OUTDOOR WI-FI

Campus Deployment Examples & Lessons Learned

STEVE ROSCO, SENIOR MANAGER IT INFRASTRUCTURE, UBCO
GREG FUENTES, NETWORK ANALYST, UBC
DEVIN KETTLE, NETWORK ANALYST, UBC
CURTIS BOWDEN, NETWORK ANALYST, UNBC
IAN PROCYK, CISCO SYSTEMS CANADA

REGULATORY CONSIDERATIONS

Canada

REGULATORY CONSIDERATIONS

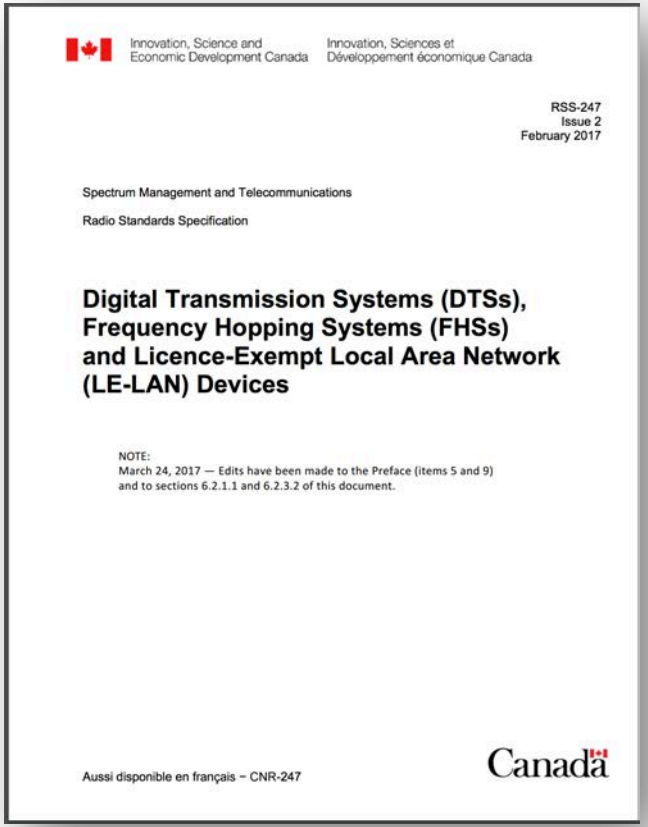
All unlicensed 2.4GHz and 5GHz ISM (Industrial Scientific Medical) spectrum in Canada is governed by ISED (ex. Industry Canada)

There are strict rules that need to be followed when deploying wireless gear outdoors.

Innovation, Science and Economic Development Canada

REGULATORY CONSIDERATIONS

- ISED RSS-247
- Outlines rules & regulations
- Take specific note of:
  - DFS requirements
  - 2.4GHz EIRP
  - 5GHZ EIRP
  - Radios approved for outdoor use



Innovation, Science and Economic Development Canada | Innovation, Sciences et Développement économique Canada

RSS-247
Issue 2
February 2017

Spectrum Management and Telecommunications

Radio Standards Specification

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

NOTE:
March 24, 2017 — Edits have been made to the Preface (items 5 and 9) and to sections 6.2.1.1 and 6.2.3.2 of this document.

Aussi disponible en français – CNR-247

Canada

REGULATORY CONSIDERATIONS – DFS CHANNELS

- 6.3.1 DFS radar signal detection threshold Devices shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. The device must detect radar signals within its entire emission bandwidth. The minimum DFS radar signal detection threshold is described below in Table 1.

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices RSS-247

Table 1: DFS Detection threshold for master devices and slave devices with radar detection

Devices	DFS Threshold
Devices with an e.i.r.p. < 200 mW AND a Power Spectral Density < 10 dBm/MHz	-62 dBm
Devices with 200 mW ≤ e.i.r.p. ≤ 1 W	-64 dBm
Note: The detection threshold power is the received power, averaged over a 1-microsecond reference to a 0 dBi antenna.	

REGULATORY CONSIDERATIONS – DFS CHANNELS A REALITY

Mount Sicker E.C. Weather Radar

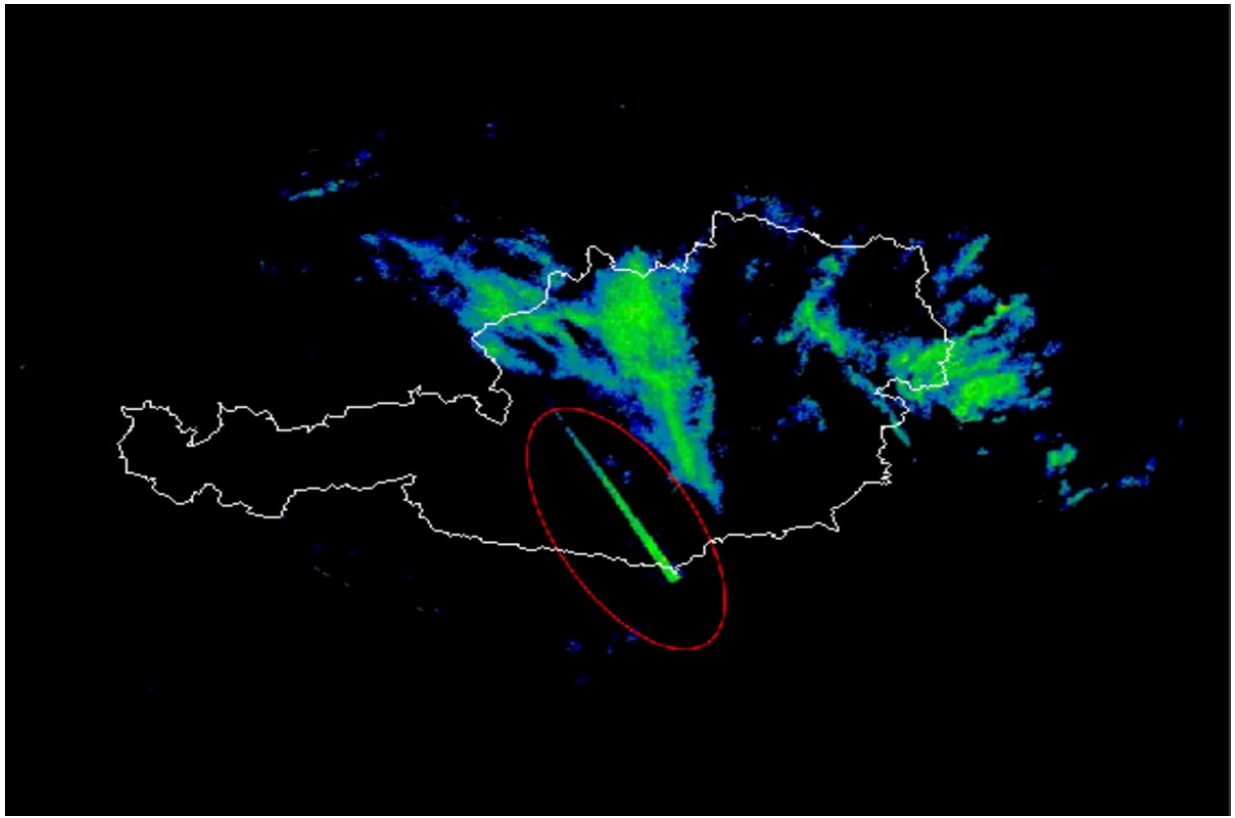
Station Callsign: XSI / CFR741

Frequency: 5.620GHz (channel 124)

TX Power: 251 watts

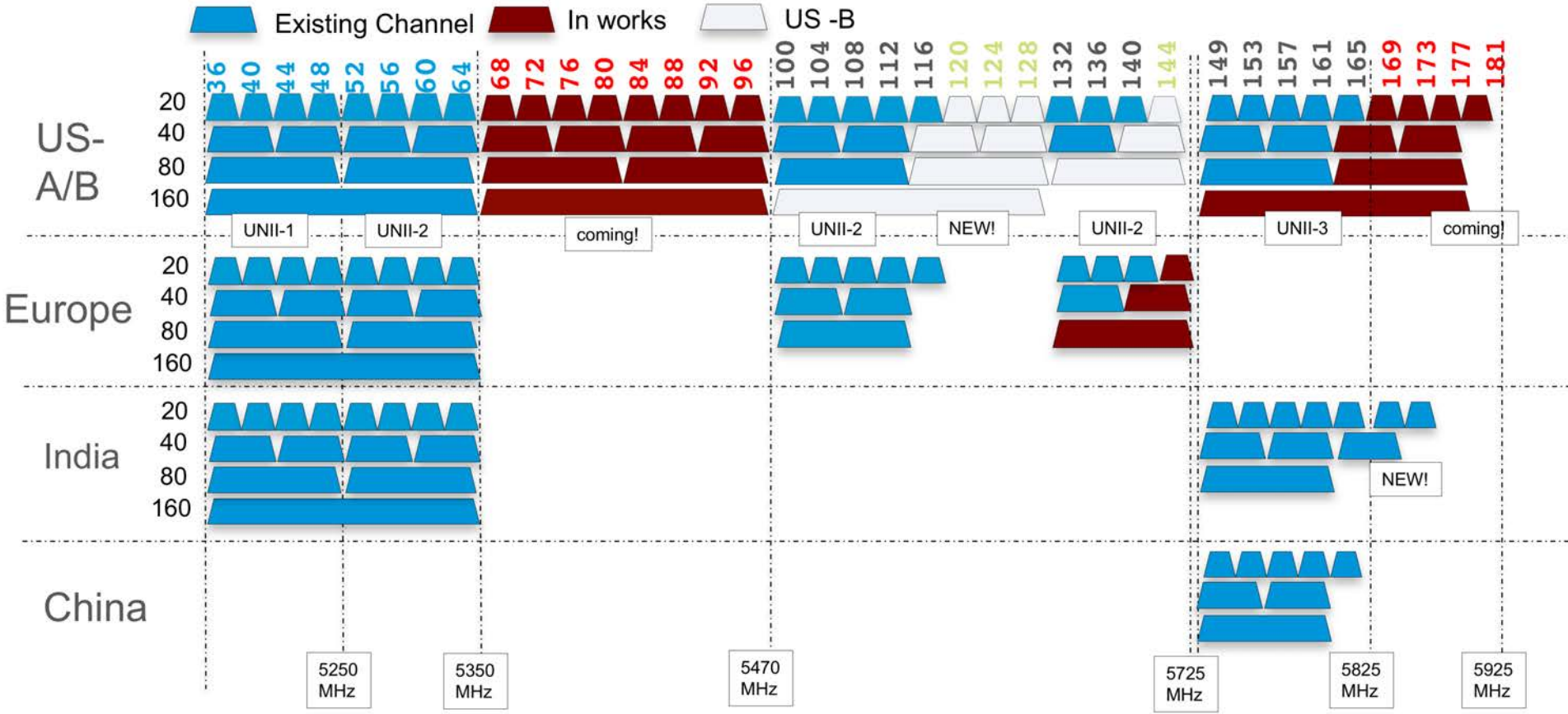
Effective TX Power: +70dBW – 10MW pulse

REGULATORY CONSIDERATIONS



The impact Wi-Fi networks operating on incorrect 5GHz channels can have on weather radar...

