



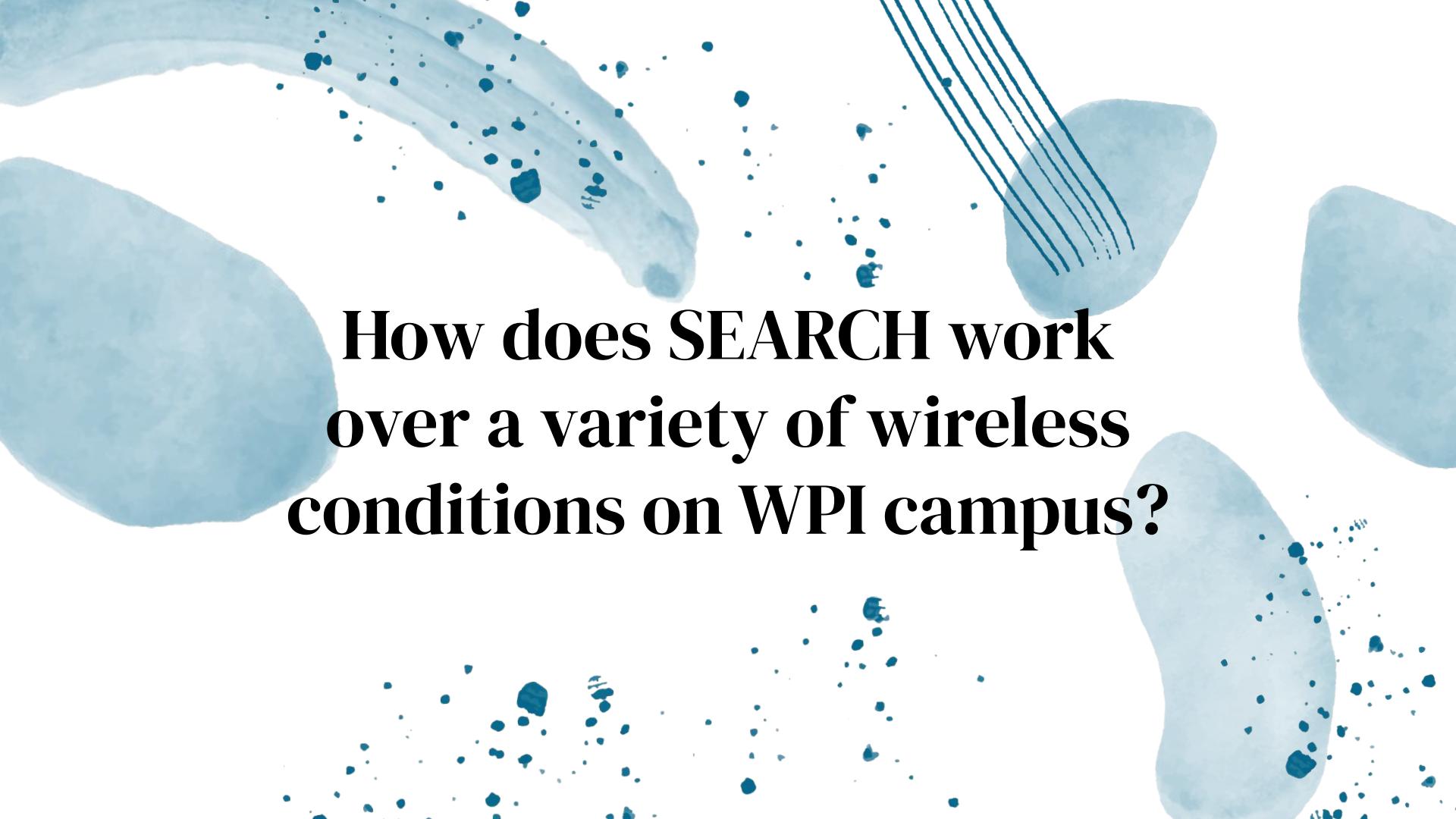
WPI

SEARCH Wireless Network Traces

Computer Science Independent Study - C Term 2024

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Professor Mark Claypool, Maryam Ataei Kachooei



**How does SEARCH work
over a variety of wireless
conditions on WPI campus?**

Methodology

1. Develop scripts and tools

To serialize data collection and analysis

2. Understand WPI wifi network

Gather connectivity data on many campus locations

3. Test SEARCH:

Select a few locations, compare SEARCH, HyStart off, Hystart on

How does SEARCH perform with a variety of wireless conditions?

