

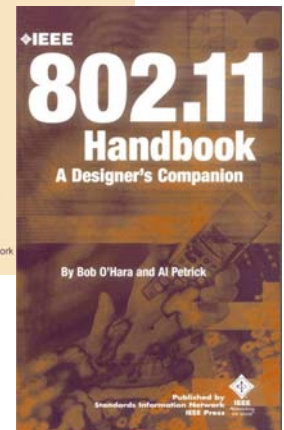
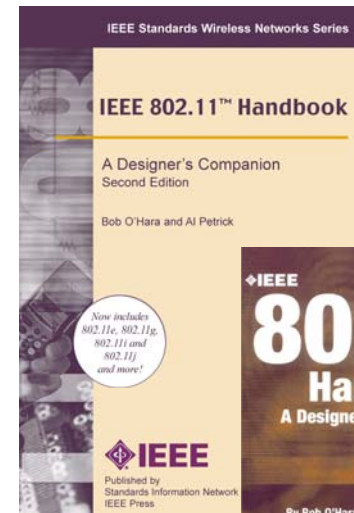
2008 WLAN Bake-Off

Testing Takeaways

- The Ruckus ZoneFlex **continually demonstrated significantly higher TCP throughput** at the farthest and most challenging locations
- In single 802.11g client testing with interference, Ruckus ZoneFlex performed **2.5x faster than the competitive average**
- At the farthest distance, the Ruckus ZoneFlex delivered 15.66 Mbps of aggregate **TCP throughput to 20 clients, nearly 3x more than the nearest competitor**
- In single 802.11g client testing, the Ruckus ZoneFlex exhibited **the highest average TCP downstream throughput** over all competitive products
- In voice over Wi-Fi tests, the Ruckus ZoneFlex demonstrated the **highest quality MOS (4.33) and R-Value (90.47) scores** across all locations over all competitive systems

The Tester

- Jones-Petrick and Associates is a well-respected wireless testing and consulting company in Orlando, Florida
- Al Petrick is a renowned wireless veteran with some 25 years of experience
 - Co-author of patents on 802.11 WLAN technology
 - Vice-Chairman of the IEEE 802.11 working group
 - Co-author of the “IEEE 802.11 Handbook, A Designer’s Companion”



The Testing

- **Objective(s)**

To determine the real-world Wi-Fi performance (relative to range) of the Ruckus ZoneFlex system versus the top 5 enterprise wireless LAN systems within a typical office environment for four test configurations