5 GHz 20/40/80/160 MHz Channels



SAFETY CONSIDERATIONS

(PHYSICAL & RF)

SAFETY CONSIDERATIONS - PHYSICAL

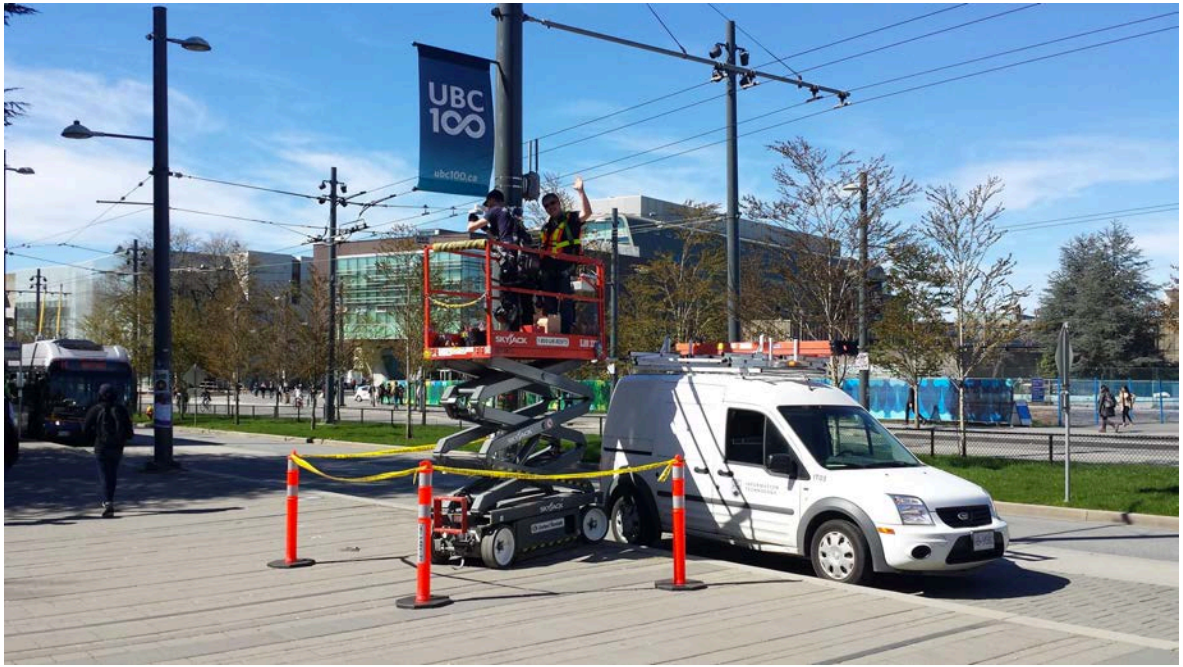
- All staff trained in fall protection

- Current equipment
  -full body harness
  -horizontal lifelines
  -rope grabs
  -hardhats with chinstraps.

SAFETY CONSIDERATIONS - PHYSICAL

- Eliminate use of ladders where possible and practical.

- Make sure to isolate work area, especially in public spaces where “stuff” dropping can be of concern.



SAFETY CONSIDERATIONS – INSTALLATIONS @ HEIGHT

- Staff trained on use of bucket trucks & boom lifts such as JLG's.

- High installations about 30ft are very expensive and often impractical in high density areas.

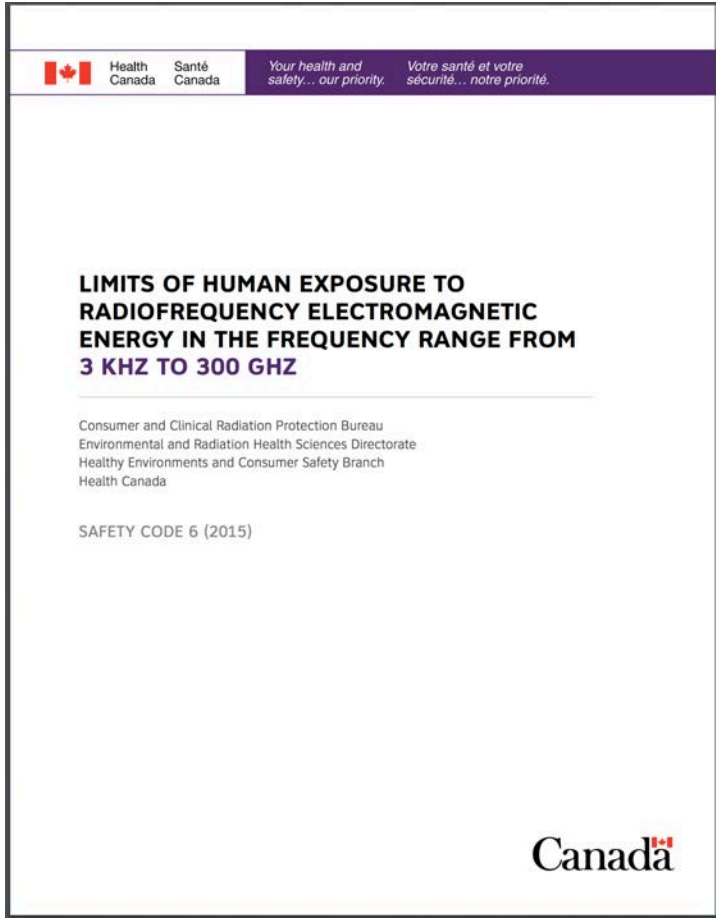
SAFETY CONSIDERATIONS - PHYSICAL

- Limit time @ height during troubleshooting

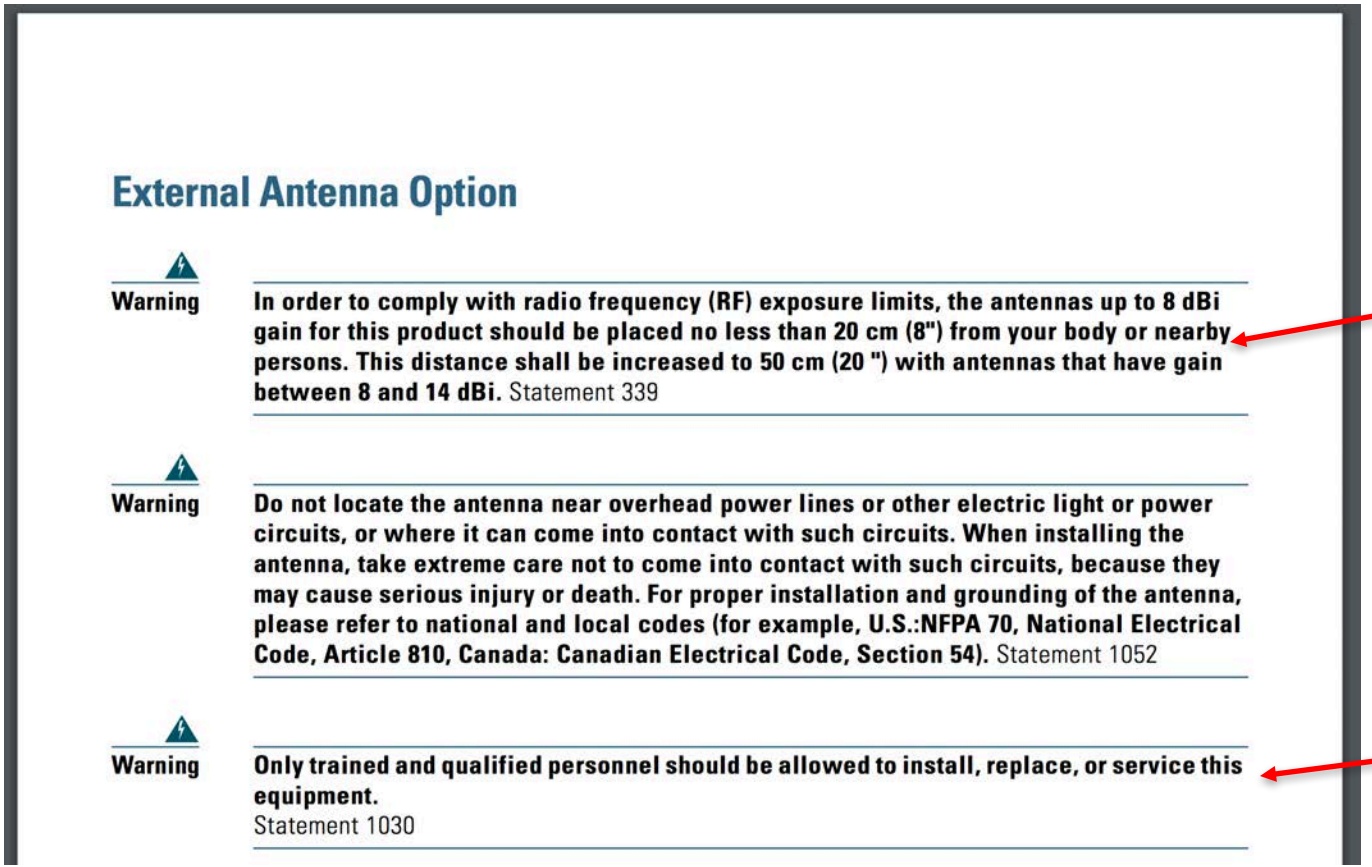
- Use remote console for debugs (shown here is an Airconsole) which has a range of ~150ft in outdoors