Test Hardware

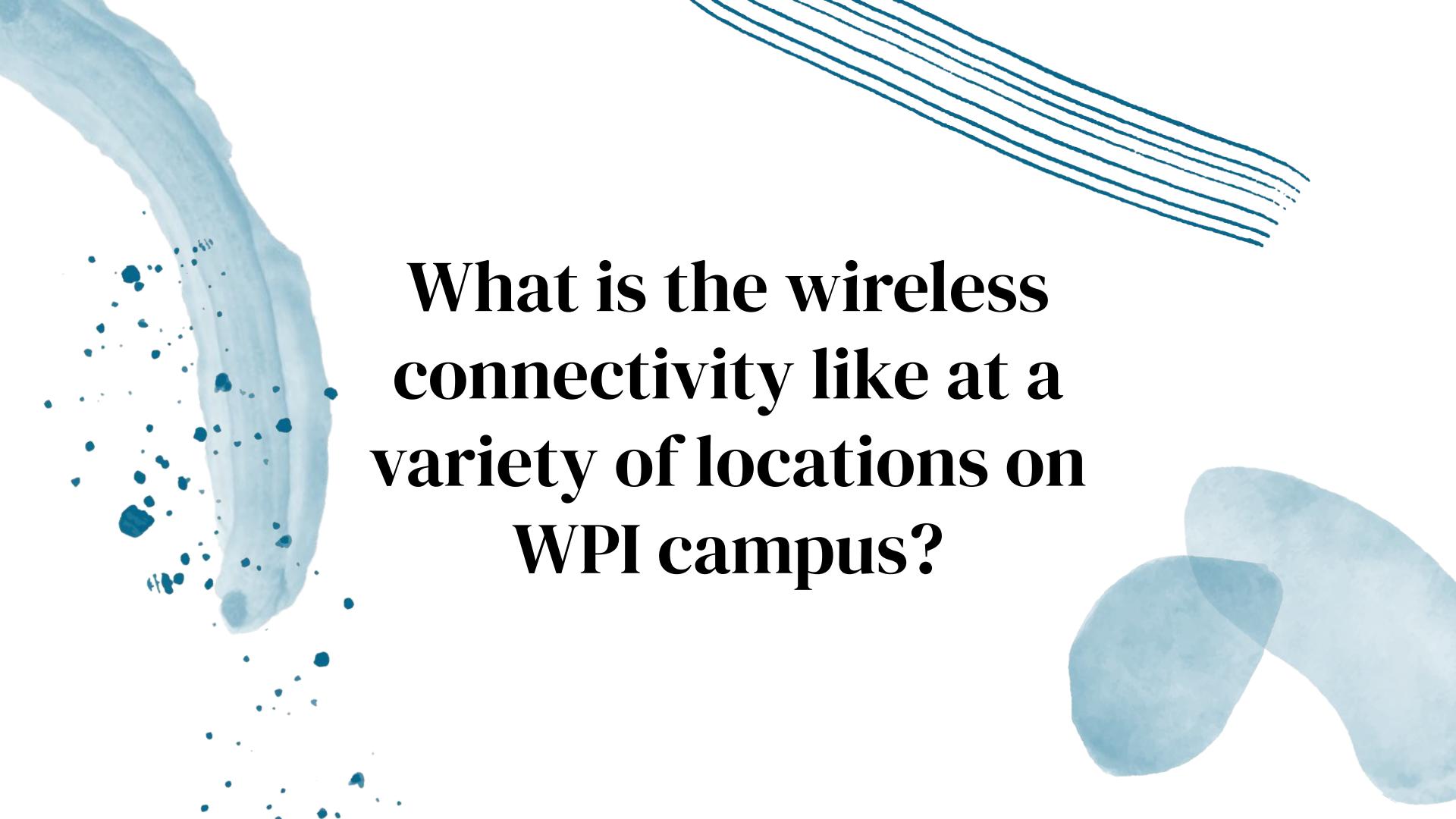


Laptop
(uploads to MLCNetB)



MLCNetB
(downloads from laptop)

- **Kernel:** Darwin 23.2.0
- **OS:** MacOS Sonoma
- **Processor:** Apple M1 Pro, 8 cores @ 3228Mhz
- **Network:** ac@5Ghz (866Mbps link)
- **Kernel:** Linux 5.4.0-169-generic
- **OS:** X64_86 Ubuntu 20.04.6 LTS
- **Processor:** Intel Xeon E312xx, 1 core @ 2500Mhz
- **Network:** Server rack connected via Ethernet (1Gbps link)



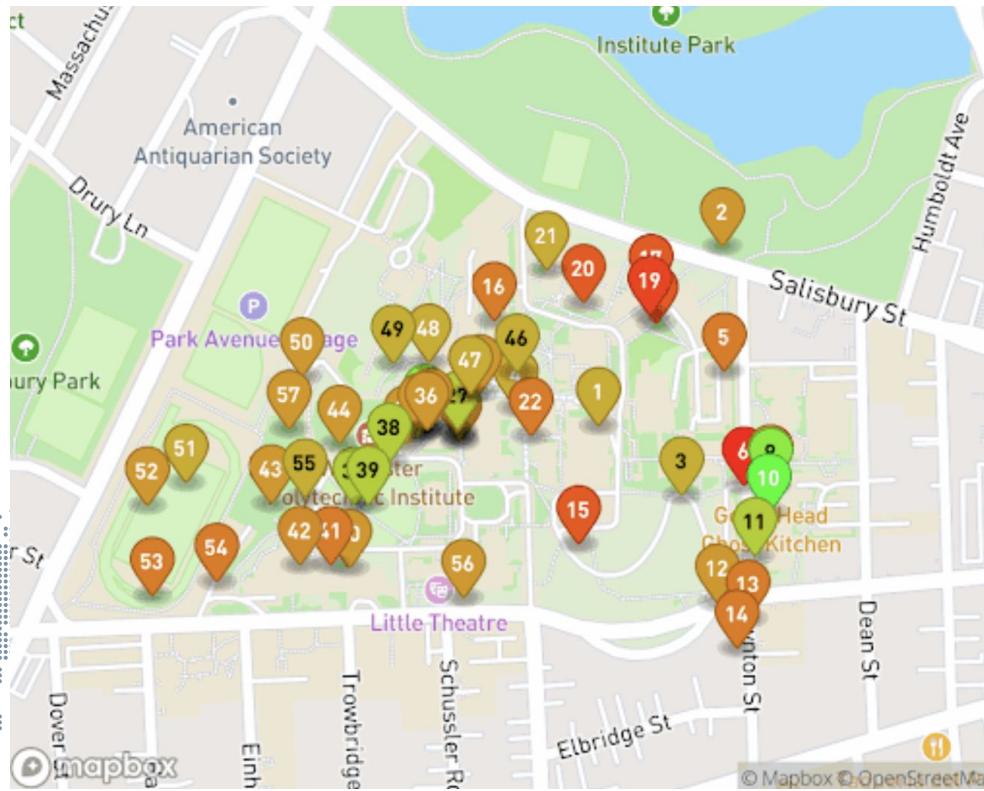
**What is the wireless
connectivity like at a
variety of locations on
WPI campus?**

Connectivity Test Methods

Find RSSI and average throughput in each campus location

1. Select spot on campus
2. **Laptop:** Start iperf Server
3. **Laptop:** Start tcpdump on port 2401
4. **Laptop:** Collect WIFI information
5. **Laptop:** Collect Lat/Lon from device
6. **MLCnetb:** Connect iperf to server
7. **MLCnetb:** Start tcpdump on port 2401, 10 second test
8. Compute average RSSI from logs and throughput from tcpdump pcap

