Industry's First 3-Stream 802.11n Competitive Testing

October, 2012

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Starting at the End (Key Findings)

1. Independent testing performed by Syracuse University at Syracuse University (Ruckus did not pay for testing)
2. Ruckus worked with SU on test bed but **not** allowed to influence actual testing
3. Wide variations between vendor claims and actual performance of 3-stream 802.11n APs (surprise, surprise)
4. At distance and as environment becomes difficult (e.g. more clients, interference), AP performance degrades
5. Ruckus doesn't win all tests but delivers overall **best** TCP performance and client capacity

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Test Overview

- **Goal:** Determine real-world 3-stream AP performance via independent testing at Syracuse
- Industry's first competitive testing of three-stream capable 802.11n enterprise APs

Aerohive
330

Aruba
135

Cisco
3602i

Meraki
24

Ruckus
7982

- Three tests performed:
  1. Single AP, single client
  2. Single AP, multiple clients
  3. Multiple APs multiple clients

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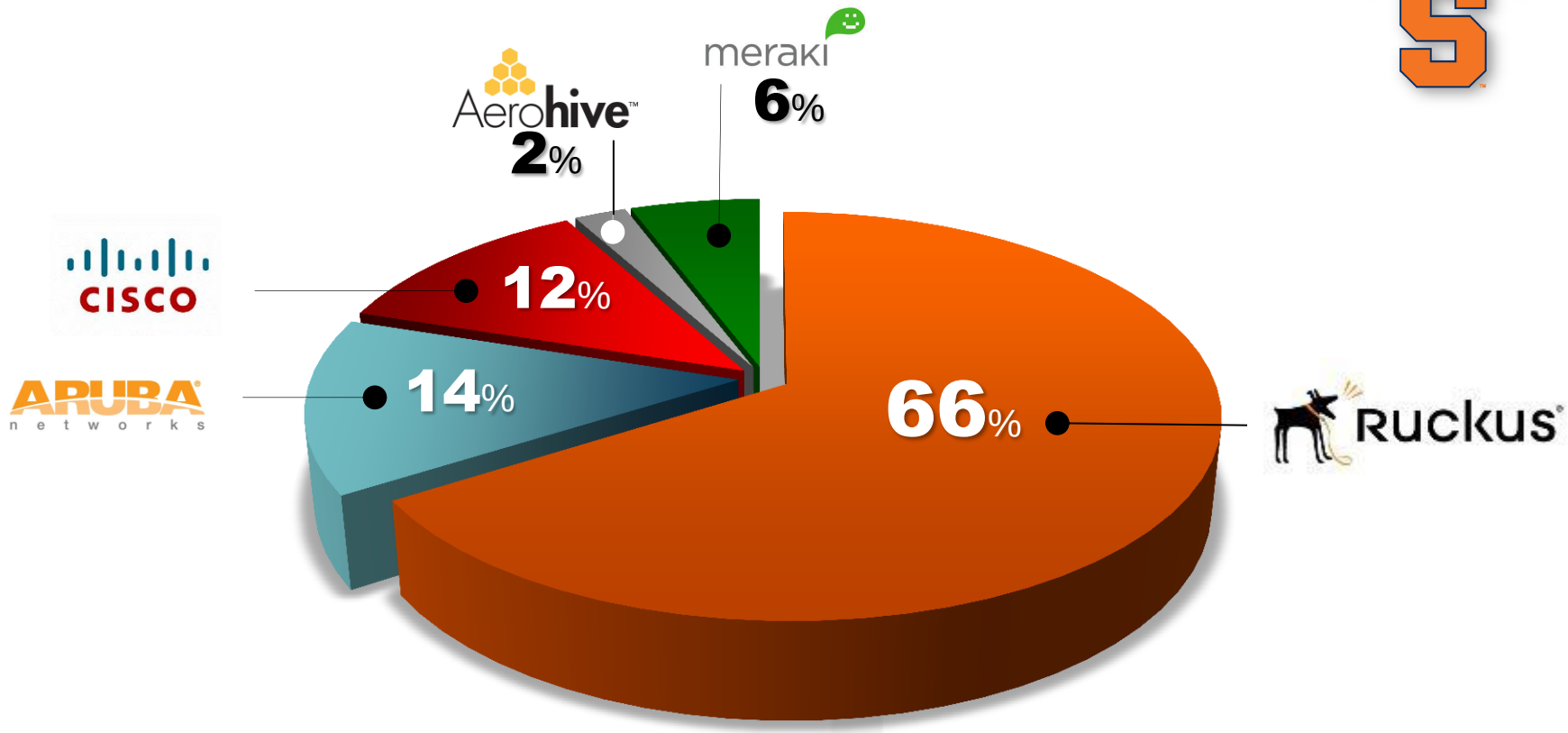
Overall Vendor Performances

Industry's First 3x3:3 802.11n Competitive Testing



Percentage of Vendor Test Wins

(87 tests)

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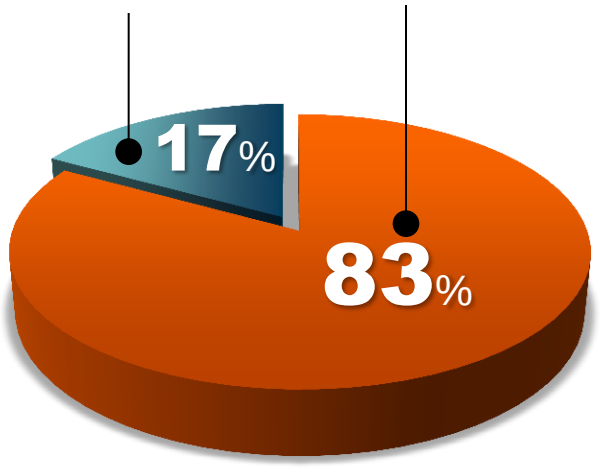
Overall Vendor Performances

Industry's First 3x3:3 802.11n Competitive Testing

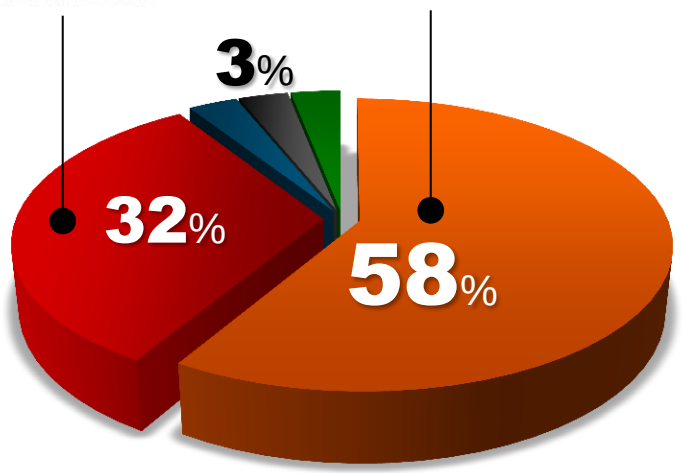


Multi-Client Tests

(12 tests)

0%

Aerohive meraki CISCO



Multi-AP Tests

(30 tests)

3%

Aerohive meraki ARUBA networks

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Test Methodology

What is it?

- Testing in an environment that closely resembles *actual* customer deployment and environment
- Focus on most deployments are capacity-based, not coverage

Why do it?