SAFETY CONSIDERATIONS

- Health Canada Safety Code 6



REGULATORY CONSIDERATIONS



External Antenna Option

Warning **In order to comply with radio frequency (RF) exposure limits, the antennas up to 8 dBi gain for this product should be placed no less than 20 cm (8") from your body or nearby persons. This distance shall be increased to 50 cm (20 ") with antennas that have gain between 8 and 14 dBi.** Statement 339

Warning **Do not locate the antenna near overhead power lines or other electric light or power circuits, or where it can come into contact with such circuits. When installing the antenna, take extreme care not to come into contact with such circuits, because they may cause serious injury or death. For proper installation and grounding of the antenna, please refer to national and local codes (for example, U.S.:NFPA 70, National Electrical Code, Article 810, Canada: Canadian Electrical Code, Section 54).** Statement 1052

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**
Statement 1030

SAFETY CONSIDERATIONS – SAFETY CODE 6
AP & ANTENNA **WORK TOGETHER AS A SYSTEM**

Declaration of Conformity for RF Exposure

This section contains information on compliance with guidelines related to RF exposure.

Generic Discussion on RF Exposure

The Cisco products are designed to comply with the following national and international standards on Human Exposure to Radio Frequencies:

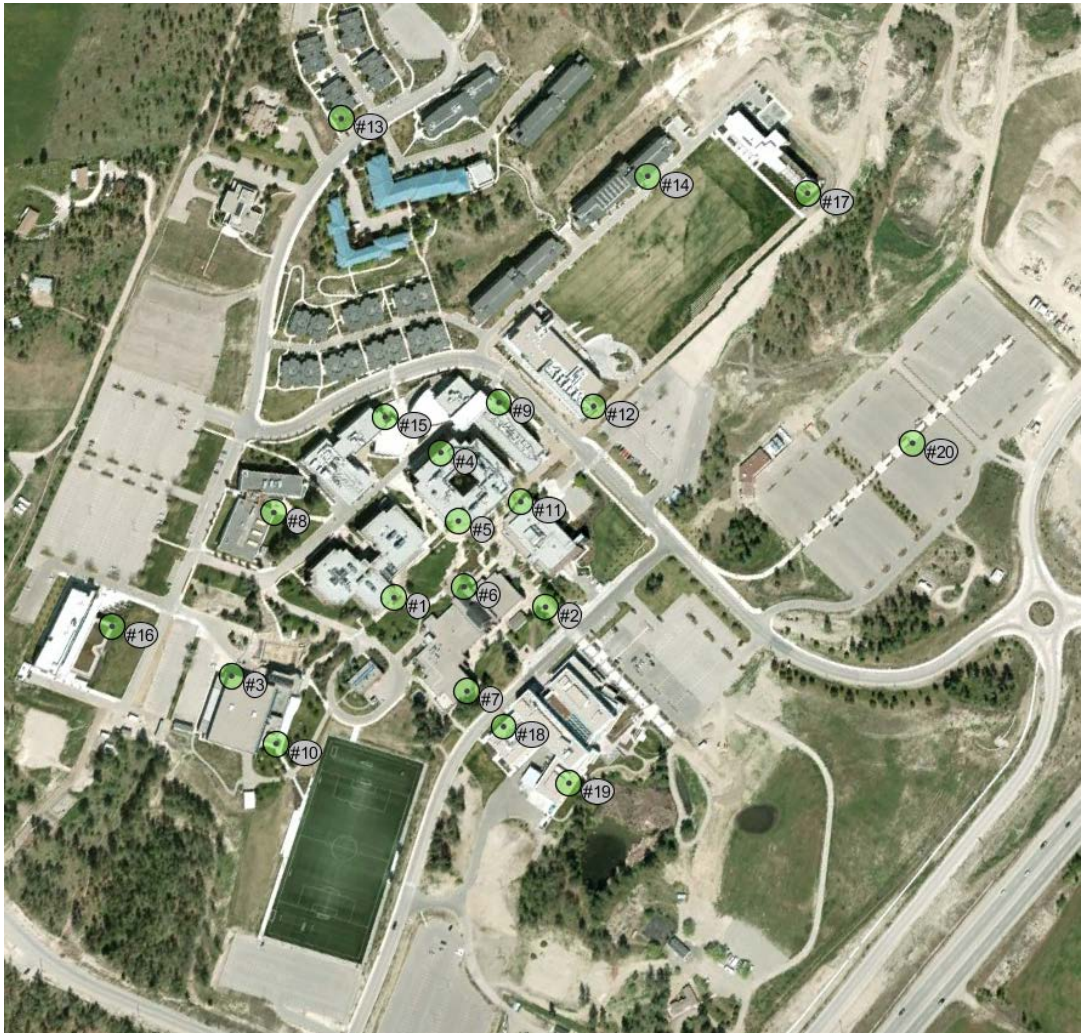
- US 47 Code of Federal Regulations Part 2 Subpart J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers / IEEE C 95.1 (99)
- International Commission on Non Ionizing Radiation Protection (ICNIRP) 98
- Ministry of Health (Canada) Safety Code 6. Limits on Human Exposure to Radio Frequency Fields in the range from 3kHz to 300 GHz
- Australia Radiation Protection Standard

To ensure compliance with various national and international Electromagnetic Field (EMF) standards, the system should only be operated with Cisco approved antennas and accessories.