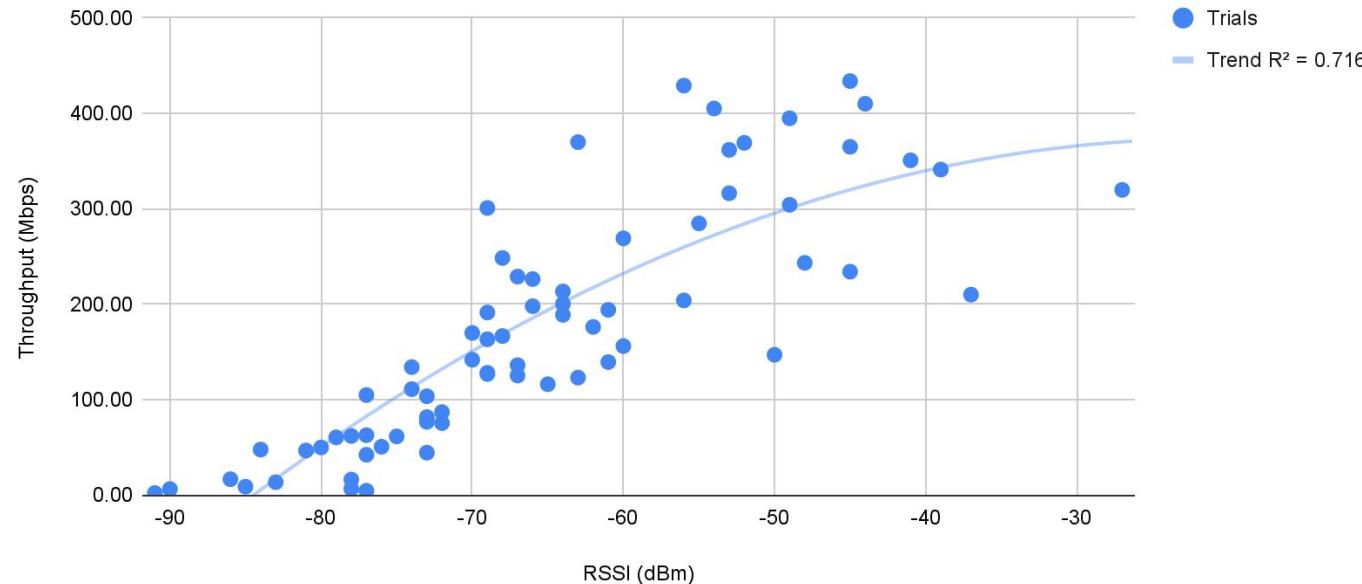
Samples: Throughput and RSSI on WPI Campus

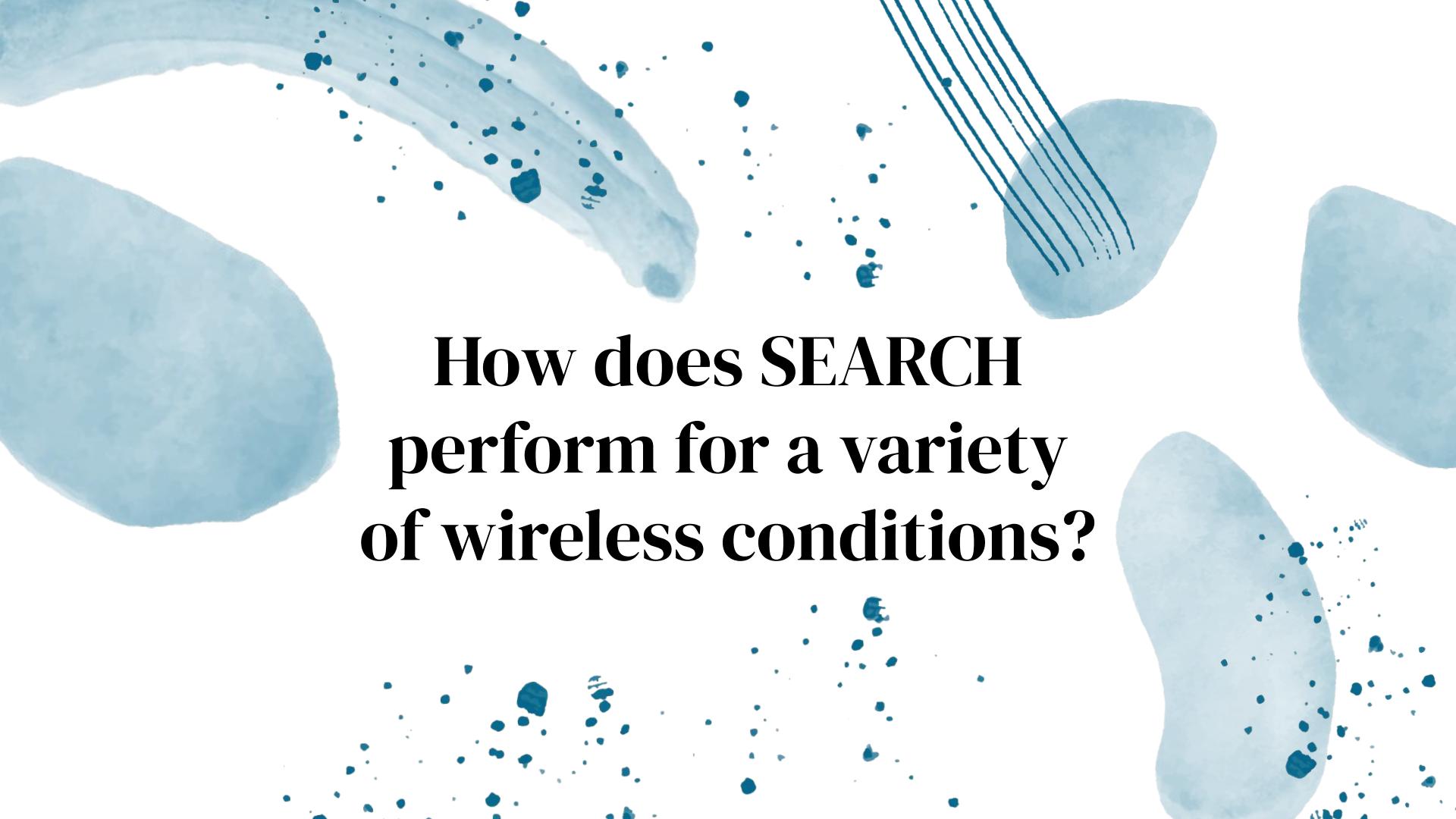


Samples: Throughput (Mbps) vs. RSSI (dBm)

Throughput vs RSSI

Correlating a trend between throughput and RSSI





**How does SEARCH
perform for a variety
of wireless conditions?**

SEARCH Performance Test Methods

1. Select spot on campus
2. **Laptop:** Collect hardware, WIFI info
3. **Laptop:** Start iperf Server
4. **Laptop:** Start tcpdump on port 2401
5. **MLCNetB:** Collect hardware info
6. **MLCNetB:** Set Hystart/SEARCH enabled/disabled
7. **MLCNetB:** Connect iperf to server, 3 second test
8. **MLCNetB:** Start tcpdump, capture SEARCH logs
9. Analyze ping, RSSI, throughput from pcaps