- **Test configurations**

- **TEST ONE**

TCP downstream throughput for a single client at varying distances

- **TEST TWO**

TCP downstream throughput for a single client with interference

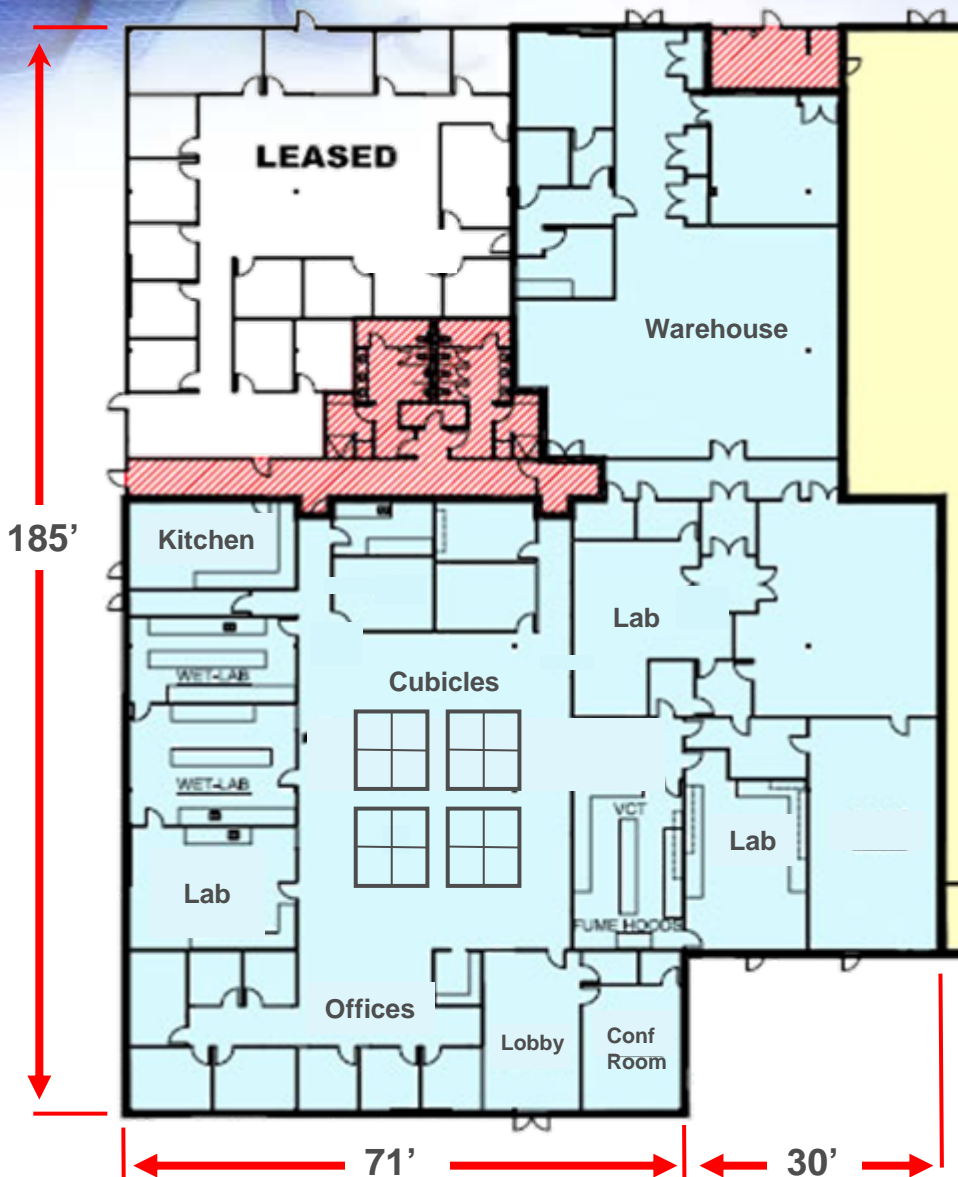
- **TEST THREE**

Aggregate TCP downstream throughput for multiple clients (20) at varying distances

- **TEST FOUR**

Mixed VoIP and data throughput

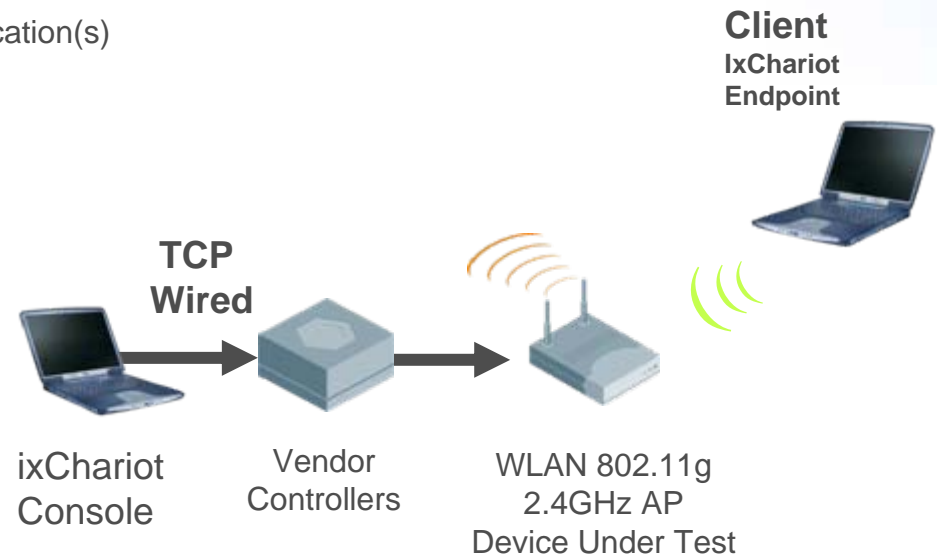
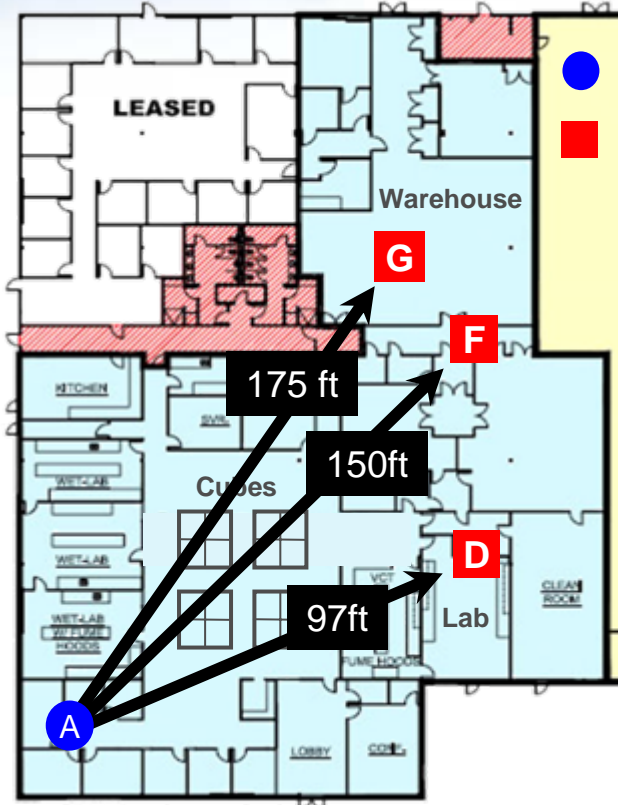
The Test Environment