USE CASES

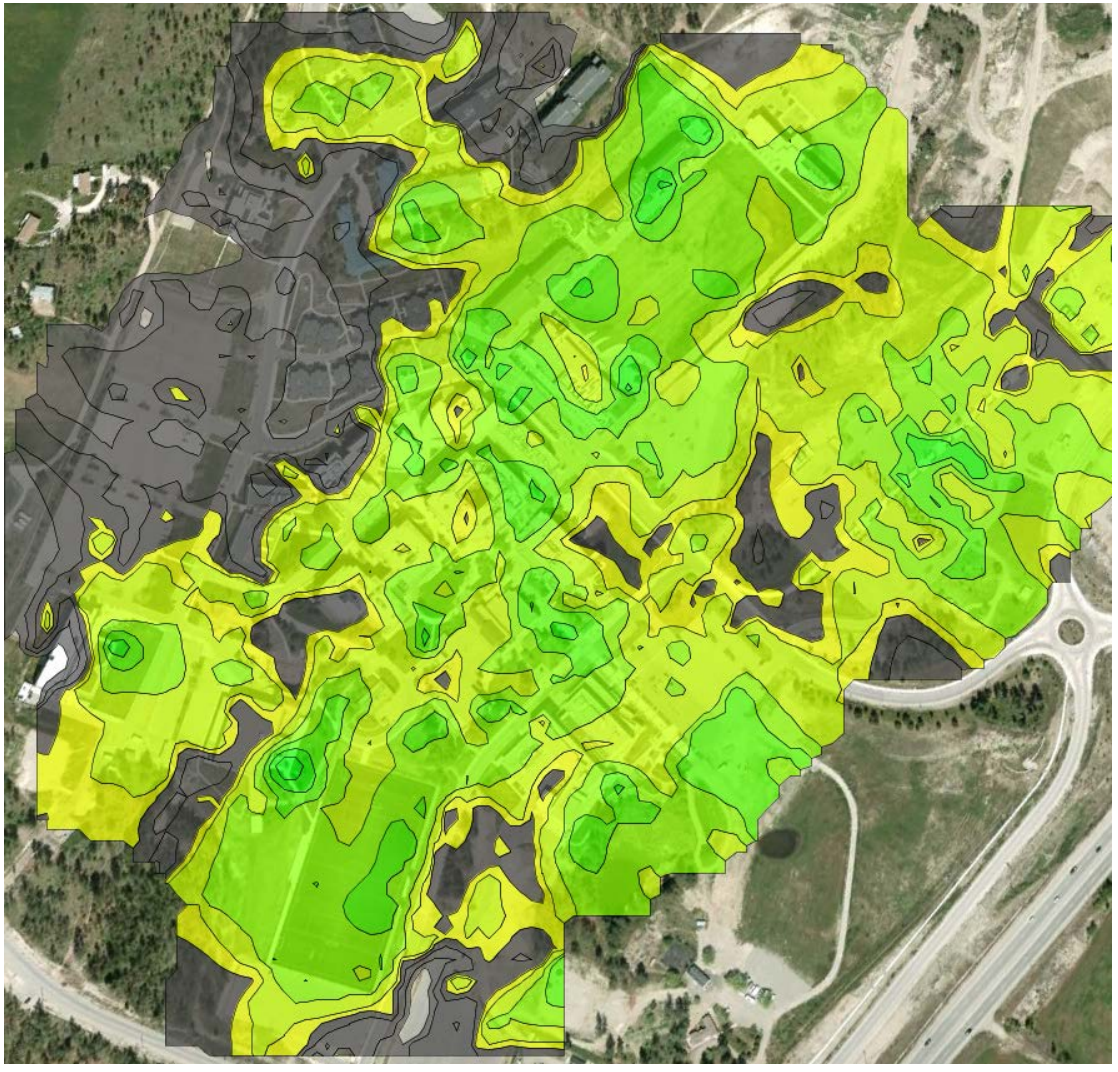
UBCO DEPLOYMENT

UBCO OUTDOOR MESH LOCATIONS

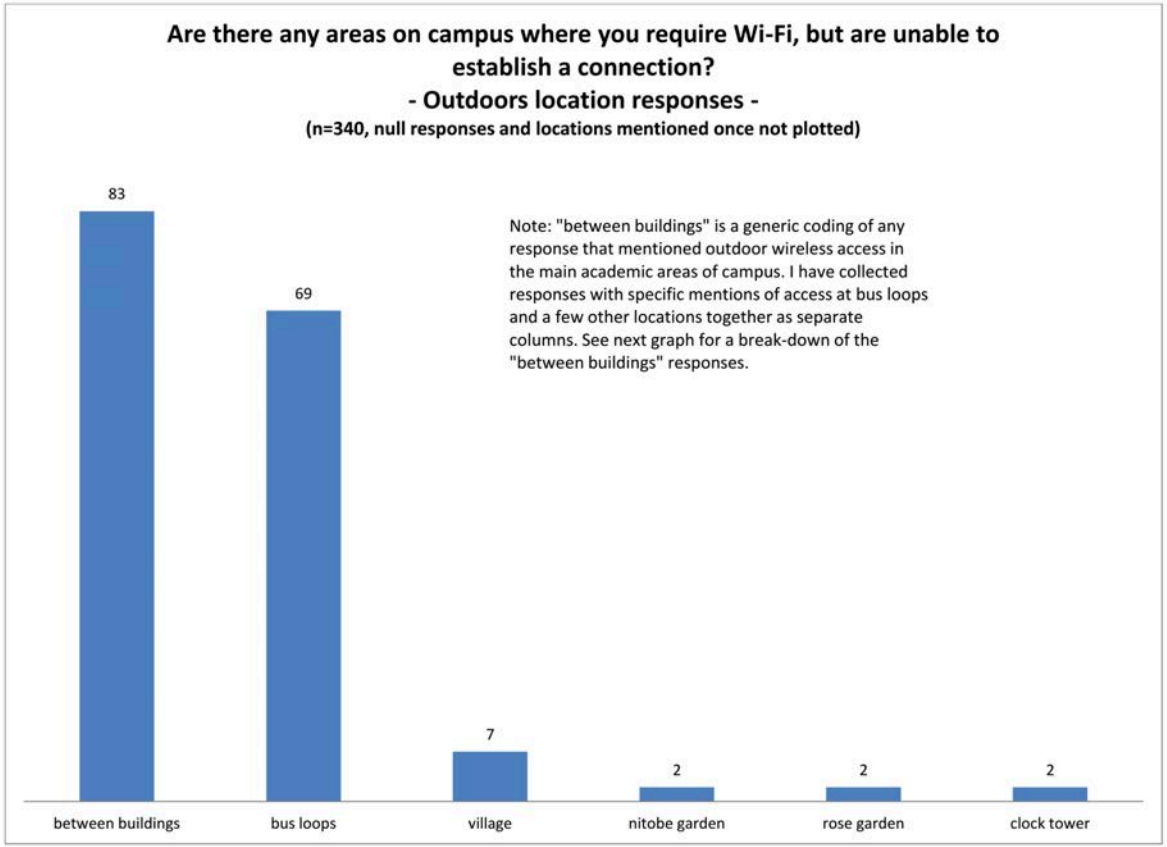


SITE SURVEY PATH

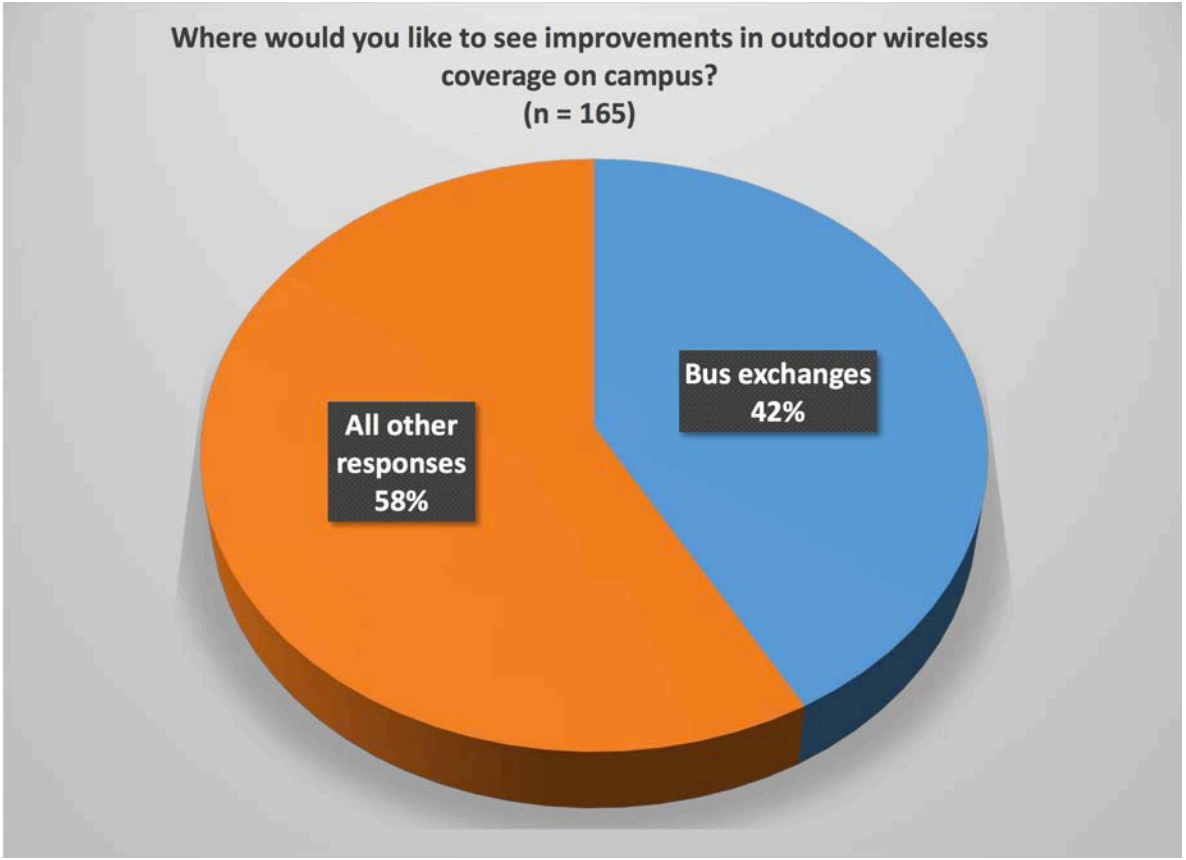
5GHZ COVERAGE RESULTS



WHERE TO START? – ASK THE USERS!



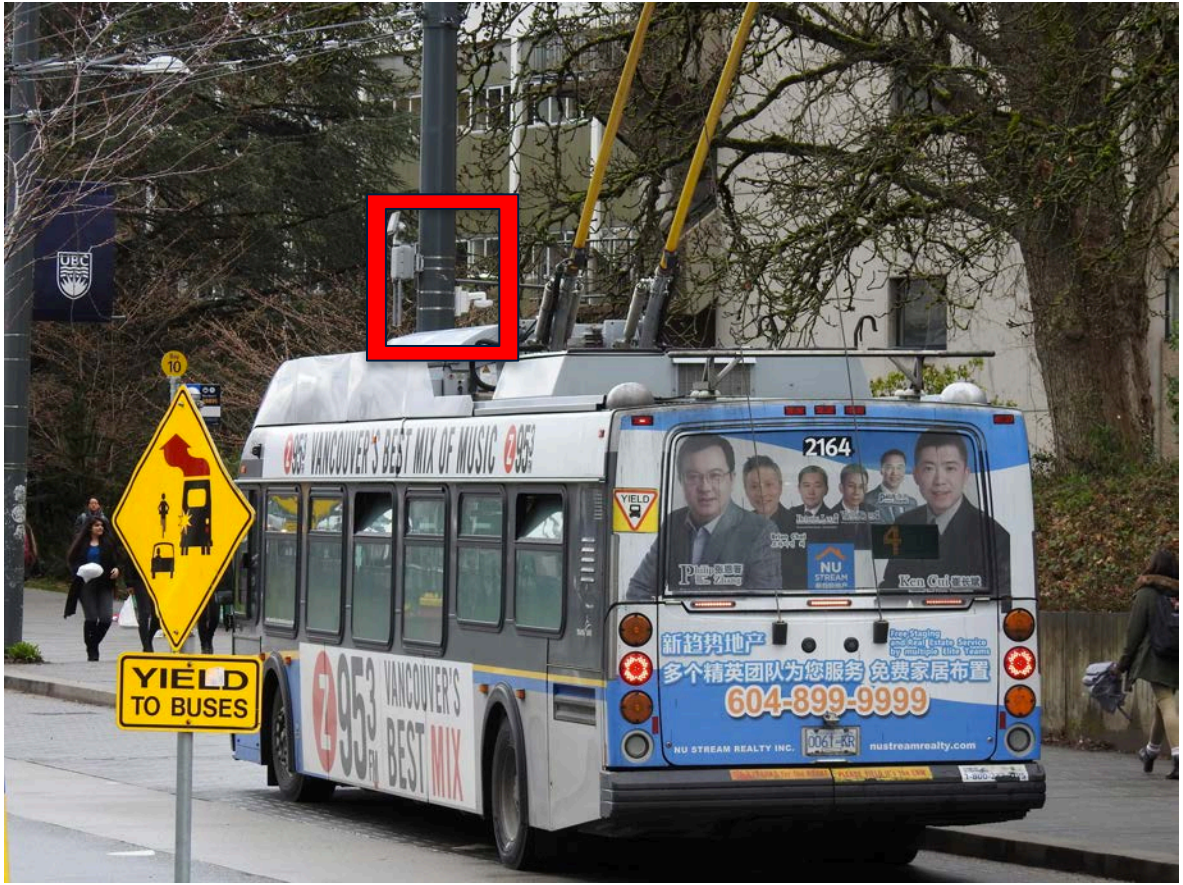
POPULAR AREAS? – ANYWHERE PEOPLE ARE BORED…