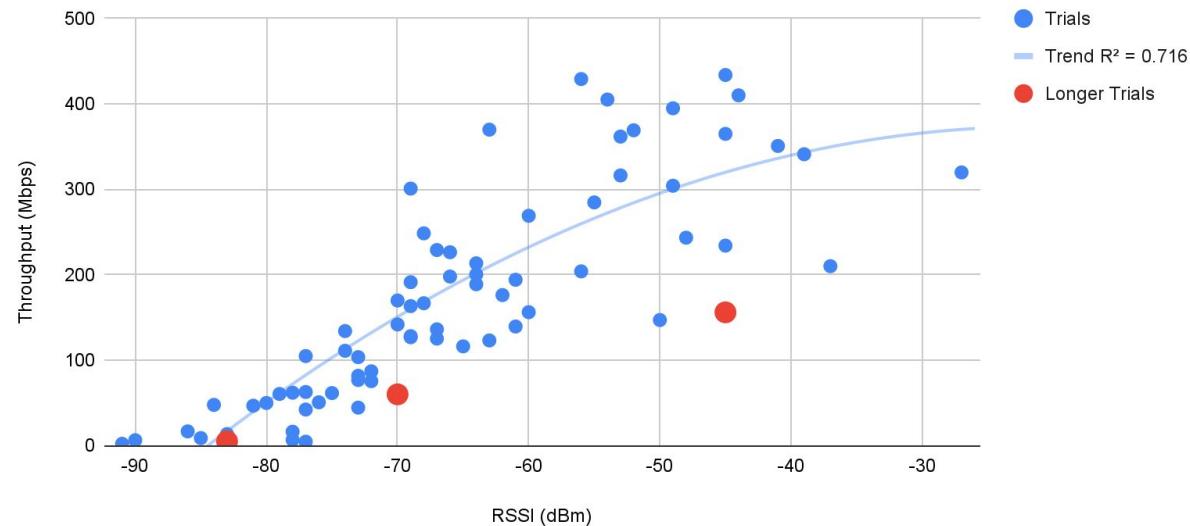
10 runs, interleaved:

1. Regular slowstart
2. SEARCH enabled
3. Hystart enabled

Selected spots: Throughput (Mbps) vs. RSSI

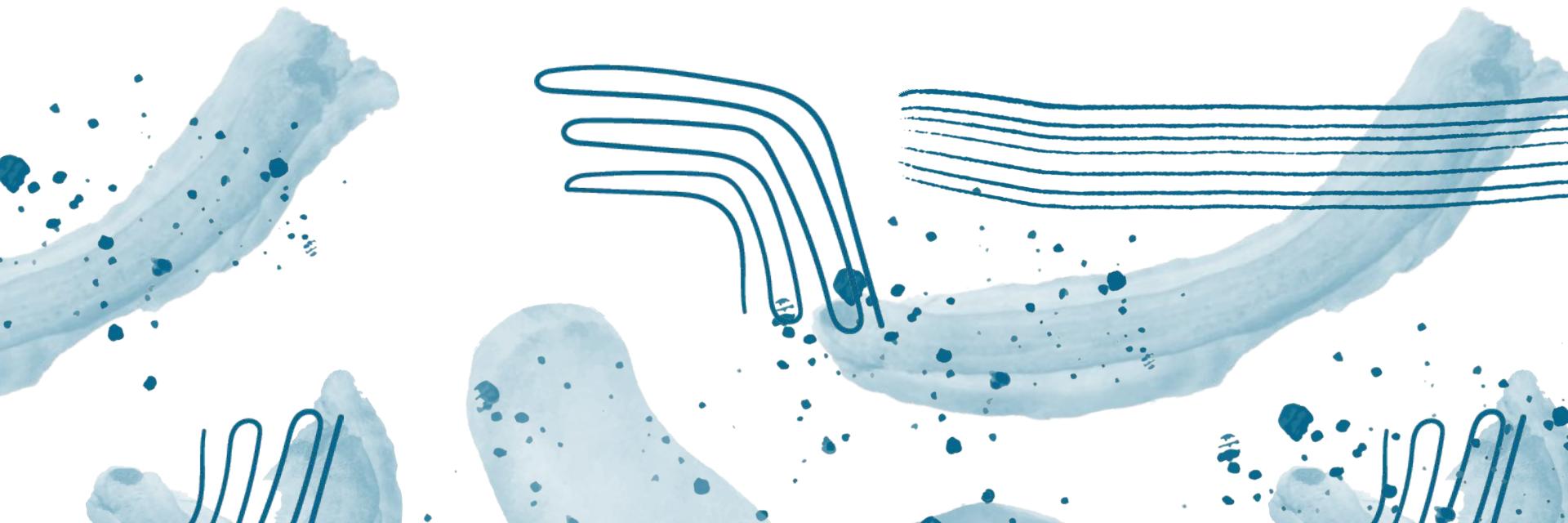
Throughput vs RSSI

Correlating a trend between throughput and RSSI



We tested the points in red

Experiment 1



Experiment 1 Summary



2024-03-01

date

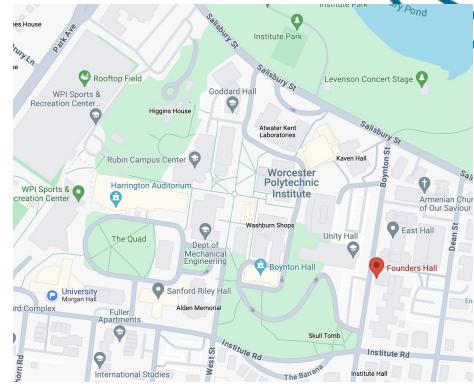


20:09:14

time



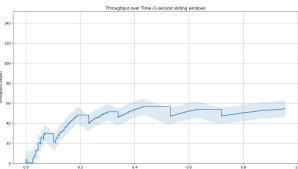
Founders, outside WPI
police department



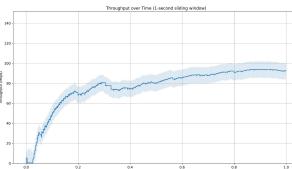
	Avg. Throughput	Std	Avg. RSSI	Std	Avg. Ping	Std
Regular Slow Start	59.92	15.64	-70	2.37	41.34	13.78
Hystart	61.58	22.5	-70.4	2.62	37.47	11.09
SEARCH	60.53	21.29	-69.9	2.62	38.31	12.74

Regular Slow Start

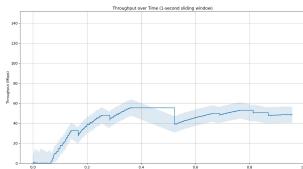
Throughput (Mbps) over time (s)