- Conventional office space
- No external Wi-Fi networks
- Fremont, California
- 18,726 square feet
- Metal, steel and glass walls

WLAN Performance for Single Client

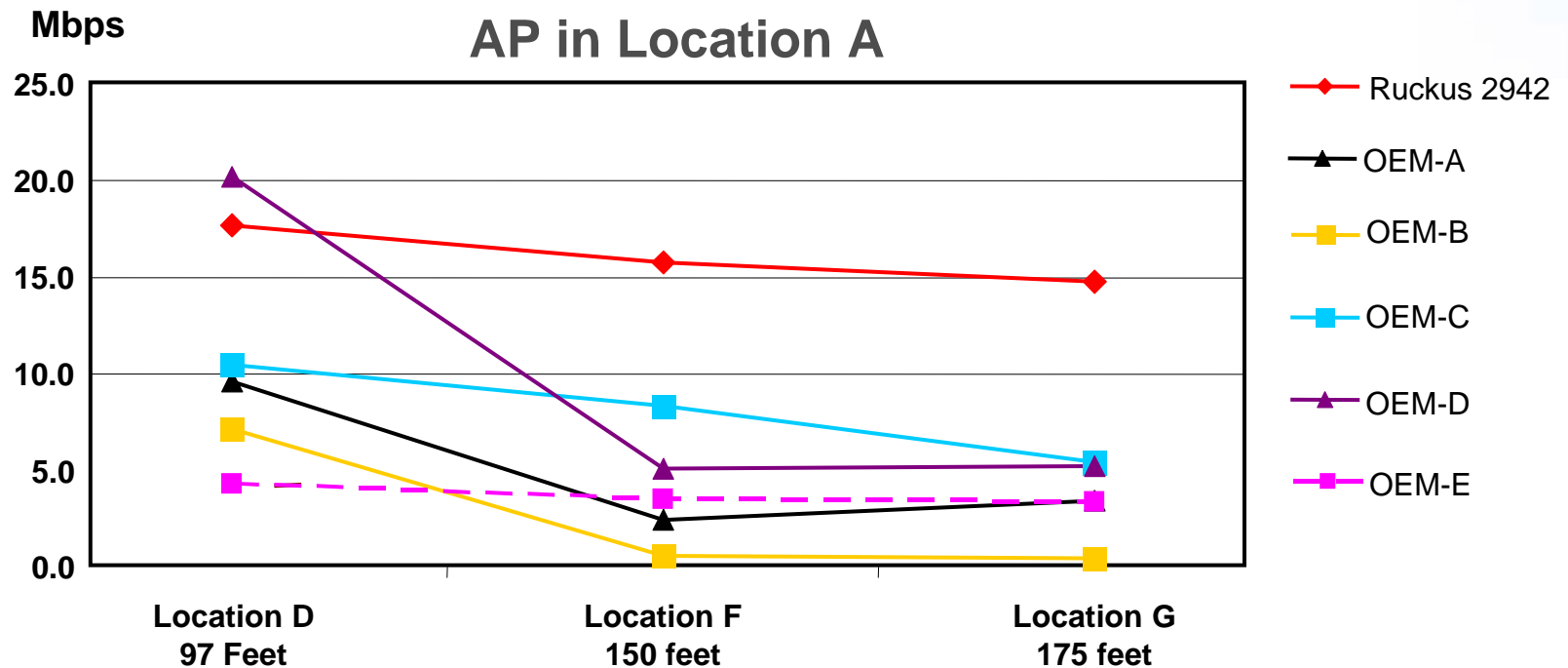
Test 1 Testbed: IxChariot TCP Downlink to Single Client