BUS LOOPS

BUS LOOPS

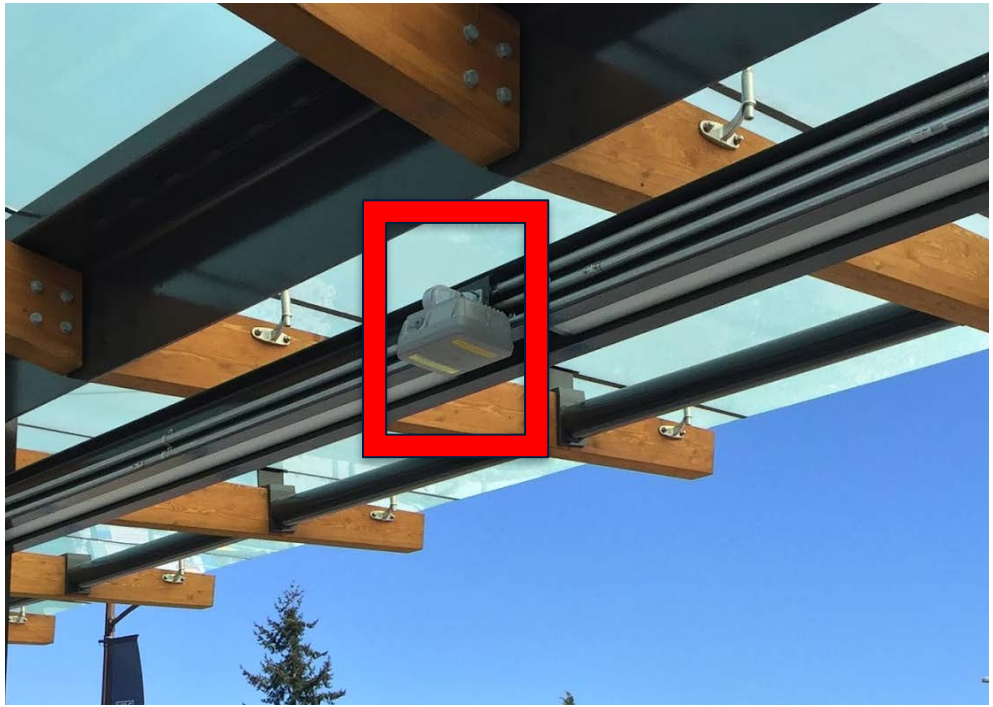
BUS LOOPS


YIELD
TO BUSES
VANCOUVER'S BEST MIX OF MUSIC
2164
新趋势地产
多个精英团队为您服务 免费家居布置
604-899-9999
NU STREAM REALTY INC.
nustreamrealty.com
95.3 FM
VANCOUVER'S
BEST MIX

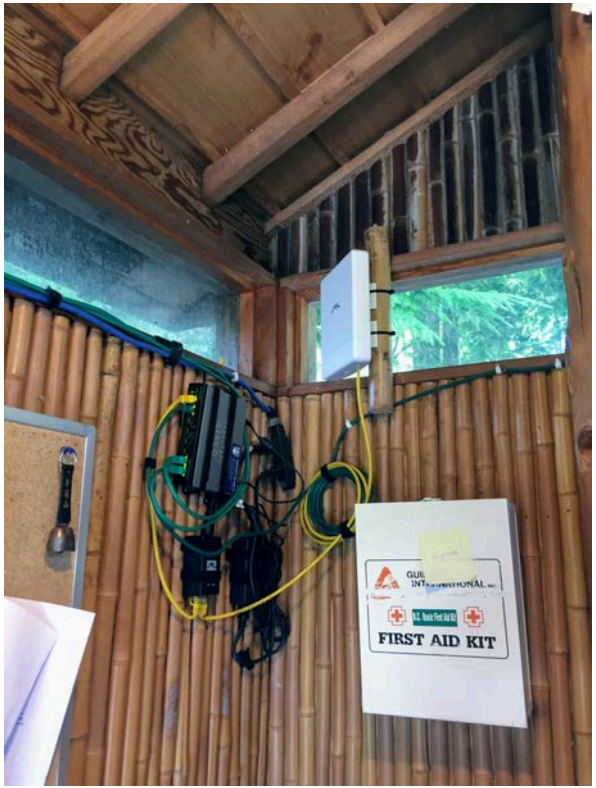
BUS LOOPS – CCTV

BUS LOOPS

BUS LOOPS



CONNECTING THOSE “OFF GRID” LOCATIONS



CONNECTING THOSE “OFF GRID” LOCATIONS @ 900MHZ

UBC FARM – CENTRE FOR SUSTAINABLE FOOD SYSTEMS FACULTY LAND & FOOD IN SOUTH CAMPUS

•No fibre link to farm - nearest wired cxn back to main campus ~450m away

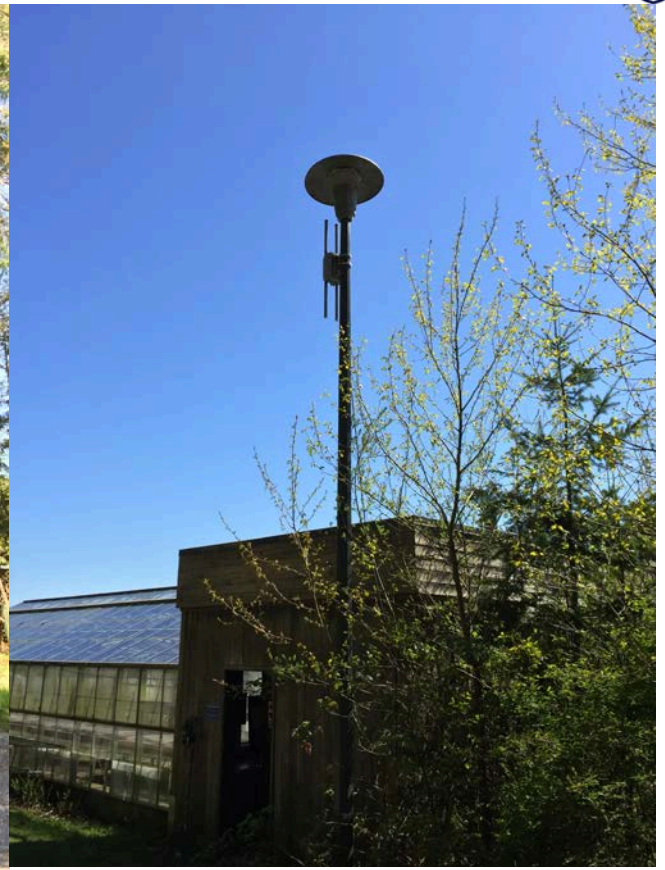
•15 - 20 UBC farm staff, students, faculty & volunteers using farm office

•Outdoor mesh AP on Farm office roof links: 1 hop to transformer building, 2 hops to either nurseries greenhouses, or CCM, or south campus warehouse roof.

UBC FARM (POINT GREY) MESH

UBC FARM (POINT GREY) MESH

UBC FARM (POINT GREY) MESH



BLUE LIGHT DEPLOYMENTS ALONGSIDE CCTV

Looking to retrofit campus blue lights to include AP's directly connected to SM fiber.

•Ideal mounting location, close to ground, good line of sight.

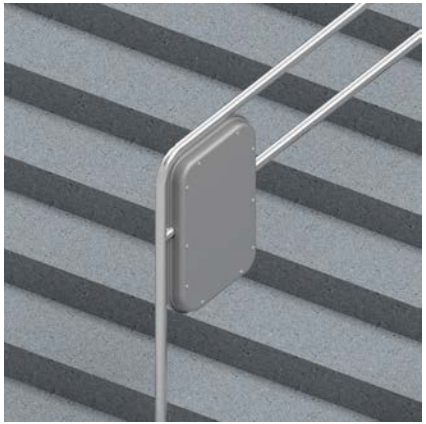
•High capacity connection

AESTHETIC CONSIDERATIONS

AESTHETIC CONSIDERATIONS – KEY POINTS…

- Pole Mounted Outdoor Access Points
- Camouflaged and Concealed
- Under Seats in stadiums (keep Safety Code 6 in mind)
- Hand Rail Mounts
- Vanity Plates (Paintable)
- Enclosures with vinyl wrap to blend in
- Imagination!

AESTHETIC CONSIDERATIONS – KEY POINTS…



AESTHETIC CONSIDERATIONS – KEY POINTS…

CAN YOU SEE THE OUTDOOR AP?

CAN YOU SEE THE OUTDOOR AP?

CAN YOU SEE THE OUTDOOR AP?

