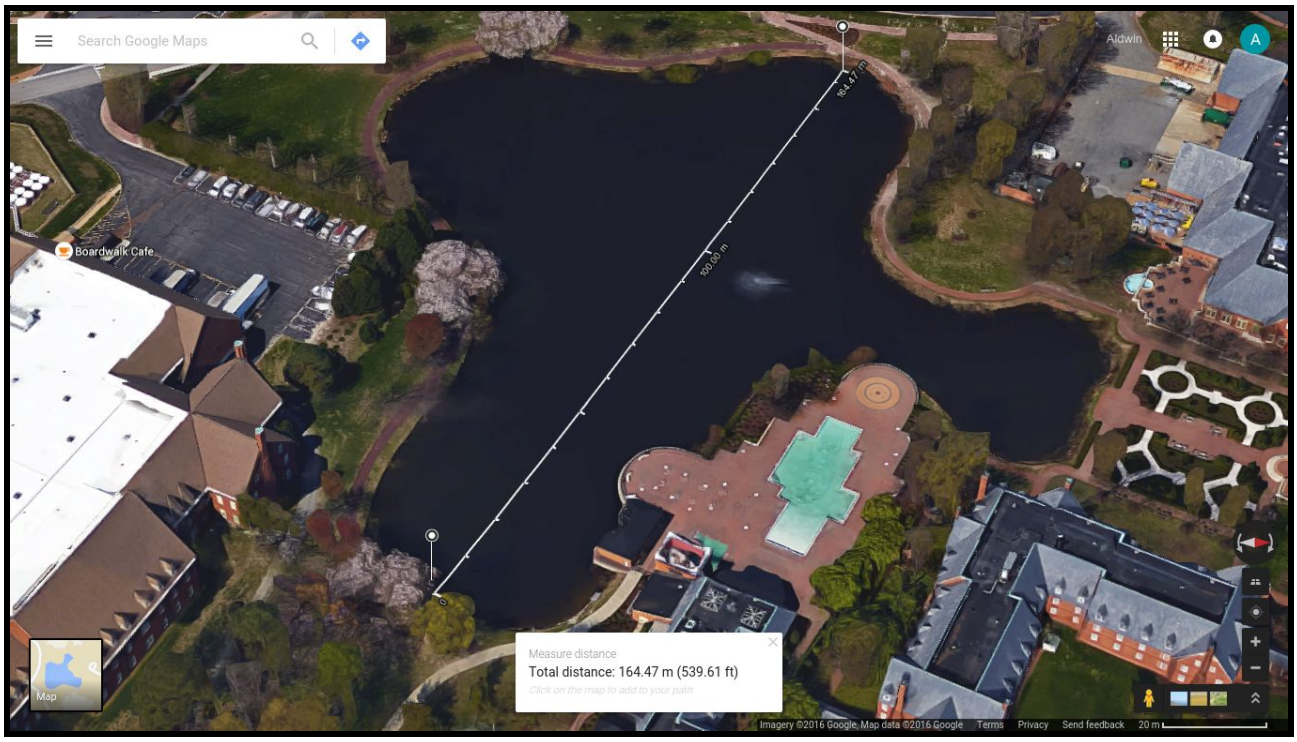
Makara 05 Wireless Link

Date: 07/02/2016

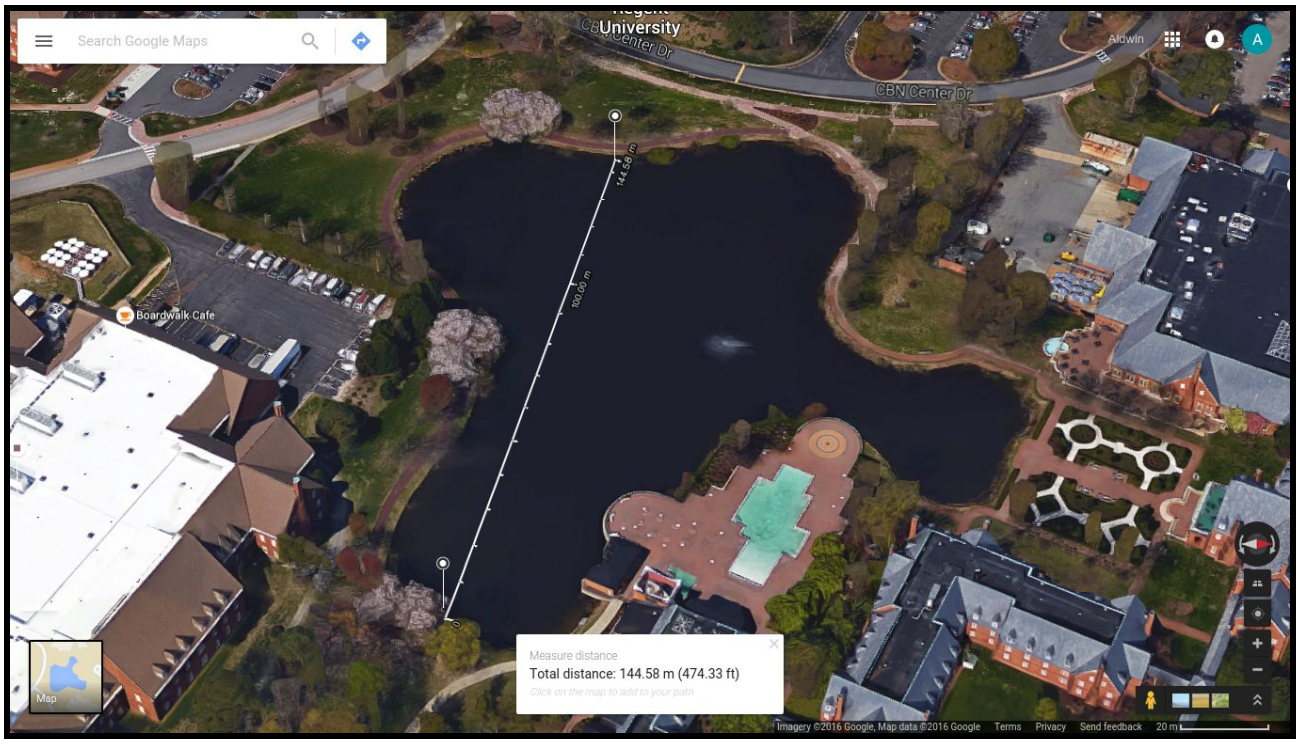
Requirements

- Need 165 meters of wireless link (from dock to the farthest point of the pond)
- Need 145 meters of wireless link (from dock to the farthest point of mission arena)
- Using other than 2.4Ghz (each year, the 2.4GHz frequency is over-saturated in the team area causing network slowdown) to avoid Interference with other team.
- List of data that are going to be sent :
  - Videos (below 64 KB JPEG)
  - Flight Mode (AUTO or MANUAL)
  - PID Input and Output (STEERING and THROTTLE PID)
  - 13 Sonar Data (uint8)
  - Heartbeat Status (~78 Bytes + HTTP Header for JSON)
  - Start/ Run Status (HTTP Header for JSON)
  - Mission Status (Varies between mission tasks)
  - Nodes Status (Every ROS Log (INFO, WARN, ERROR))

(Side view of 165 meters of wireless link)



(Side view of 145 meters of wireless link)



Additional Information

- The higher the transmit power the higher the power transmitted to the antenna
  - Units of transmit power is dBm. 30 dBm = 1 Watt