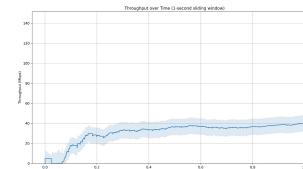
Run 1



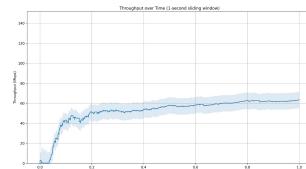
Run 2



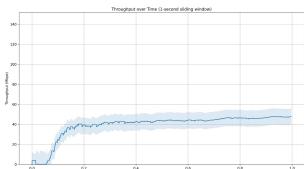
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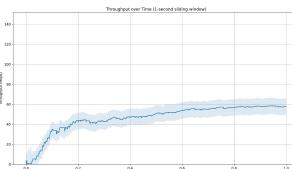
Run 4



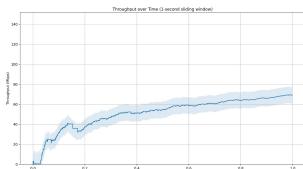
Run 5



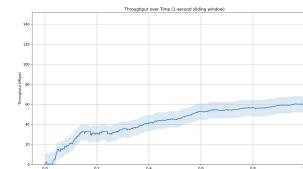
Run 6



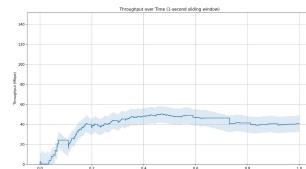
Run 7



Run 8



Run 9



Run 10

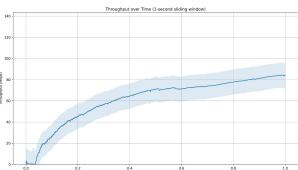
59.92 Mbps
Average Throughput

-70 dBm
Average RSSI

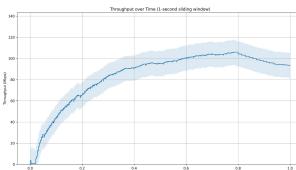
41.34 ms
Average Ping

SEARCH: Experiment 1/5

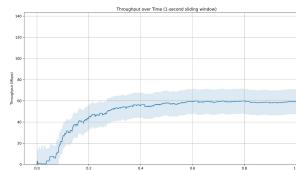
Throughput (Mbps) over time (s)



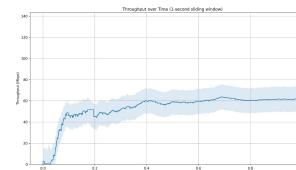
Run 1



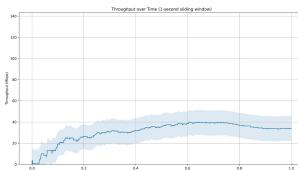
Run 2



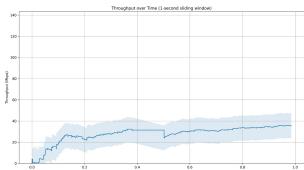
Run 3



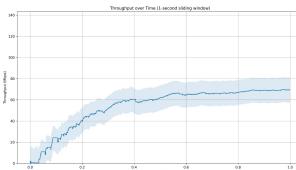
Run 4



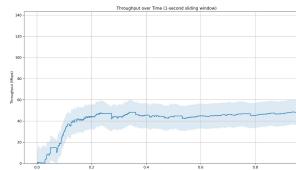
Run 5



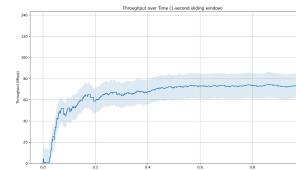
Run 6



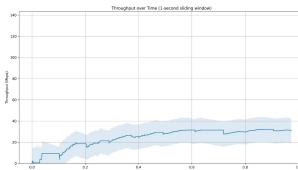
Run 7



Run 8



Run 9



Run 10

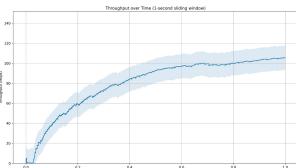
60.53 Mbps
Average Throughput

-69.9 dBm
Average RSSI

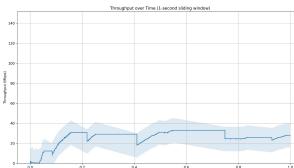
38.31 ms
Average Ping

Hystart: Experiment 1/5

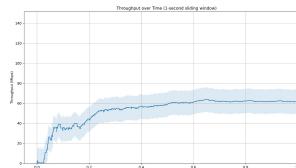
Throughput (Mbps) over time (s)