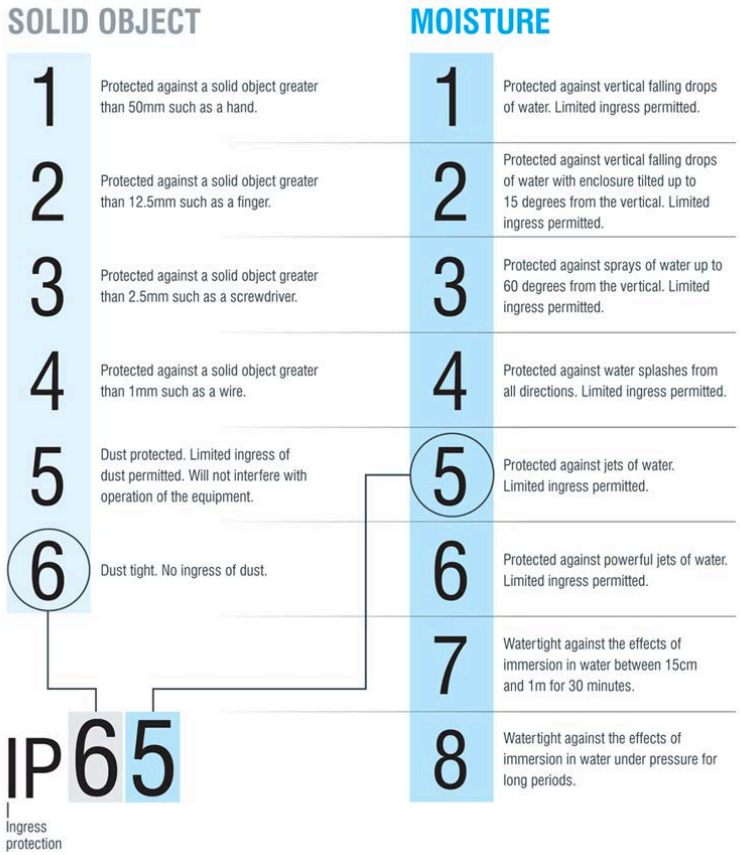
CAN YOU SEE THE OUTDOOR AP?

ENVIRONMENTAL CONSIDERATIONS

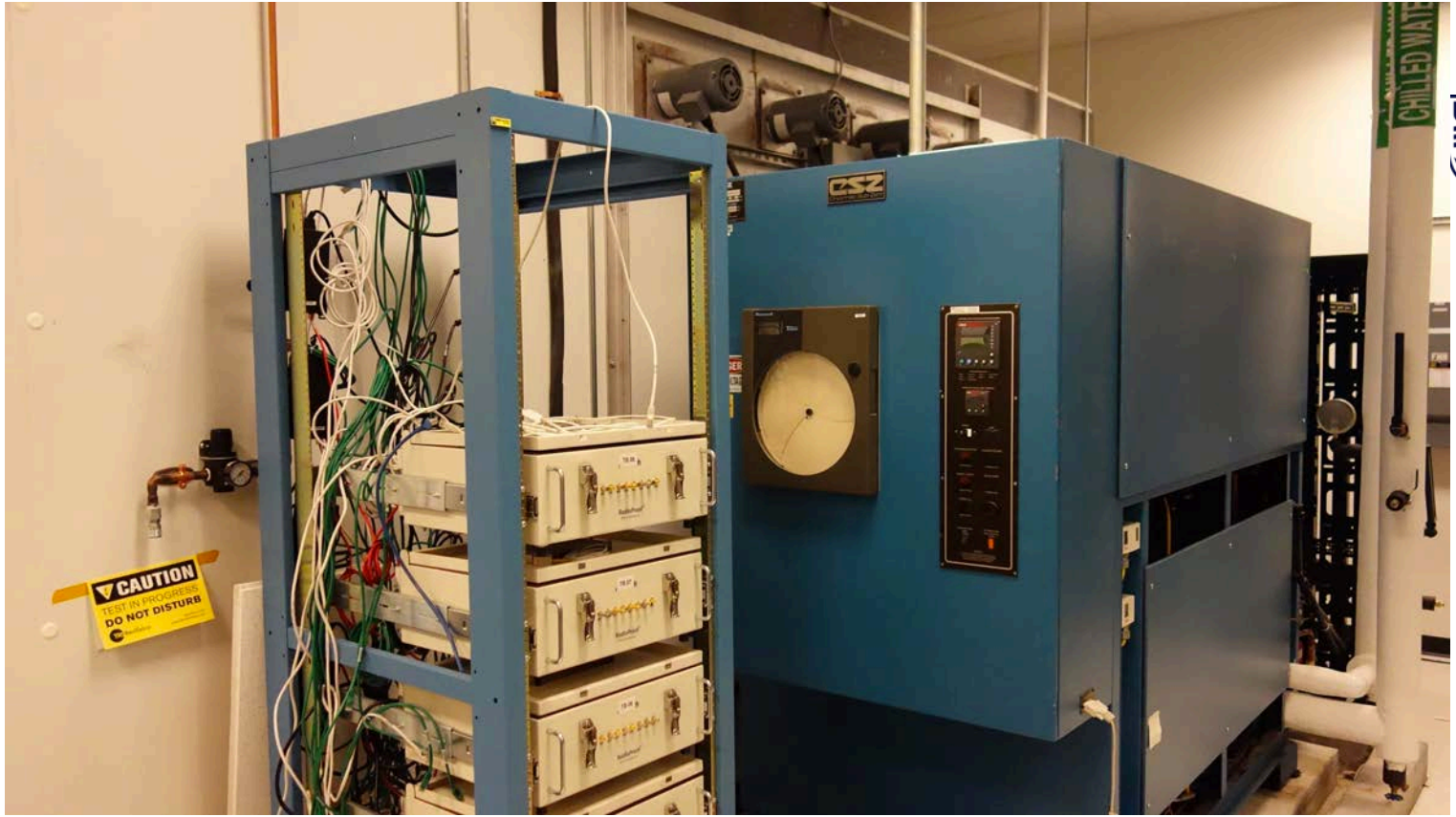
ENVIRONMENTAL CONSIDERATIONS – INGRESS PROTECTION

Image Source:
https://bboxblog.files.wordpress.com/2014/10/ipratings2-copy.jpg

ENVIRONMENTAL CONSIDERATIONS – INGRESS PROTECTION



ENVIRONMENTAL CONSIDERATIONS – TEMPERATURE TESTING



ENVIRONMENTAL CONSIDERATIONS – TEMPERATURE -25°C

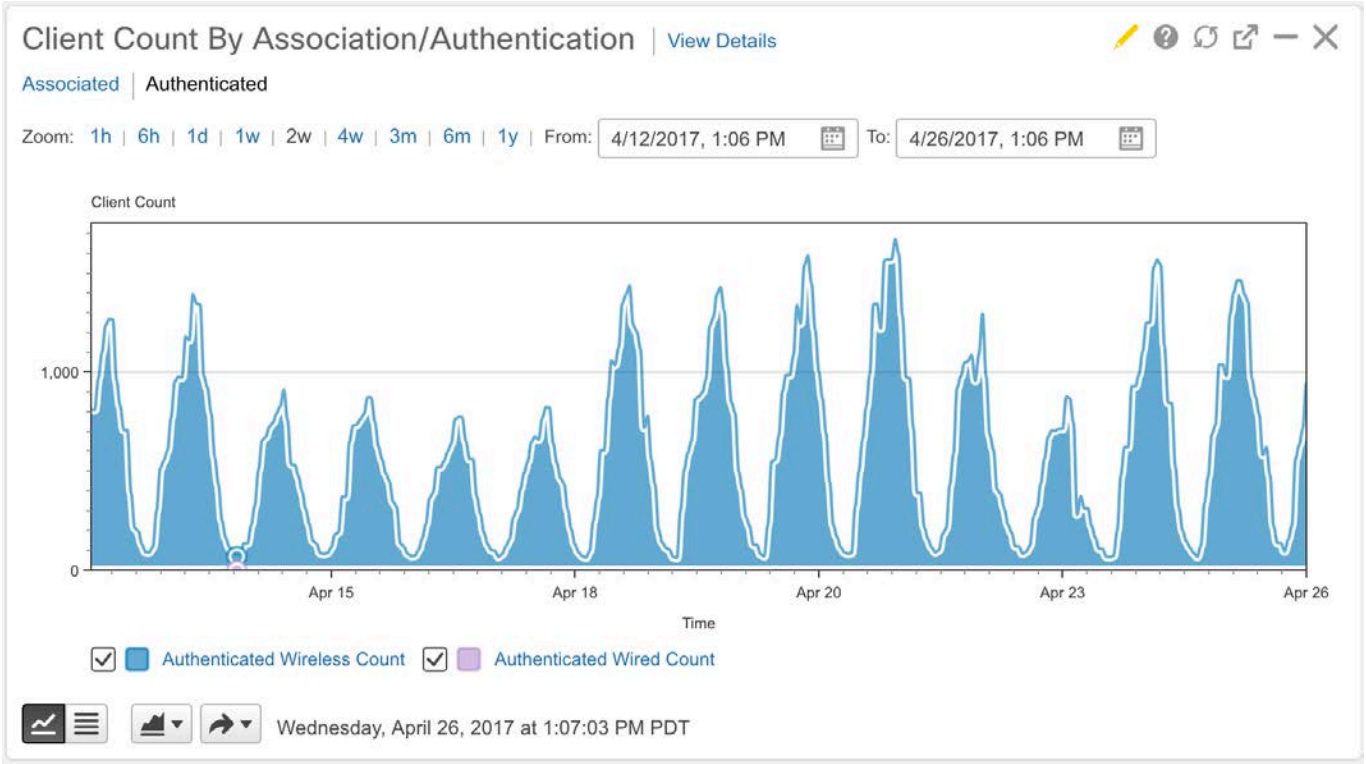
ENVIRONMENTAL CONSIDERATIONS – TEMPERATURE -55ºC