- The higher the antenna gain the narrower the beam of the antenna, which means narrowing the area of the wifi signal
  - Units of antenna gain is dBi.
- If using 5.8Ghz Access Point
  - According to http://www.afar.net/tutorials/fcc-rules , maximum transmit power is **30 dBm** and maximum antenna gain is **6 dBi** for **non point-to-point** link to stay compliant with FCC regulations (FCC part 15).
  - According to http://www.afar.net/tutorials/fcc-rules , maximum transmit power is **30 dBm** and maximum antenna gain is **23 dBi** for **point-to-point link** to stay compliant with FCC regulations (FCC part 15).

Proposed Solution

Base Station Access Point

- Using NanoStation M5 (NSM5)
  - Product Website https://www.ubnt.com/airmax/nanostationm/
  - Product Datasheet https://dl.ubnt.com/datasheets/nanostationm/nsm_ds_web.pdf
  - **27 dBm** of transmit power at 6-24 Mbps data rate and **14.6 - 16.1 dBi** of antenna gain
  - Approved FCC Part 15.247, IC RS210, and CE

(FCC Part 15 Approval)

Regulatory/Compliance Information				
Model	NSM5/NSM2/locoM5/locoM2	NSM3	NSM365	locoM9
Wireless Approvals	FCC Part 15.247, IC RS210, CE	-	FCC Part 90Z	FCC Part 15.247, IC RS210
RoHS Compliance	Yes	Yes	Yes	Yes