- One client/one AP does not guarantee a successful, multi-client deployment
- Vendor claims ≠ actual throughput

Goals

- Show real, meaningful, achievable performance

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Cross-Test Constants

- Very clean RF environment
  (tests performed at night)
- 3-stream MacBook Pros and NETGEAR USBs dongles
- IxChariot: Throughput.scr
  - 1MB file transfer for 2 minutes
  - High Performance Throughput script for single AP tests
    - 10MB file transfer for 2 minutes
- 20MHz channel width for 2.4GHz, 40MHz for 5GHz
- AP channel selection
  - Single AP: ch. 1 (2.4 GHz), ch 36 (5 GHz)
  - Multi AP: automated channel selection, then set manually
- “Winner” determined by aggregate TCP throughput

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Hinds Hall

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Wi-Fi Test Overview

1. Single AP, single client per radio at various distances
   - 2.4 GHz, 5 GHz, 2.4 GHz *and* 5 GHz
   - 135 tests for each AP (5 locations, “3” bands, 3 orientation, up/down/bi)
2. Single AP, multiple clients
   - One AP, three rooms, 30 clients/room
   - Rooms are different distances away from AP
   - 2.4 GHz, 5 GHz, 2.4 GHz *and* 5 GHz
3. Multi-AP, multi-client
   - 1 - 4 rooms of 30 clients (120 clients)
   - Channel selection, client load balancing, band steering all enabled
   - Tests with and without an interfering Wi-Fi neighbor network

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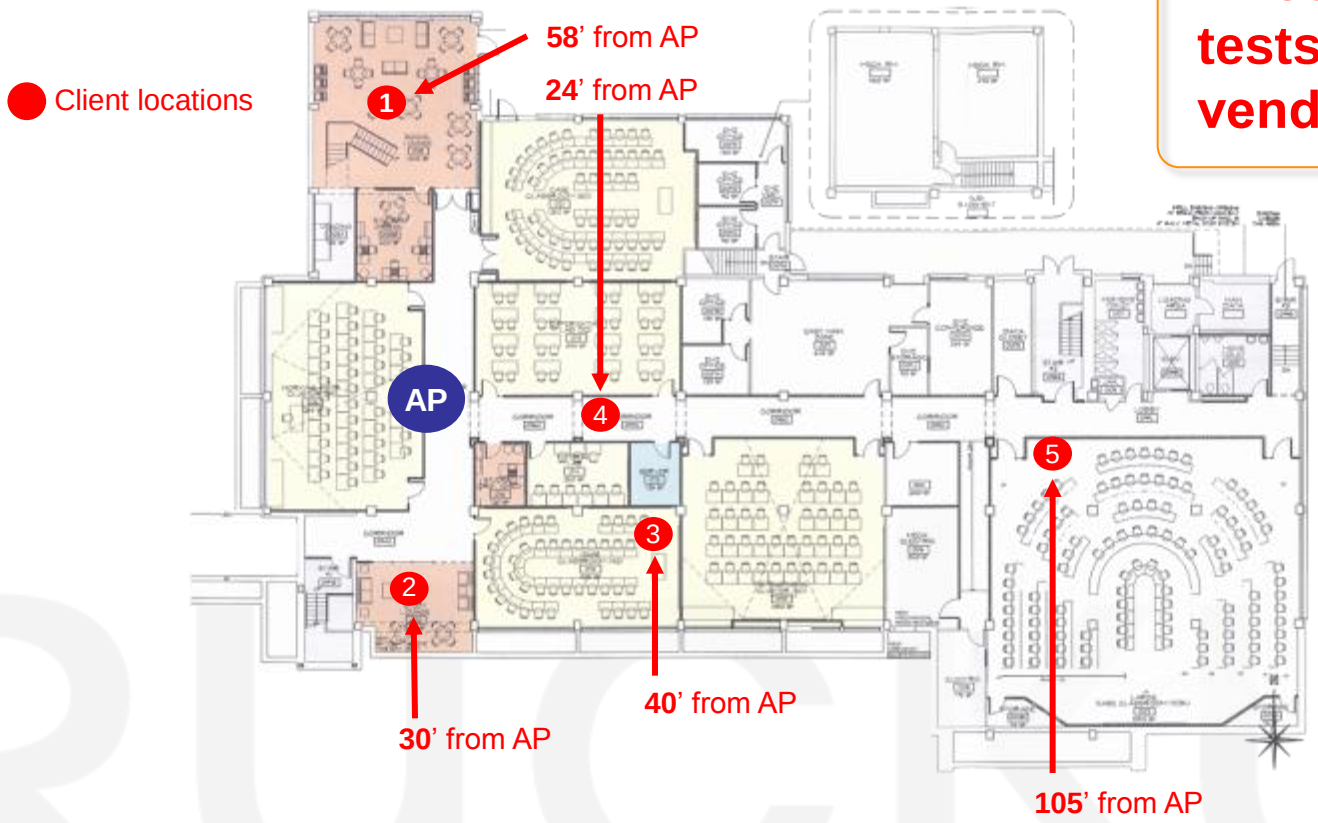
Test 1: Single AP Single Client

- 5 locations of varied distances and difficulties
- 2.4 GHz, 5GHz, simultaneous
- Up/down/bi-directional
- 3 orientations

= 135 (5 * 3 * 3 * 3) **tests for each vendor's AP**

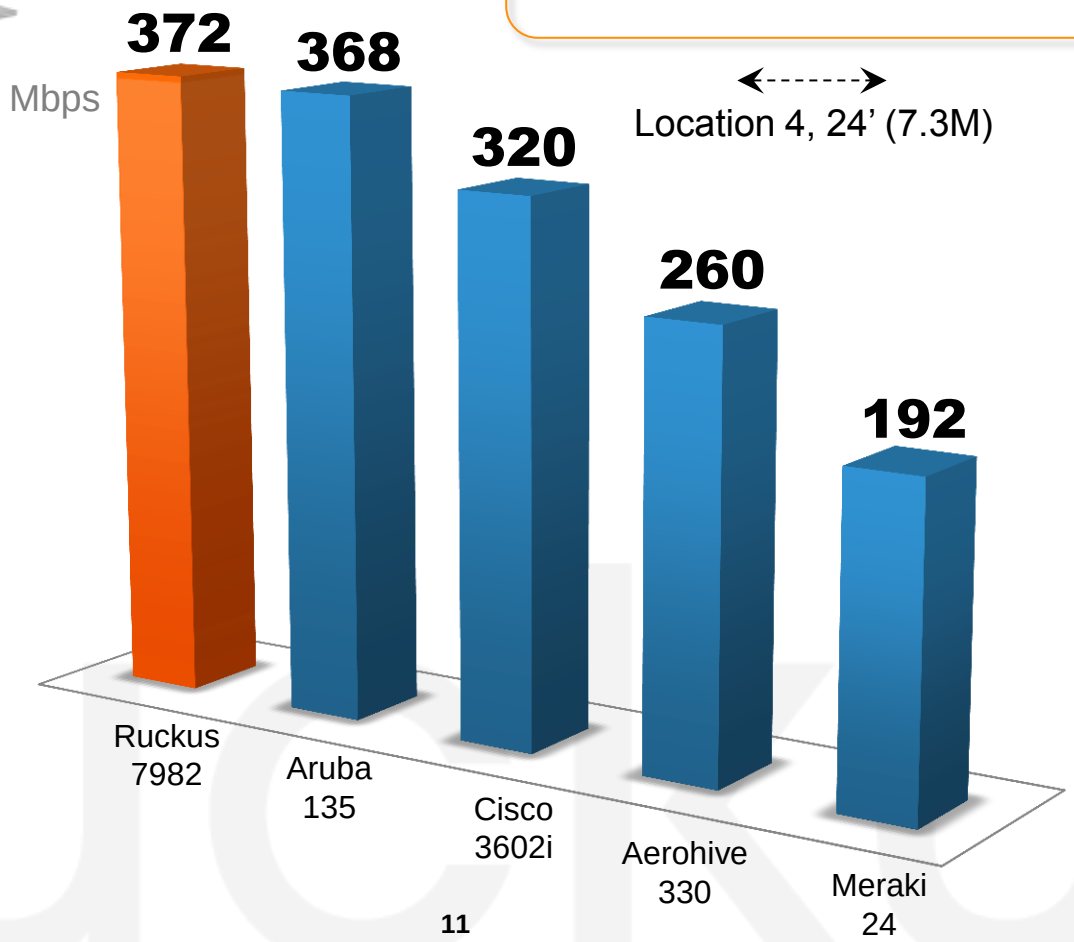


HINDS HALL

Single AP, Single Client Performance

Average of three discrete runs (client rotated each time) with two clients (each transmitting and receiving on different bands)

