram. Each access point should be configured with a channel width of 20 MHz to minimise wave collisions and maximise wireless efficiency, improving all aspects of the business. This design and configuration will best meet the Bancroft System’s business requirements whilst appropriately managing the constraints caused by the physical layout of the warehouse.

Q2 – Network Security

Q3 – Wide Area Network (WAN)

Q4 – Network Diagram