ENVIRONMENTAL CONSIDERATIONS – WHEN IN DOUBT, CONSULT THE PRODUCT DATA SHEET…

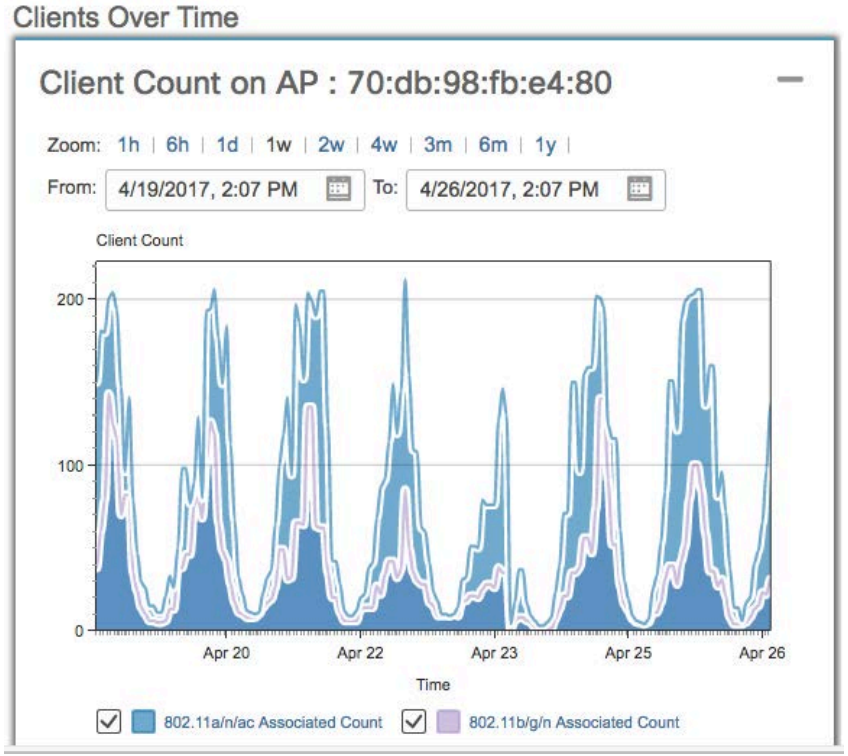
Weight	• 6.7 lb (3.0 kg)
Environmental	• Nonoperating (storage) temperature: -40° to +185°F (-40° to +85°C) • Nonoperating (storage) altitude test: +25°C, 15,000 ft. • Operating temperature: -40° to +158°F (-40° to +70°C) with solar load and still air • Extended operating temperature (DC powered): -58° to +167°F (-50° to +75°C) without solar loading, still air, and cold start limited to -40°C • Operating type test: +85°C for 16 hours • Operating humidity: 0% to 100% (condensing) • Operating altitude: 15,000 ft.
Surge	• Surge protection to ± 2 kV (line-earth) and ± 1 kW (line-line) on DC power input • Surge protection to ± 4 kV on Ethernet ports

PERFORMANCE EXPECTATIONS

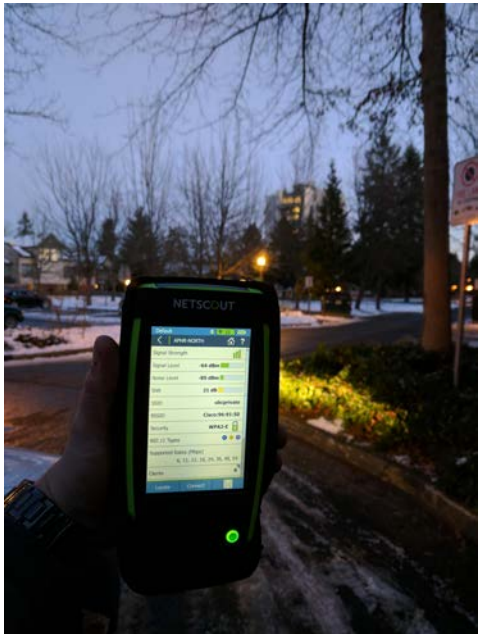
OUTDOOR MESH NETWORK USAGE @ UBC VANCOUVER



OUTDOOR MESH NETWORK USAGE – BUS LOOP

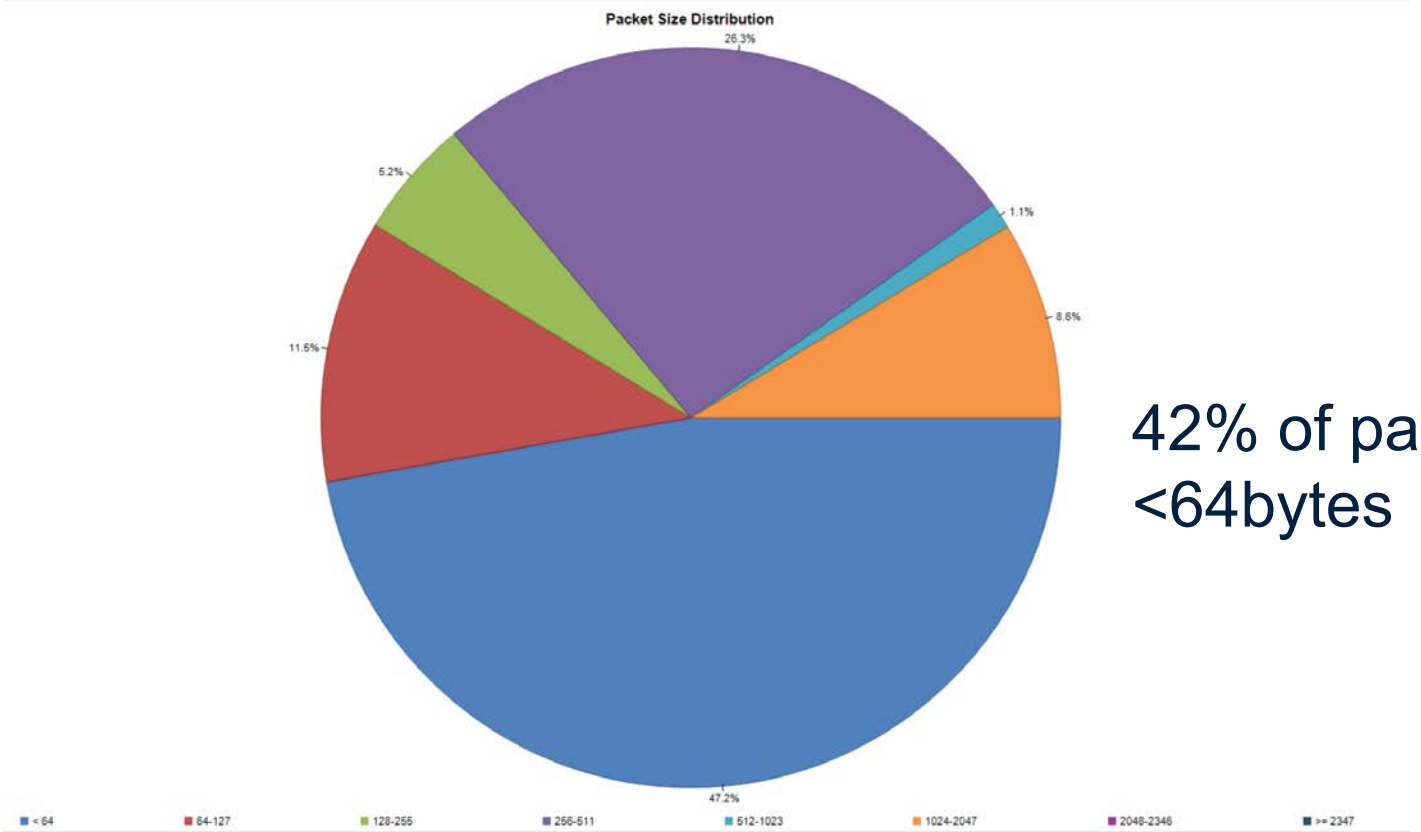


REALTIME OUTDOOR NETWORK STATS COLLECTION



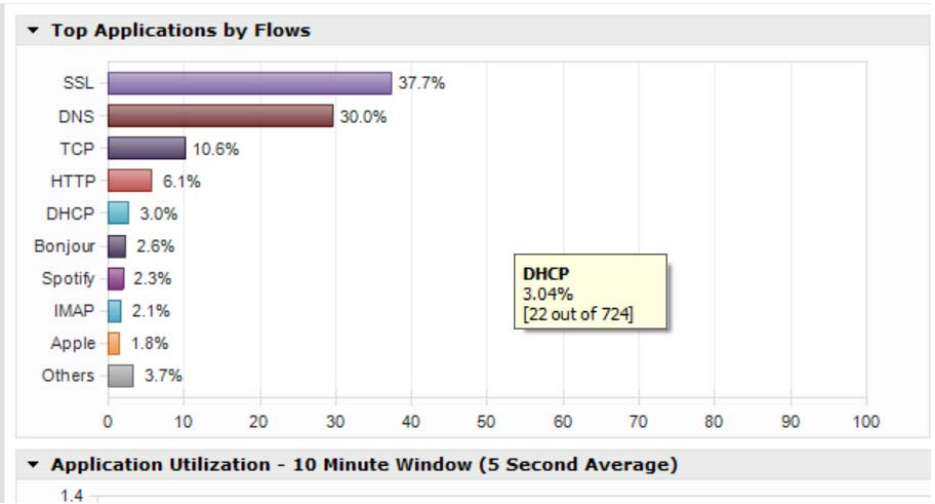
REALTIME OUTDOOR NETWORK STATS COLLECTION

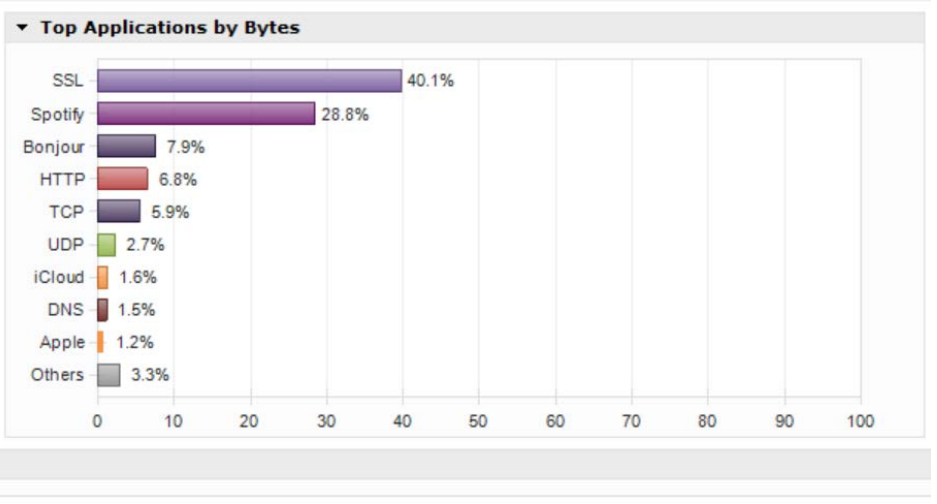
OUTDOOR NETWORK SNIFFING (LOTS OF SMALL PACKETS)