BI-DIRECTIONAL
TCP THROUGHPUT
FOR DUAL BAND CLIENTS
SHORT DISTANCE



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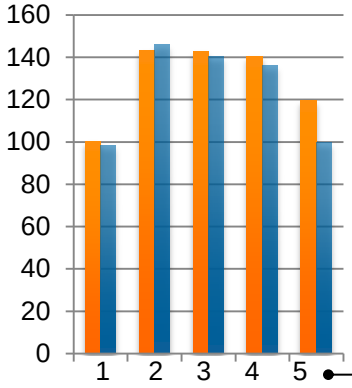
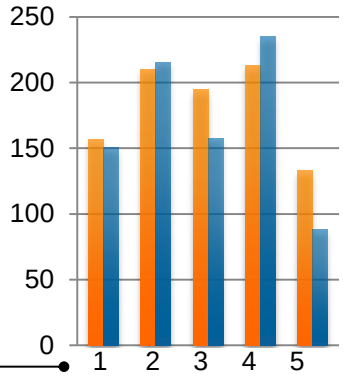
Aruba 135 vs. ZoneFlex 7982

DOWN



2.4GHz

Ruckus
Aruba

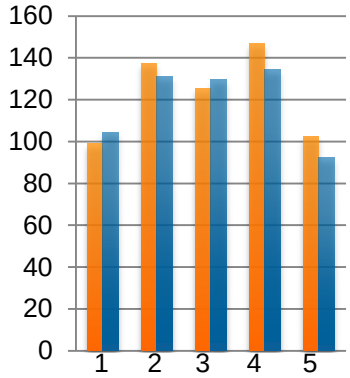


5GHz

Ruckus
Aruba

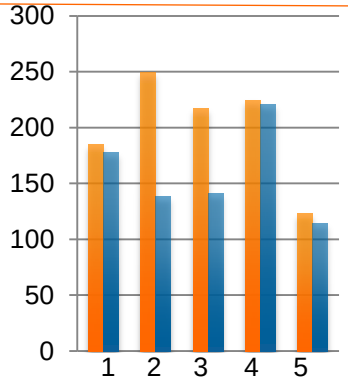
LOCATIONS

UP



2.4GHz

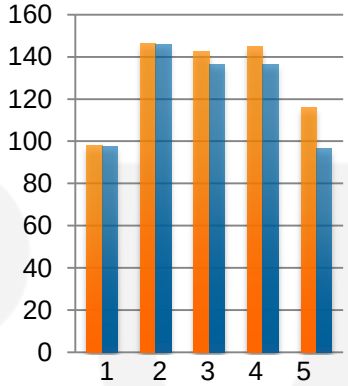
Ruckus
Aruba



5GHz

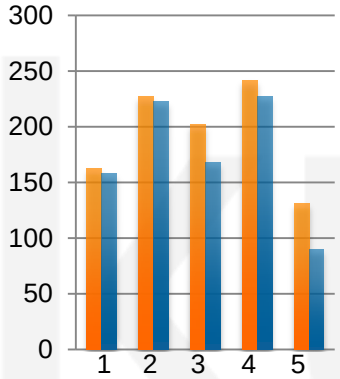
Ruckus
Aruba

Both



2.4GHz

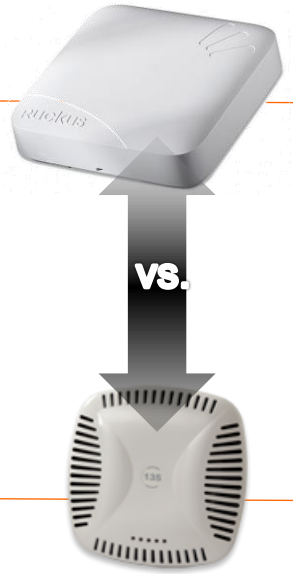
Ruckus
Aruba



5GHz

Ruckus
Aruba

SYRACUSE



ARUBA networks

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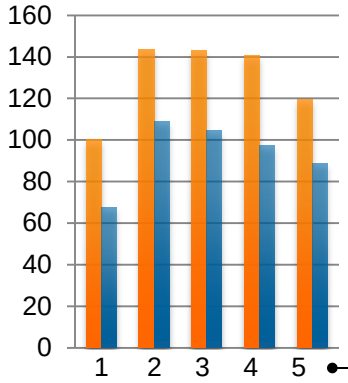
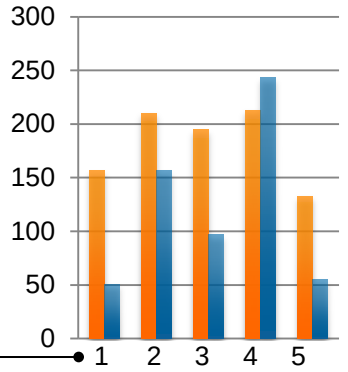
Cisco 3602i vs. ZoneFlex 7982