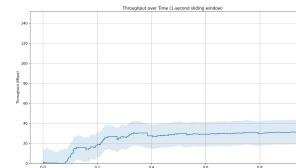
Run 1



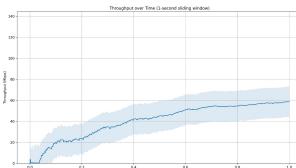
Run 2



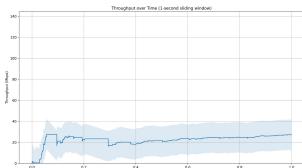
Run 3



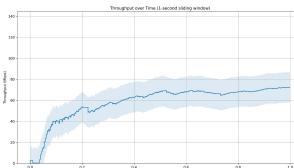
Run 4



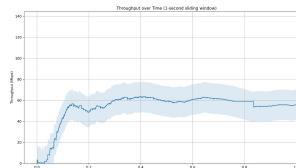
Run 5



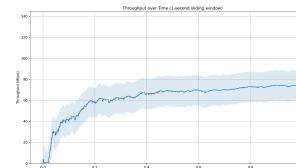
Run 6



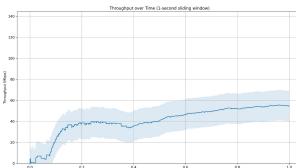
Run 7



Run 8



Run 9



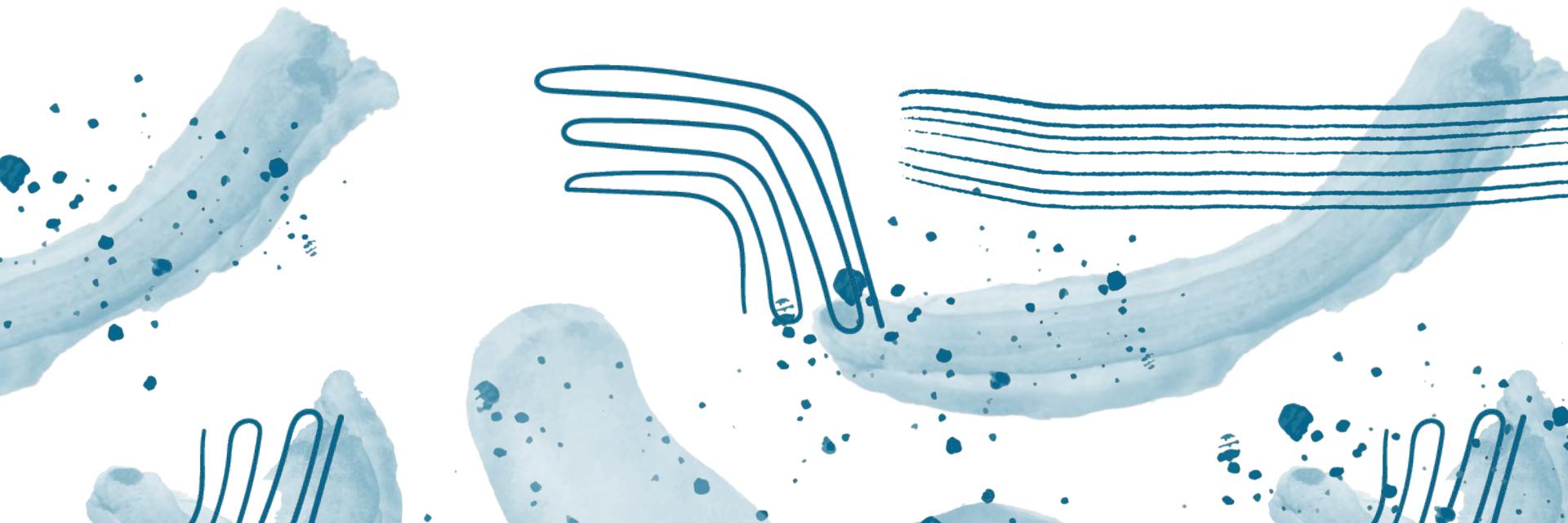
Run 10

61.58 Mbps
Average Throughput

-70.4 dBm
Average RSSI

41.34 ms
Average Ping

Experiment 2



Experiment 2 Summary



2024-03-02

date

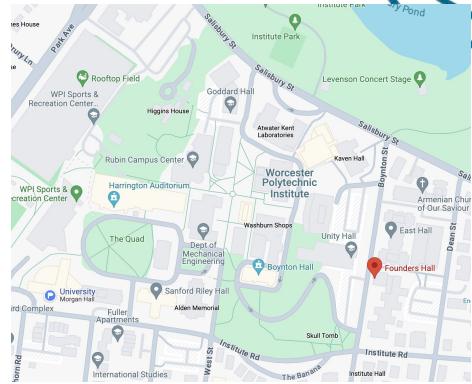


14:18:41

time



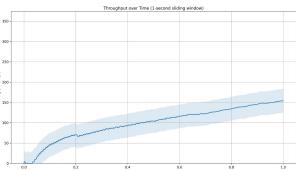
Founders, on floor under
a wireless access point



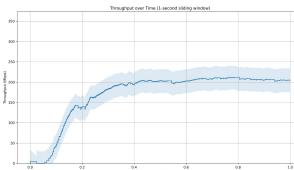
	Avg. Throughput	Std	Avg. RSSI	Std	Avg. Ping	Std
Regular Slow Start	158.44	46.38	-46.2	1.47	22.26	5.24
Hystart	160.99	33.02	-45.6	1.62	25.39	10.53
SEARCH	156.47	15.82	-46.1	1.45	20.95	1.72

Regular Slow Start

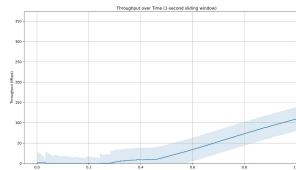
Throughput (Mbps) over time (s)



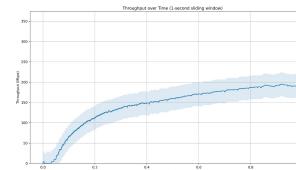
Run 1



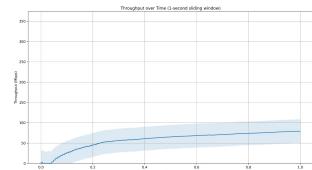
Run 2



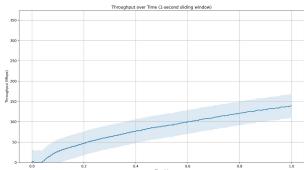
Run 3



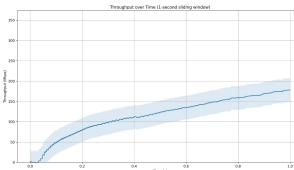
Run 4



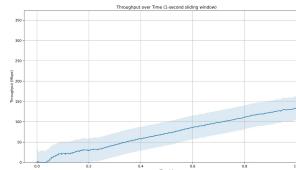
Run 5



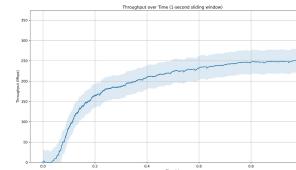
Run 6



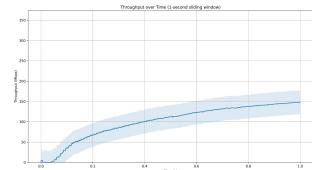
Run 7



Run 8



Run 9



Run 10

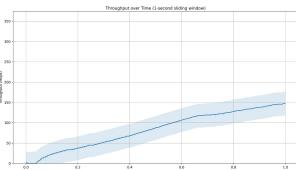
158.44 Mbps
Average Throughput

-46.2 dBm
Average RSSI

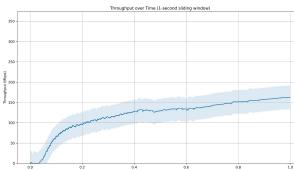
22.26 ms
Average Ping

SEARCH

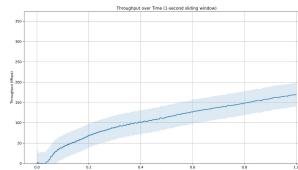
Throughput (Mbps) over time (s)