(Transmit Power)

5 GHz TX POWER SPECIFICATIONS			
	Data Rate/MCS	Avg. TX	Tolerance
11a	6-24 Mbps	27 dBm	± 2 dB
	36 Mbps	25 dBm	± 2 dB
	48 Mbps	23 dBm	± 2 dB
	54 Mbps	22 dBm	± 2 dB

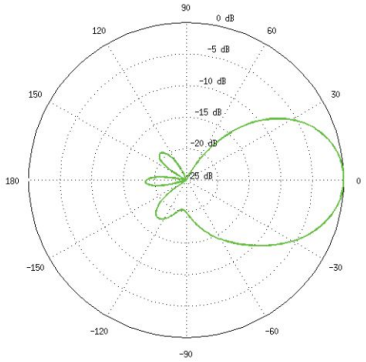
(Antenna Gain)

Antenna Information	
Gain	14.6 - 16.1 dBi
Cross-pol Isolation	22 dB Minimum
Max. VSWR	1.6:1
Beamwidth	43° (H-pol) / 41° (V-pol) / 15° (Elevation)

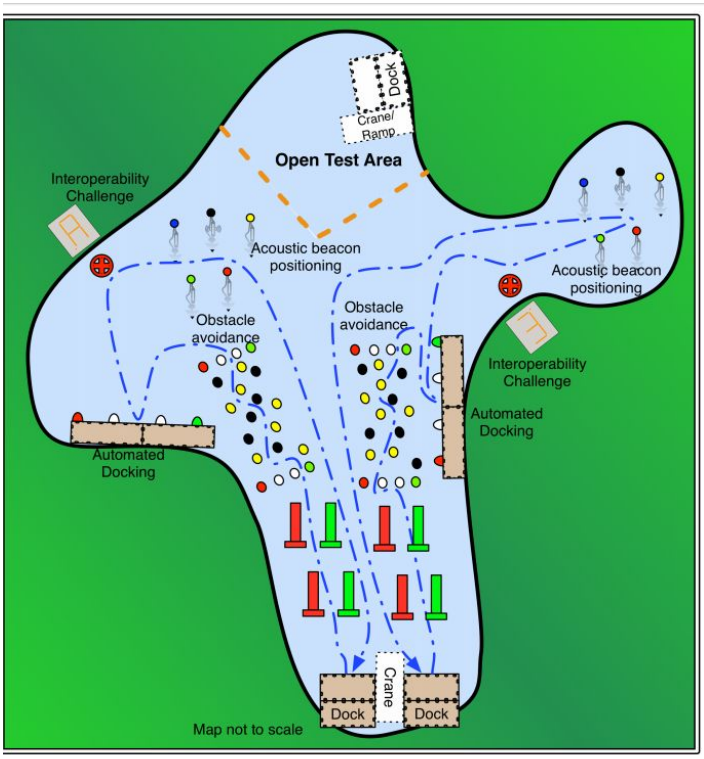
(Beamwidth)

Beamwidth	43° (H-pol) / 41° (V-pol) / 15° (Elevation)

Horizontal Azimuth



The 43 Degree Beamwidth will cover enough area of one course run.



(**Covered Area**)

Vehicle Receiver

- Using EDUP EP-AC1605 with an external 9 dBi Antenna
  - Product Website http://www.szedup.com/show.aspx?id=1791
  - Support USB3.0
  - Support 20MHz/40MHz/80MHz frequency
  - 5G compatible with IEEE 802.11ac and IEEE 802.11a standard
  - Internal Omni-directional Antenna
  - Support 2.4G and 5G dual band
  - Low consumption management

Links to buy the product

- NanoStation M5 (NSM5)
  - https://www.tokopedia.com/spinet/ubiquiti-nanostationm5-nanostation-m5-nsm5
  - Price : **Rp 1.213.000**
- EDUP EP-AC1605
  - https://www.tokopedia.com/ogahrepot/edup-dual-band-80211ac-wifi-adapter-usb-dongle-1200mbps-ep-ac1605
  - Price : **Rp 279.000**
- External 9 dBi Antenna
  - https://www.tokopedia.com/tokoheli/58g-9dbi-omni-rubber-duck-antenna-rp-sma-fpv-antena
  - Price : **Rp 143.000**

Total Price

Rp 1.635.037