DOWN



2.4GHz

Ruckus
Cisco

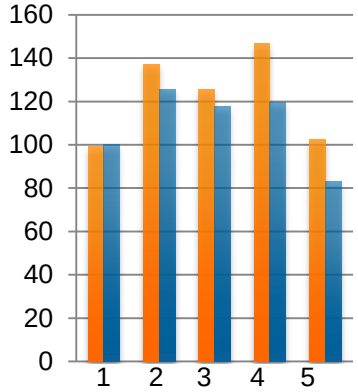


5GHz

Ruckus
Cisco

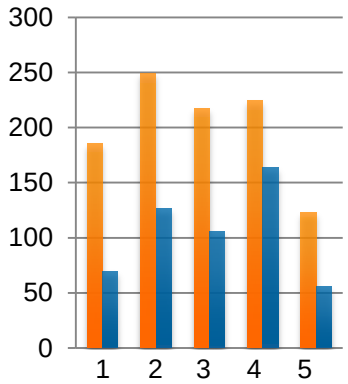
LOCATIONS

UP



2.4GHz

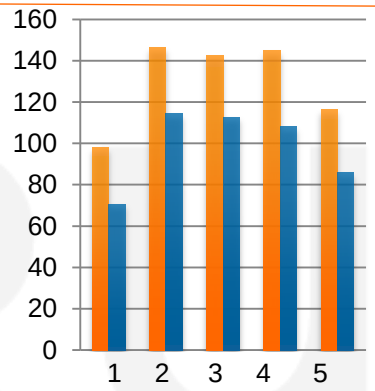
Ruckus
Cisco



5GHz

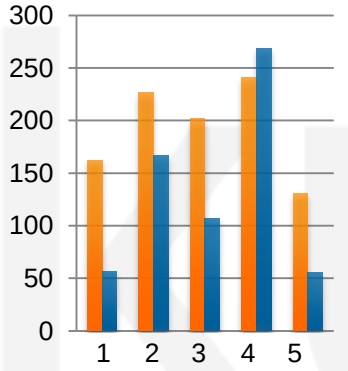
Ruckus
Cisco

Both



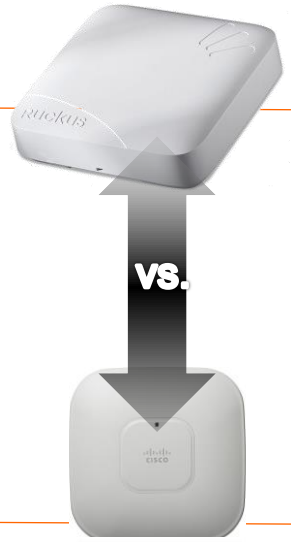
2.4GHz

Ruckus
Cisco



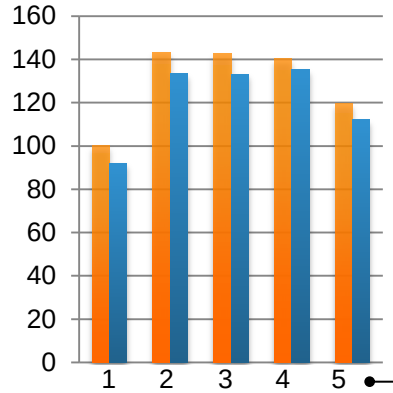
5GHz

Ruckus
Cisco



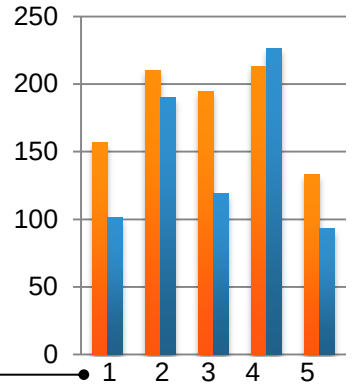
Aerohive 330 vs. ZoneFlex 7982

DOWN



2.4GHz

Ruckus
Aerohive

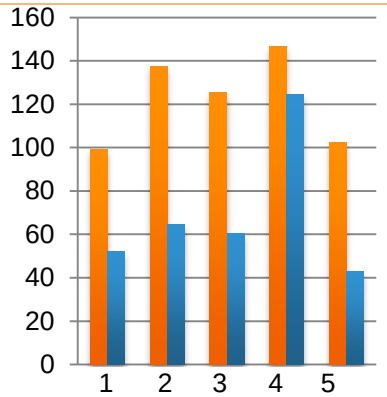


5GHz

Ruckus
Aerohive

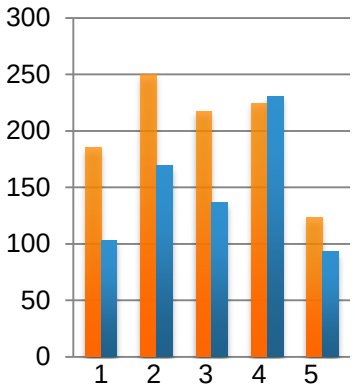
LOCATIONS

UP



2.4GHz

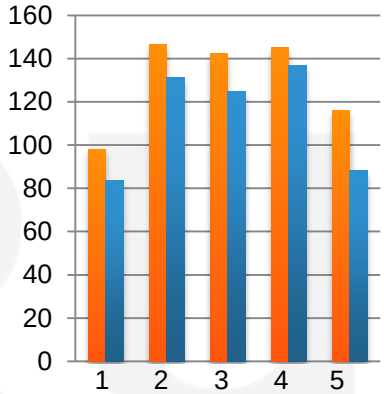
Ruckus
Aerohive



5GHz

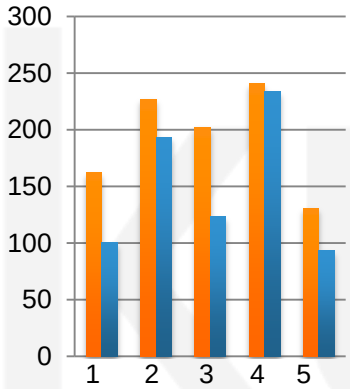
Ruckus
Aerohive

Both



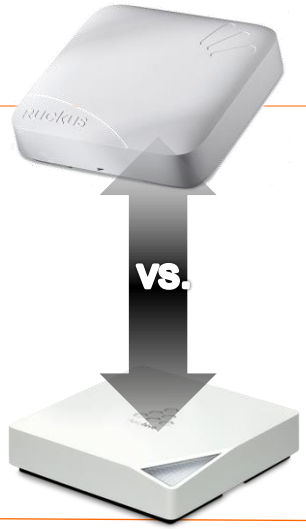
2.4GHz

Ruckus
Aerohive



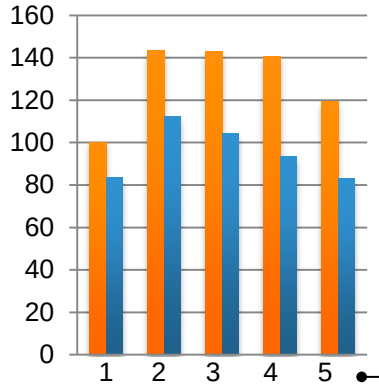
5GHz

Ruckus
Aerohive



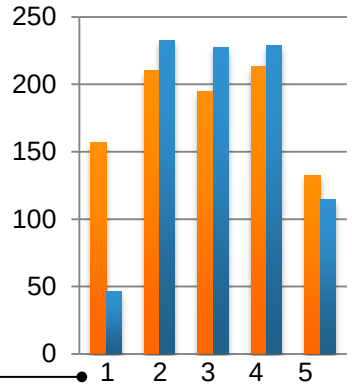
Meraki 24 vs. ZoneFlex 7982

DOWN



2.4GHz

Ruckus
Meraki

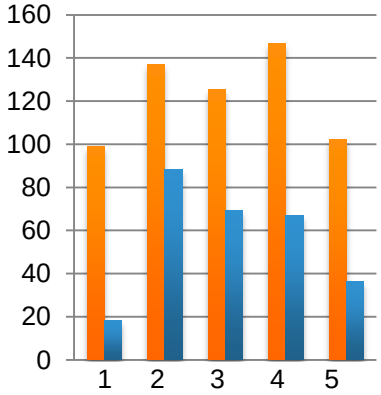


5GHz

Ruckus
Meraki

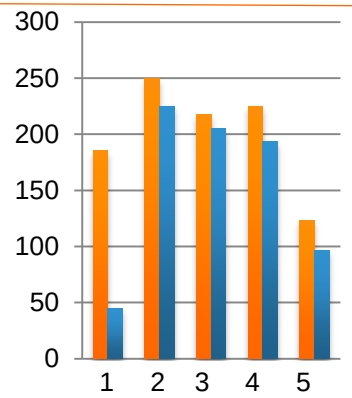
L O C A T I O N S

UP



2.4GHz

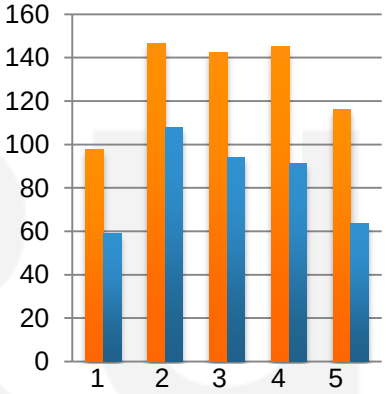
Ruckus
Meraki



5GHz

Ruckus
Meraki

Both



2.4GHz

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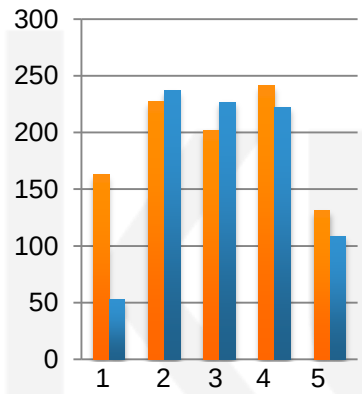
Meraki



5GHz

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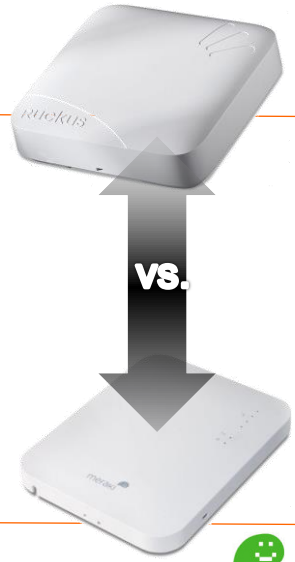
Meraki