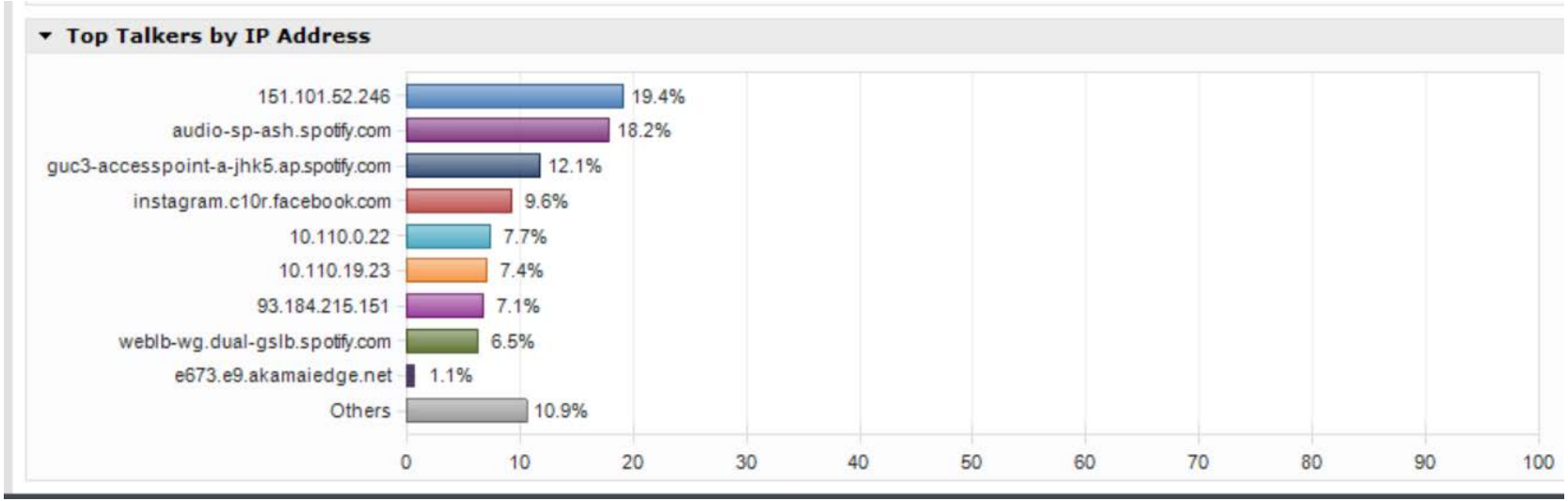
42% of packets <64bytes

OUTDOOR NETWORK SNIFFING – TOP APPLICATIONS

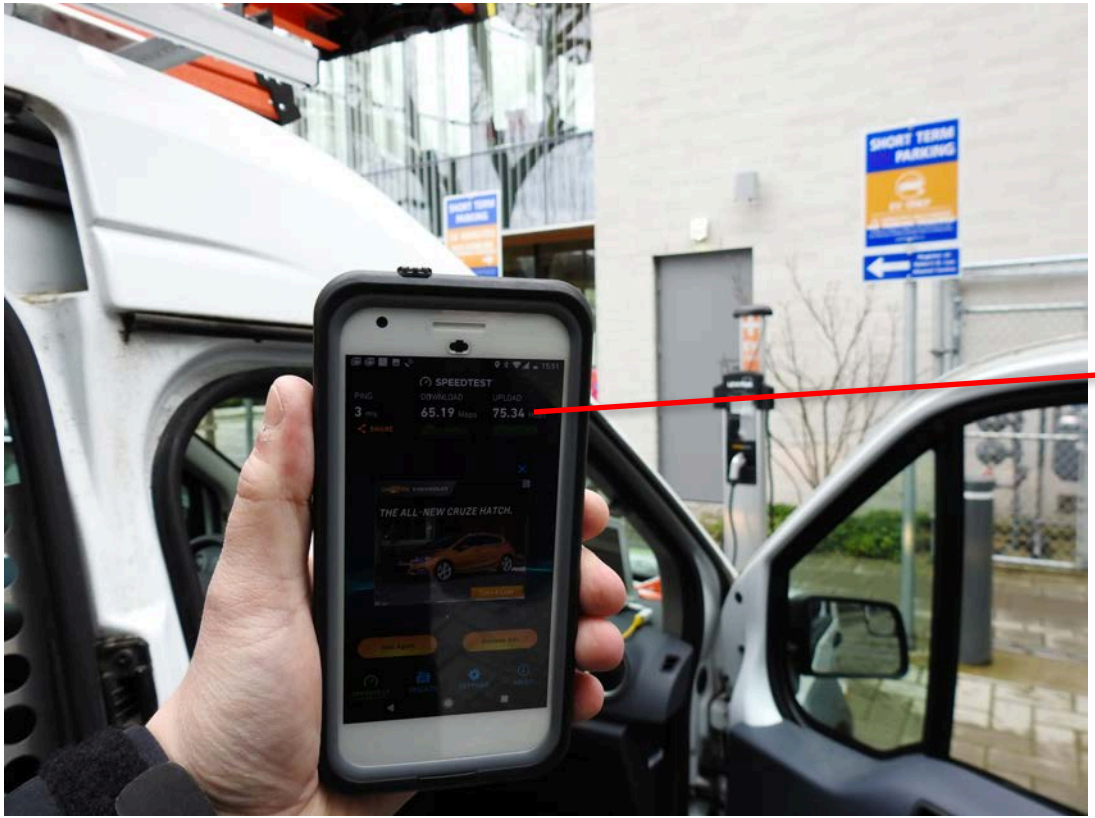


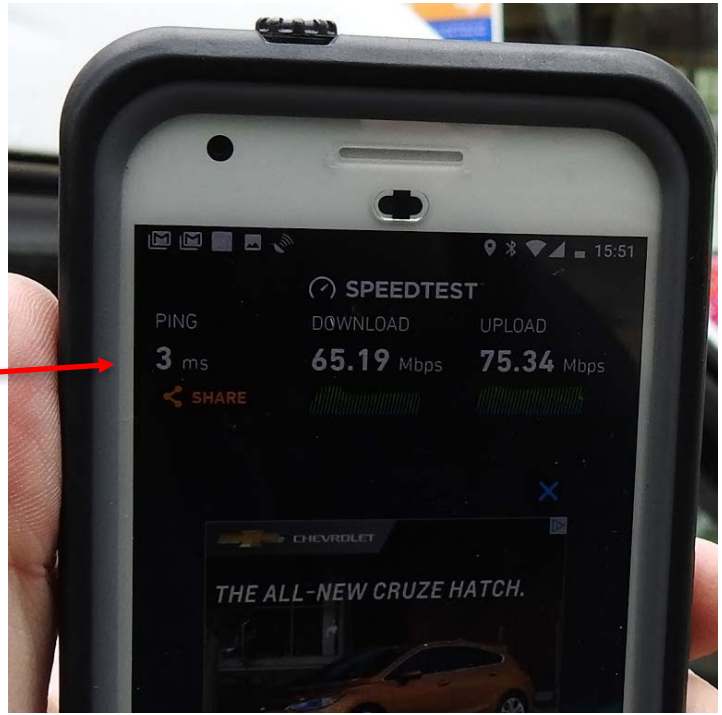


NEAR THE BOOKSTORE (SPOTIFY)



OUTDOOR NETWORK – THROUGHPUT VALIDATION…





COMPARING INDOOR VS OUTDOOR – RETRY RATE

802.11 Analysis	Packets	Bytes	Value
Average Signal Strength			39.525
Average Signal dBm			-63.133
Average Noise			36.857
Average Noise dBm			-82.469
802.11 Data	19.275%	29.371%	
802.11 Management	18.706%	13.110%	
802.11 Control	34.189%	1.764%	
Local	54.059%	14.988%	
From DS	11.837%	27.149%	
To DS	6.231%	2.098%	
DS-DS	0.043%	0.011%	
Retry	7.989%	13.112%	
Encrypted	16.409%	28.367%	
Decryption Errors	0.000%	0.000%	
Order	0.000%	0.000%	
Unprotected Data	1.440%	0.168%	
Minimum Data Rate Packets	0.043%	0.011%	

Indoor

Packets	Bytes	Value
		28.164
		-59.092
		26.725
		-79.848
18.357%	27.699%	
21.168%	23.499%	
34.525%	2.941%	
56.635%	26.600%	
10.397%	24.190%	
6.895%	2.999%	
0.123%	0.051%	
19.453%	28.501%	
7.723%	16.337%	
0.000%	0.000%	
0.000%	0.000%	
1.455%	0.324%	
0.167%	0.074%	

Outdoor


THE UNIVERSITY OF BRITISH COLUMBIA