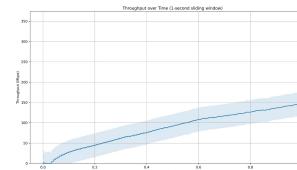
Run 1



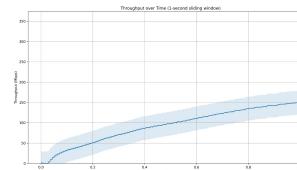
Run 2



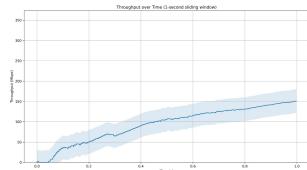
Run 3



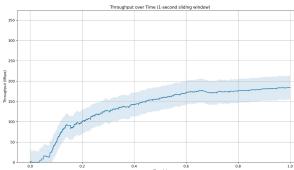
Run 4



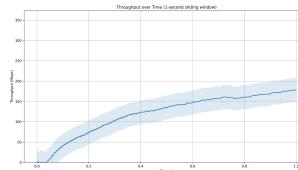
Run 5



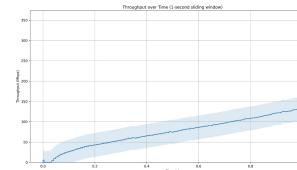
Run 6



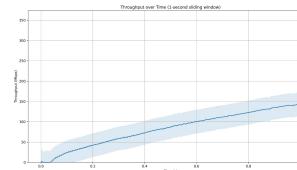
Run 7



Run 8



Run 9



Run 10

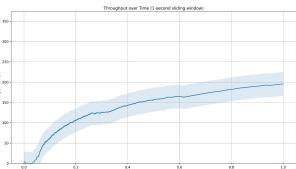
160.9 Mbps
Average Throughput

-45.6 dBm
Average RSSI

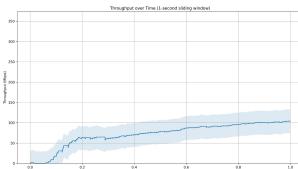
25.39 ms
Average Ping

Hystart

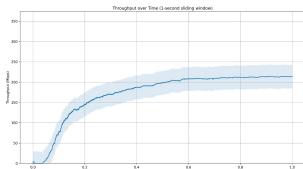
Throughput (Mbps) over time (s)



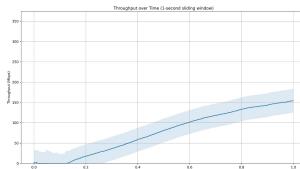
Run 1



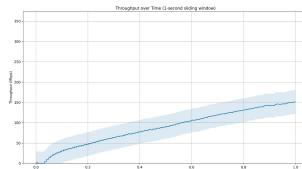
Run 2



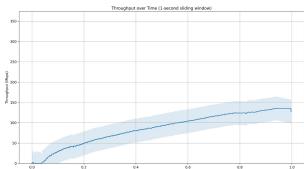
Run 3



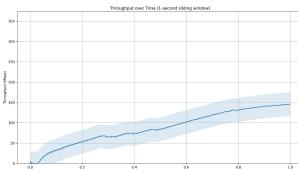
Run 4



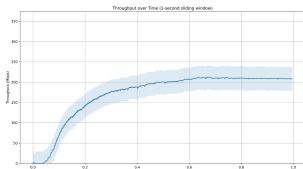
Run 5



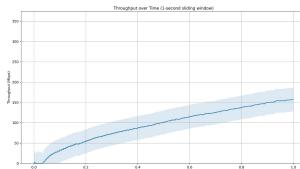
Run 6



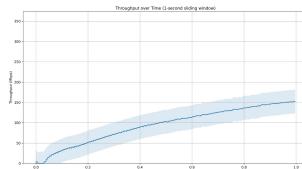
Run 7



Run 8



Run 9



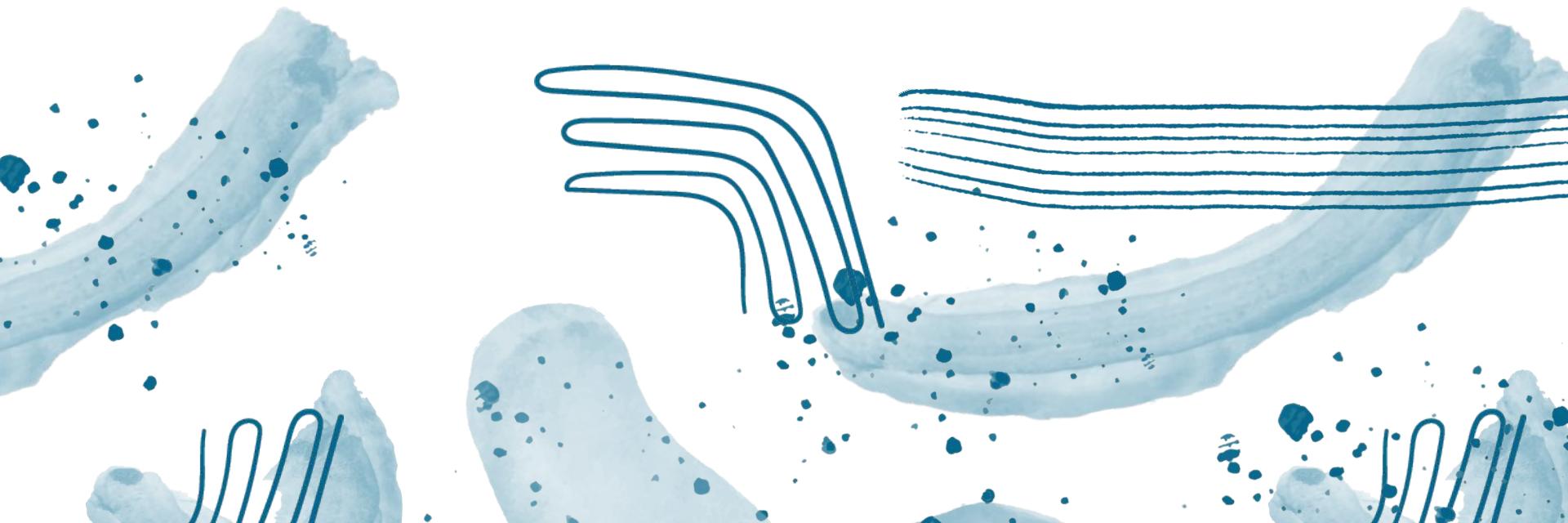
Run 10

156.47 Mbps
Average Throughput

-46.1 dBm
Average RSSI

20.95 ms
Average Ping

Experiment 3



Experiment 3 Summary



2024-03-01

date



20:40:39

time



Outside Armenian Church
of our Savior

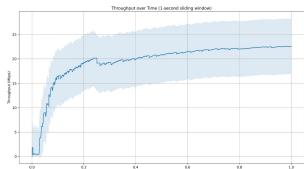


	Avg. Throughput	Std	Avg. RSSI	Std	Avg. Ping	Std
Regular Slow Start	5.39	4.86	-83	2.29	48.54	4.69
Hystart	7.57	5.67	-83.7	2.28	46.46	7.17
SEARCH	6.17	9.11	-83.7	1.9	43.83	6.97