SYRACUSE



meraki

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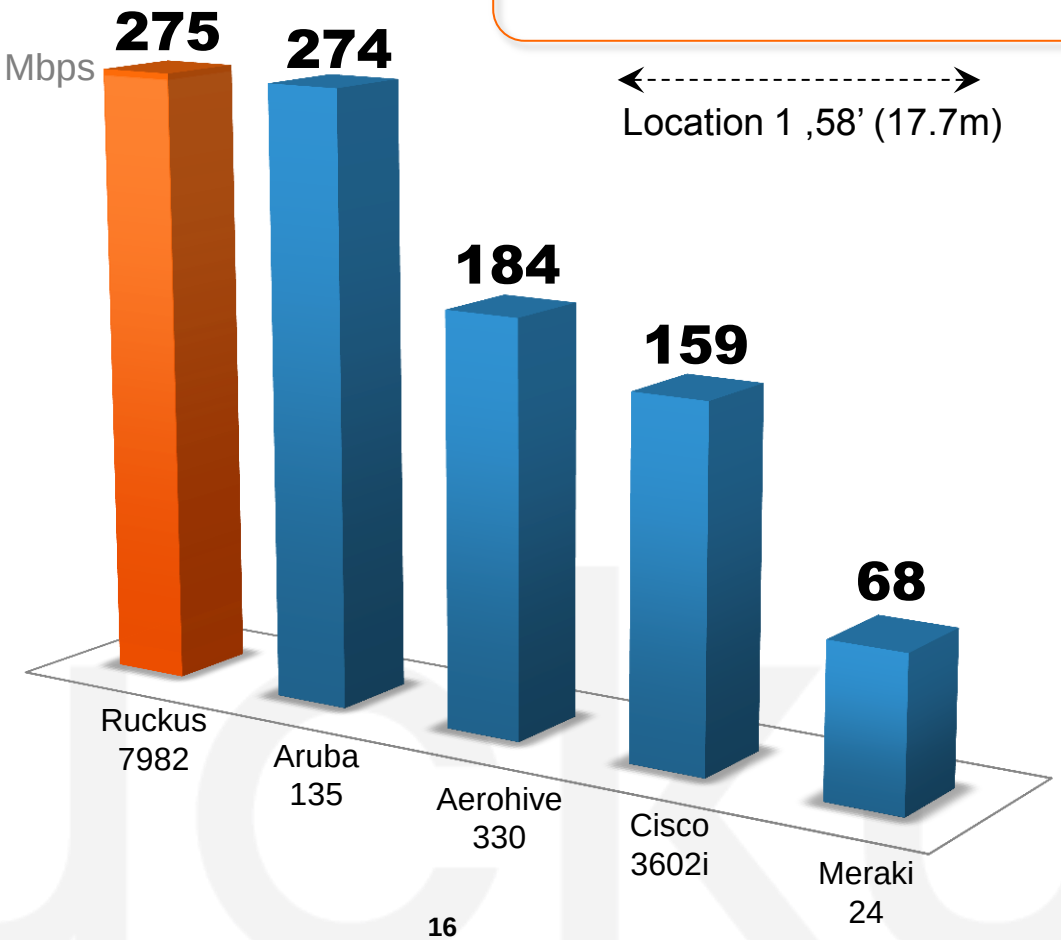
Single AP, Single Client Performance

BI-DIRECTIONAL
TCP THROUGHPUT
FOR DUAL BAND CLIENTS
MEDIUM DISTANCE

Location 1 ,58' (17.7m)



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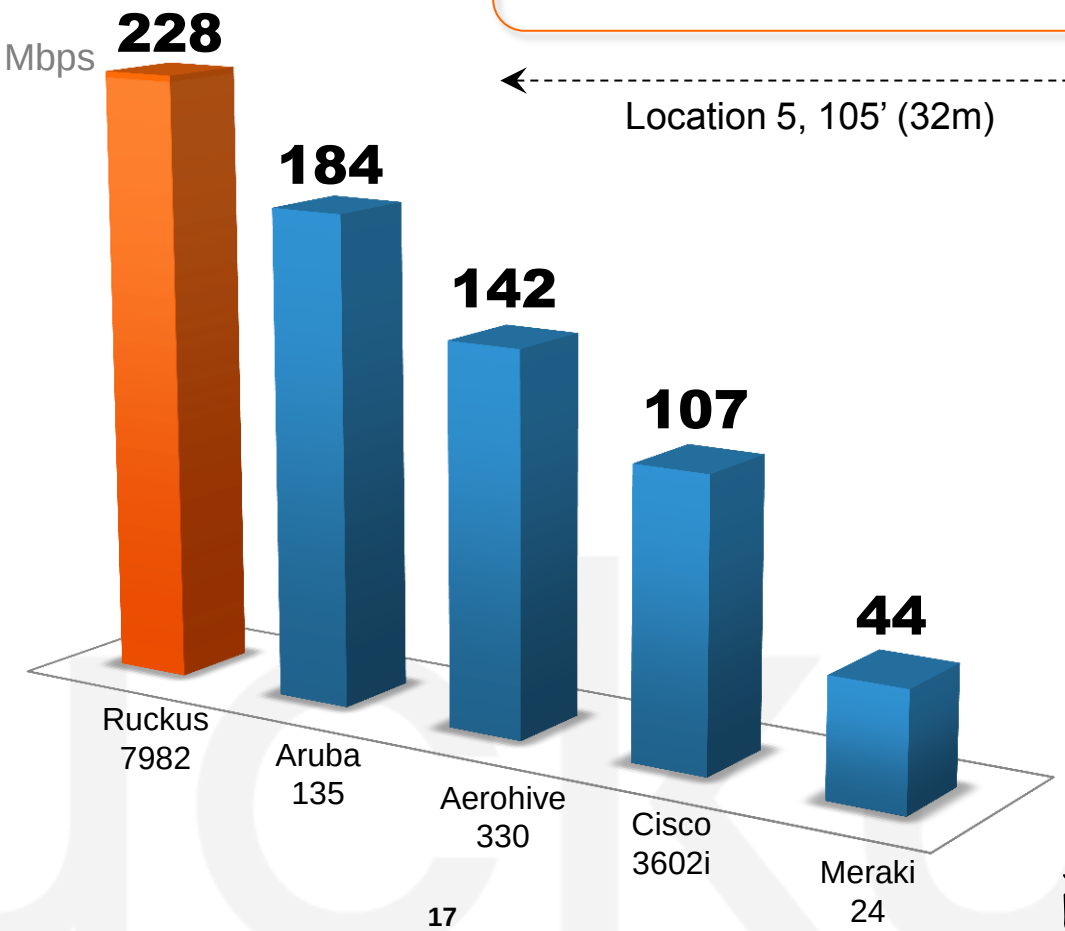
Single AP, Single Client Performance

BI-DIRECTIONAL
TCP THROUGHPUT
FOR DUAL BAND CLIENTS
LONG DISTANCE

Location 5, 105' (32m)



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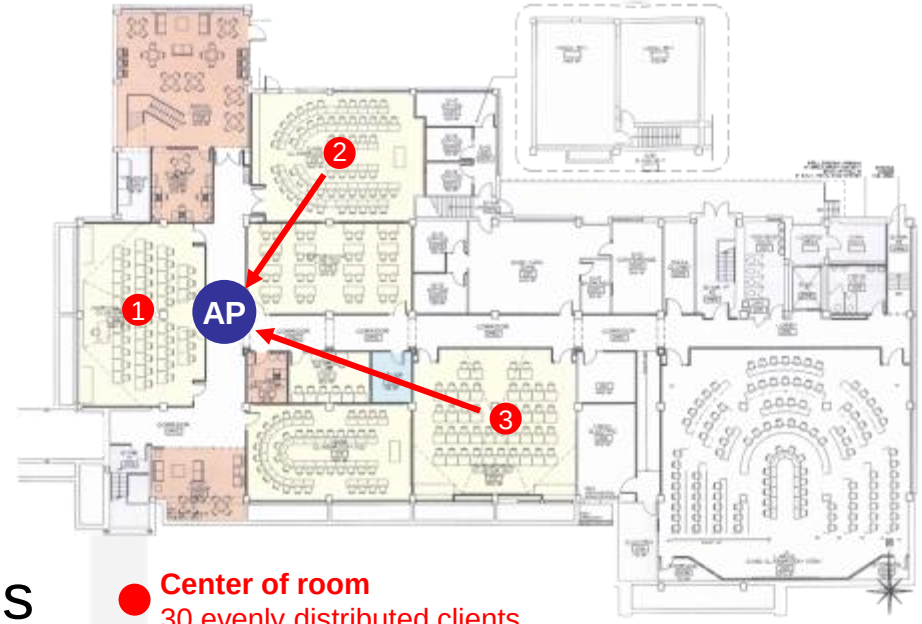
Test 2: Single AP, Multi-Client

- One AP, three rooms, 30 clients/room
- Mixed bands (⅓ on 2.4 GHz | ⅔ on 5 GHz) + bi-directionality
- All clients associated, even if not being tested

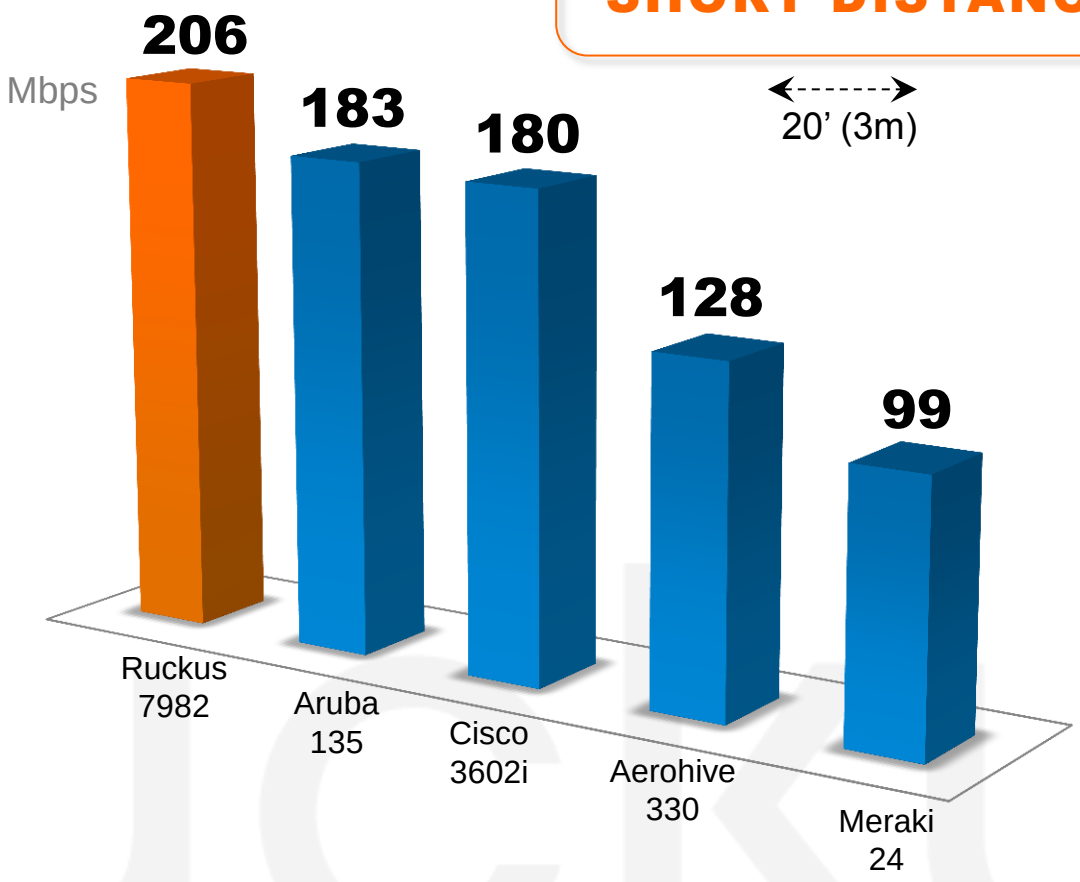
1. Room 1: 20’ from AP
   - 30 PCs with dongles
2. Room 2: 45’ from AP
   - 30 MacBook Pros
3. Room 3: 55’ from AP
   - 30 PCs with dongles
4. All rooms, 90 clients across all 3 rooms simultaneously



Center of room
30 evenly distributed clients

Single AP, Multi-Client, Room 1

BI-DIRECTIONAL
TCP THROUGHPUT
1 AP, 1 ROOM, 30 CLIENTS
SHORT DISTANCE



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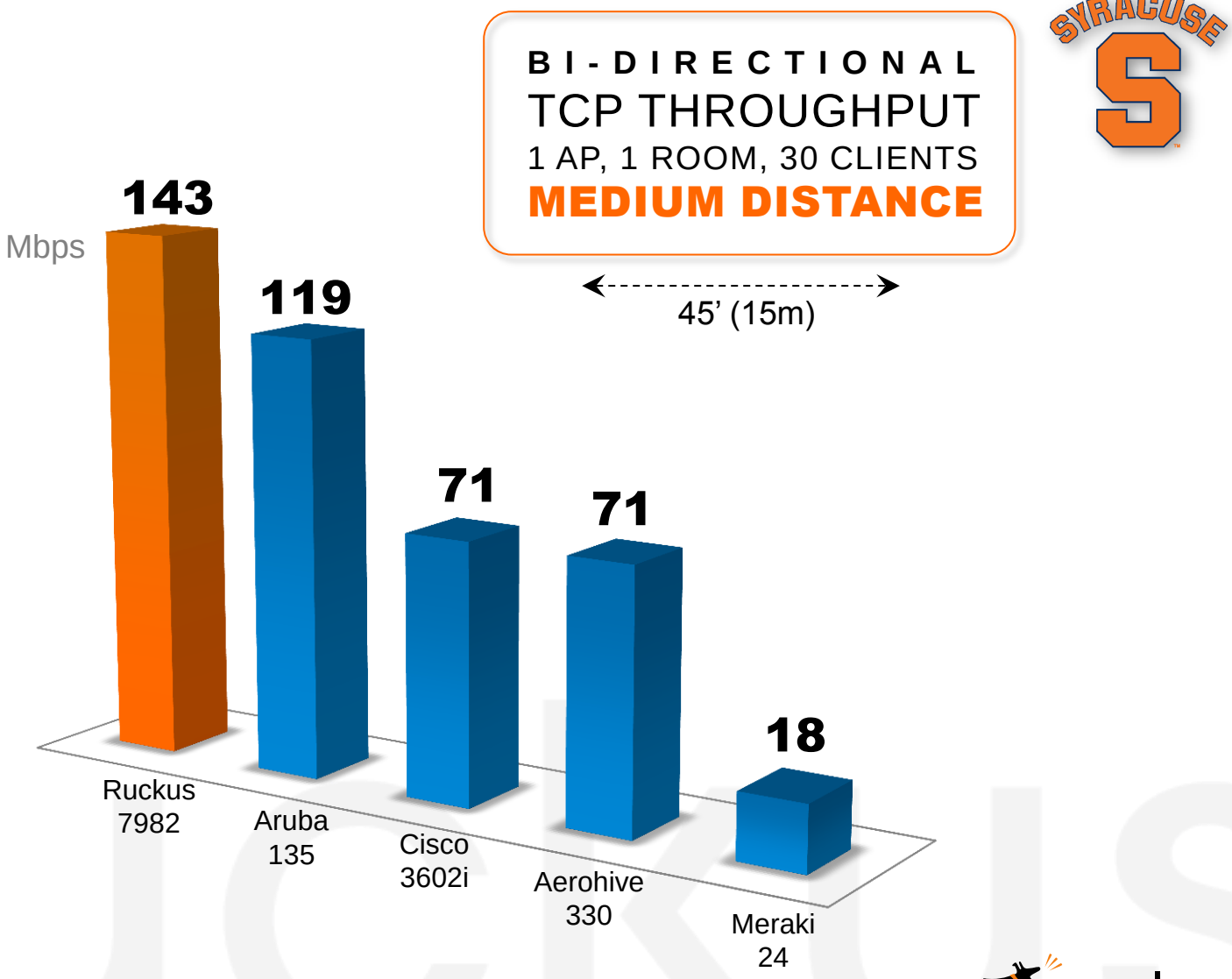
Single AP, Multi-Client, Room 2