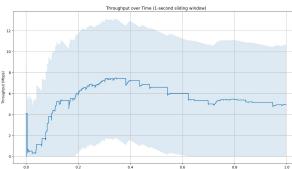
Regular Slow Start

Throughput (Mbps) over time (s)

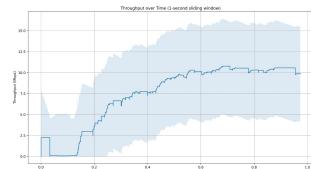
*note: scales vary



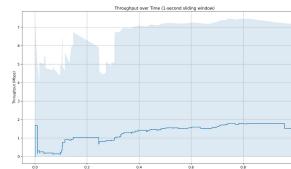
Run 1



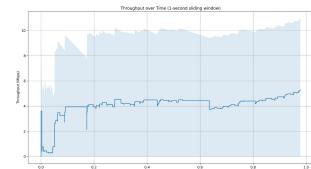
Run 2



Run 3



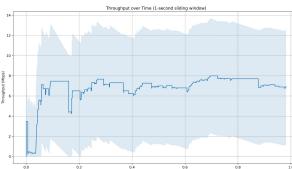
Run 4



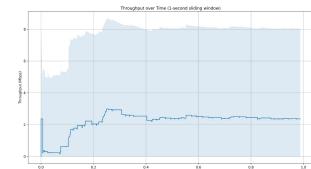
Run 5



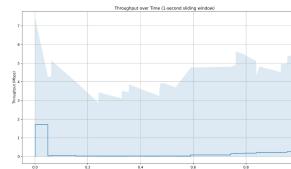
Run 6



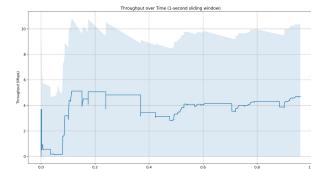
Run 7



Run 8



Run 9



Run 10

5.39 Mbps
Average Throughput

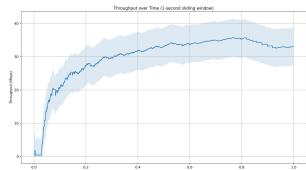
-83 dBm
Average RSSI

48.54 ms
Average Ping

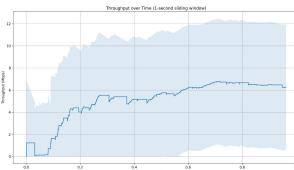
SEARCH

Throughput (Mbps) over time (s)

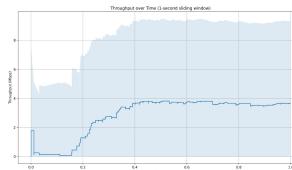
*note: scales vary



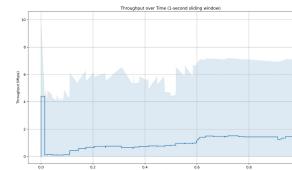
Run 1



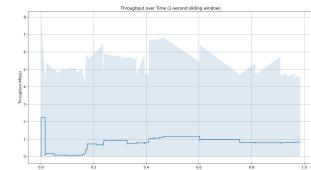
Run 2



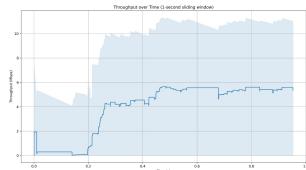
Run 3



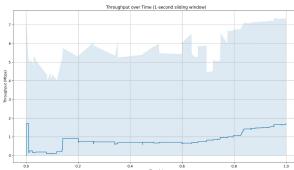
Run 4



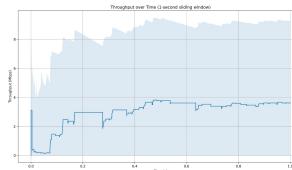
Run 5



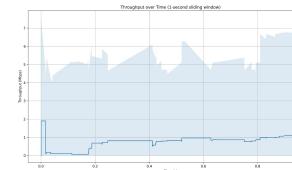
Run 6



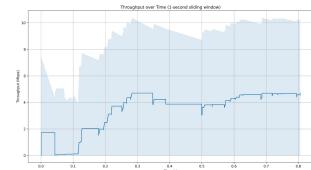
Run 7



Run 8



Run 9



Run 10

7.57 Mbps
Average Throughput

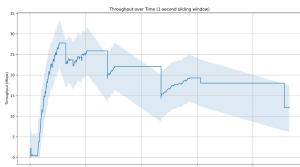
-83.7 dBm
Average RSSI

46.46 ms
Average Ping

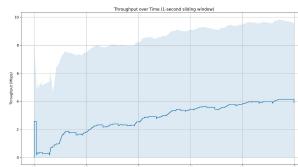
Hystart

Throughput (Mbps) over time (s)

*note: scales vary



Run 1



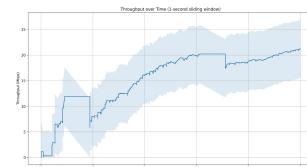
Run 2



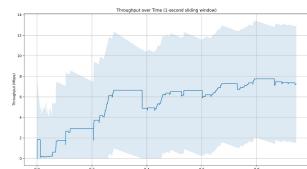
Run 3



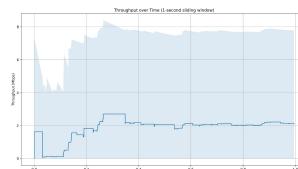
Run 4



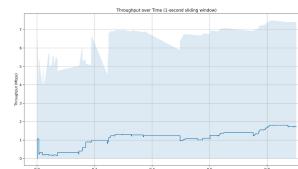
Run 5



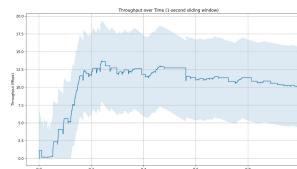
Run 6



Run 7



Run 8



Run 9



Run 10

6.17 Mbps
Average Throughput

-83.7 dBm
Average RSSI

43.83 ms
Average Ping

Summary

Location	RSSI	Hystart On	Slow Start	SEARCH
1. Founders, outside	-70.1	61.58 Mbps	59.92 Mbps	60.53 Mbps
2. Founders, inside	-46.0	160.99 Mbps	158.44 Mbps	156.47 Mbps
3. Church, outside	-83.5	7.57 Mbps	5.39 Mbps	6.17 Mbps