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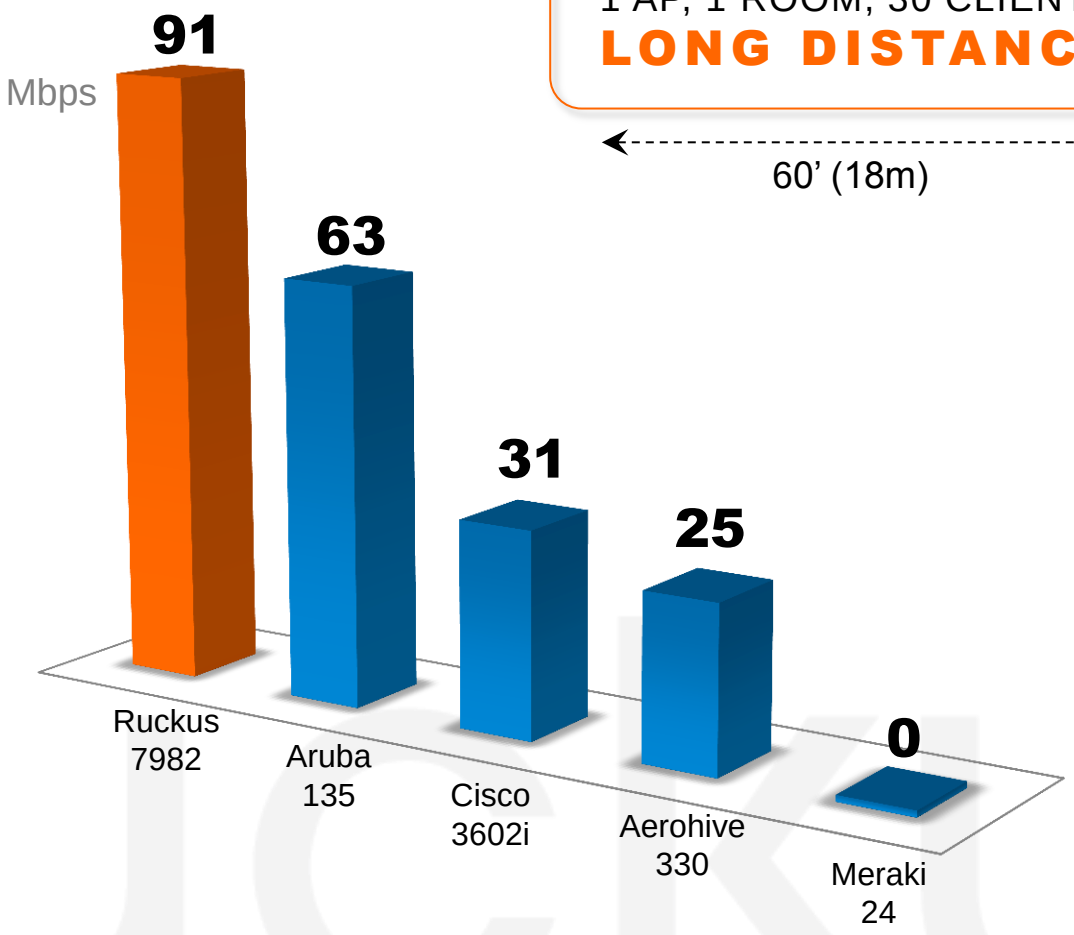
Single AP, Multi-Client, Room 3

BI-DIRECTIONAL
TCP THROUGHPUT
1 AP, 1 ROOM, 30 CLIENTS
LONG DISTANCE

60' (18m)



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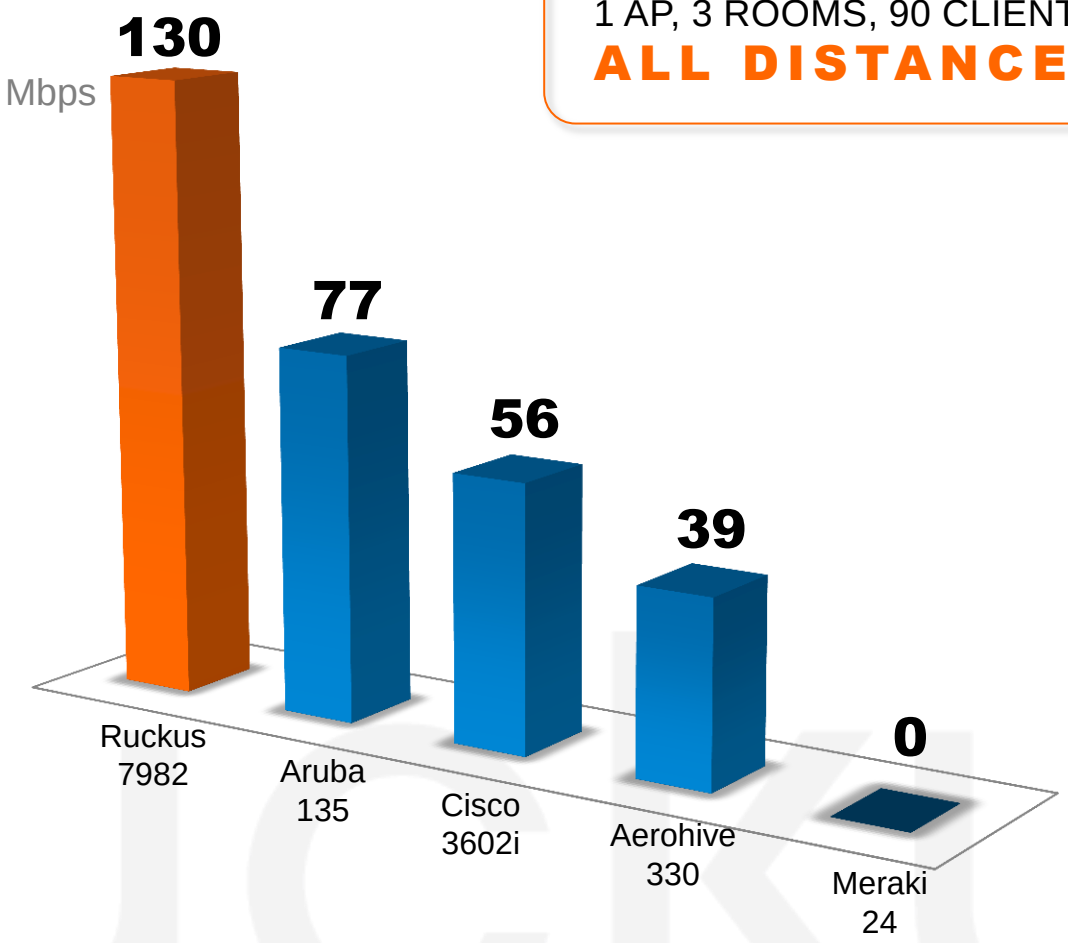
High Density TCP Performance

BI-DIRECTIONAL
TCP THROUGHPUT
1 AP, 3 ROOMS, 90 CLIENTS
ALL DISTANCES



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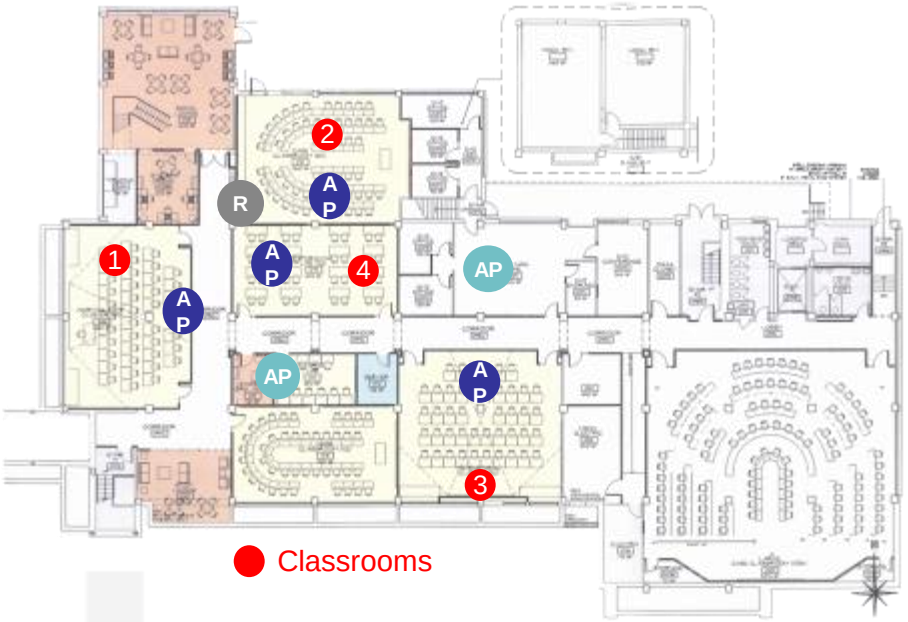
Test 3: Multiple APs, Multiple Clients

- 6 APs, 4 rooms
- Each classrooms has an AP, 30 clients (120 clients total)
  - Clients: ⅓ on 2.4 GHz, ⅔ on 5 GHz
- 2 other APs in nearby rooms
  - Features turned on:
    - Auto channel selection
    - Client load balancing
    - Airtime fairness

1. Room 1: 30 PCs w/ Netgear dongles
2. Room 2: 24 MacBooks, 6 Dell laptops
3. Room 3: 30 PCs w/ Netgear dongles
4. Room 4: 30 PCs w/ Linksys dongles



- Test with and without nearby rogue Wi-Fi network (interferer)
  - Two PCs running iPerf for the duration of the testing

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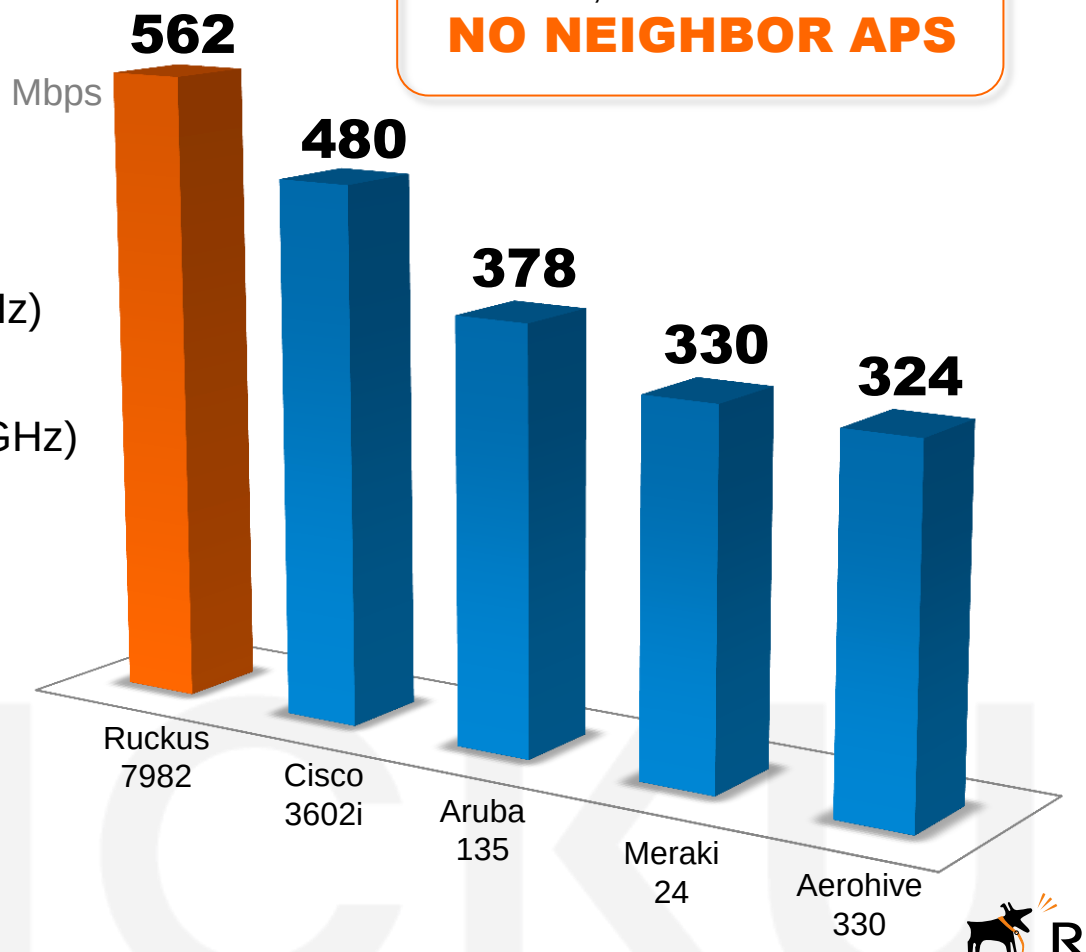
Multiple APs, Multiple Clients

BI-DIRECTIONAL
TCP THROUGHPUT
6 APs, 120 CLIENTS
NO NEIGHBOR APS

24 clients uploading
(8 on 2.4 and 16 on 5GHz)

96 clients downloading
(32 on 2.4 and 64 on 5 GHz)



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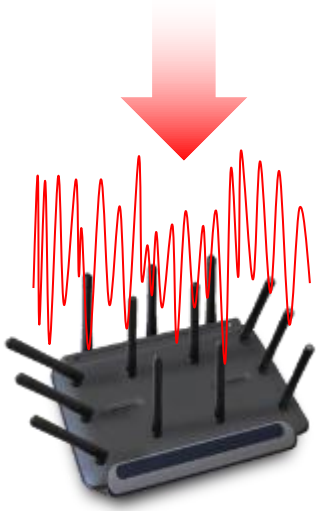
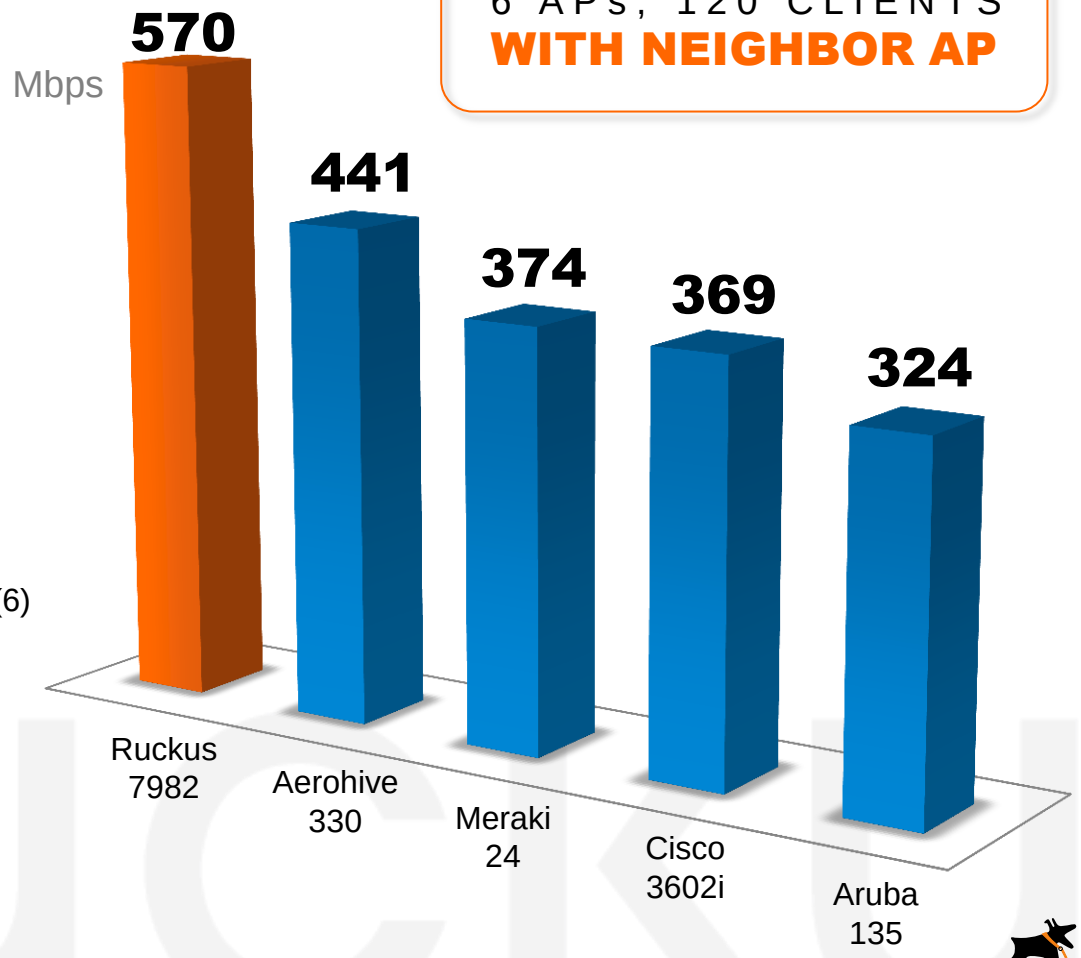
Multiple APs, Multiple Clients



ROGUE AP

Dual-band AP with two 2.4GHz laptops associated client transmitting data back and forth broadcasting on same channel (6) and 5 GHz radio broadcasting with no clients

BI-DIRECTIONAL
TCP THROUGHPUT
6 APs, 120 CLIENTS
WITH NEIGHBOR AP



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Summary

- Three-stream 802.11n won't deliver what vendors promise
- Rigorous testing methodology is essential
  - Single AP----client testing doesn't give full picture
  - Multi-AP-----multi client tests reflect more real world
  - Hundreds of tests required to determine the truth
  - Designing repeatable tests is essential
  - Ensuring all SSIDs are the same across vendors
  - Getting PC clients associated
- (Dis)advantages of cloud controller
- The ZF 7982 is a fancy piece of kit
  - Consistently *very* consistent and high performing

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The Syracuse Test Team

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