- AP to client (at three different locations)
- Client rotated (0,90,180,270) at each location
- 3 locations around AP
- Test on Ch 1, Tx Power = +20dBm
- 1 minute runtime for all tests

Farthest Client Locations from AP

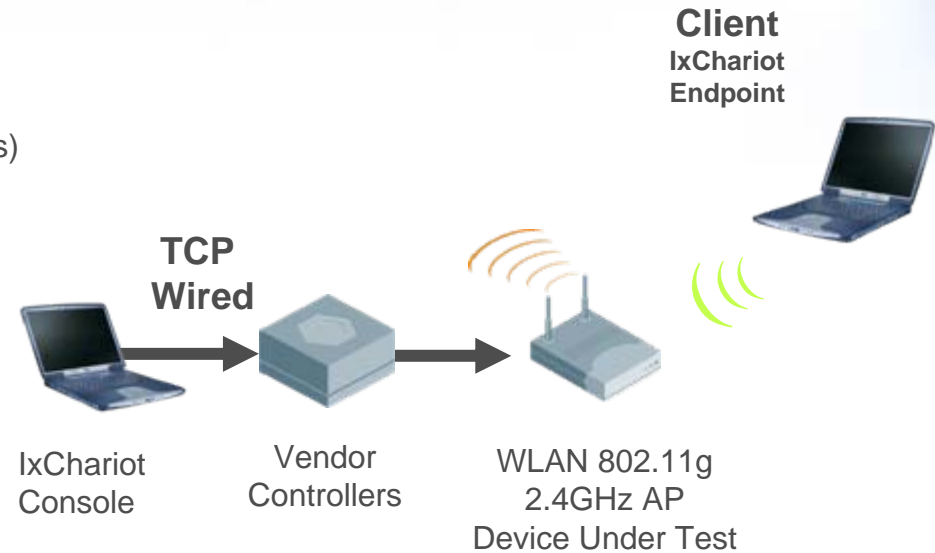
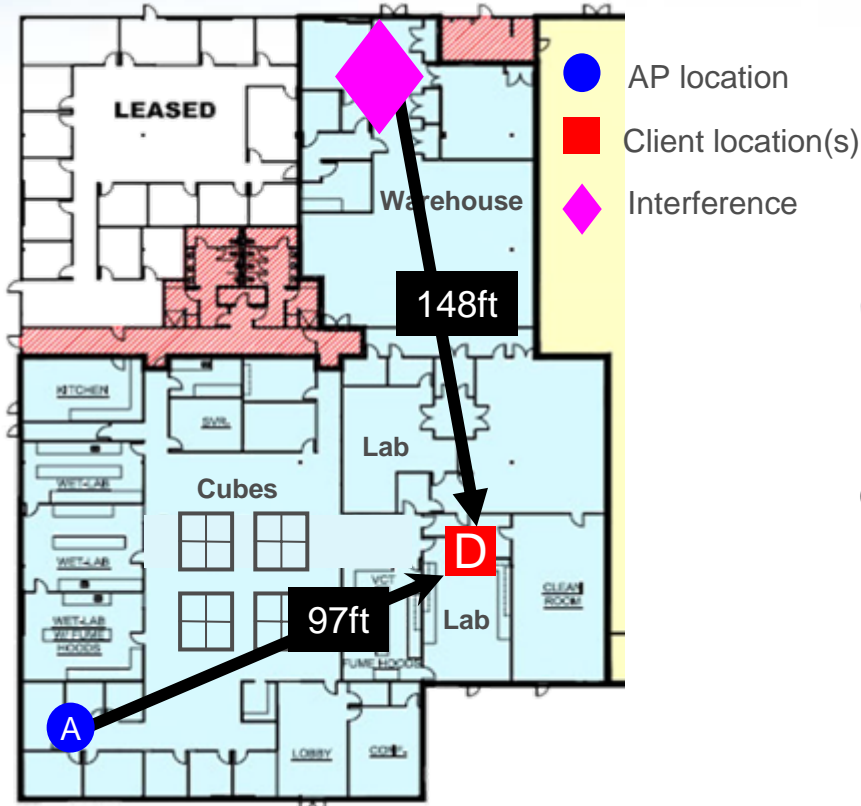
Test 1 Results: Data Throughput vs. Distance for Single 802.11g Client



Performance Measured
with IxChariot

WLAN Performance for Single Client

Test 2 Testbed: IxChariot TCP Downlink to Single Client with Interference



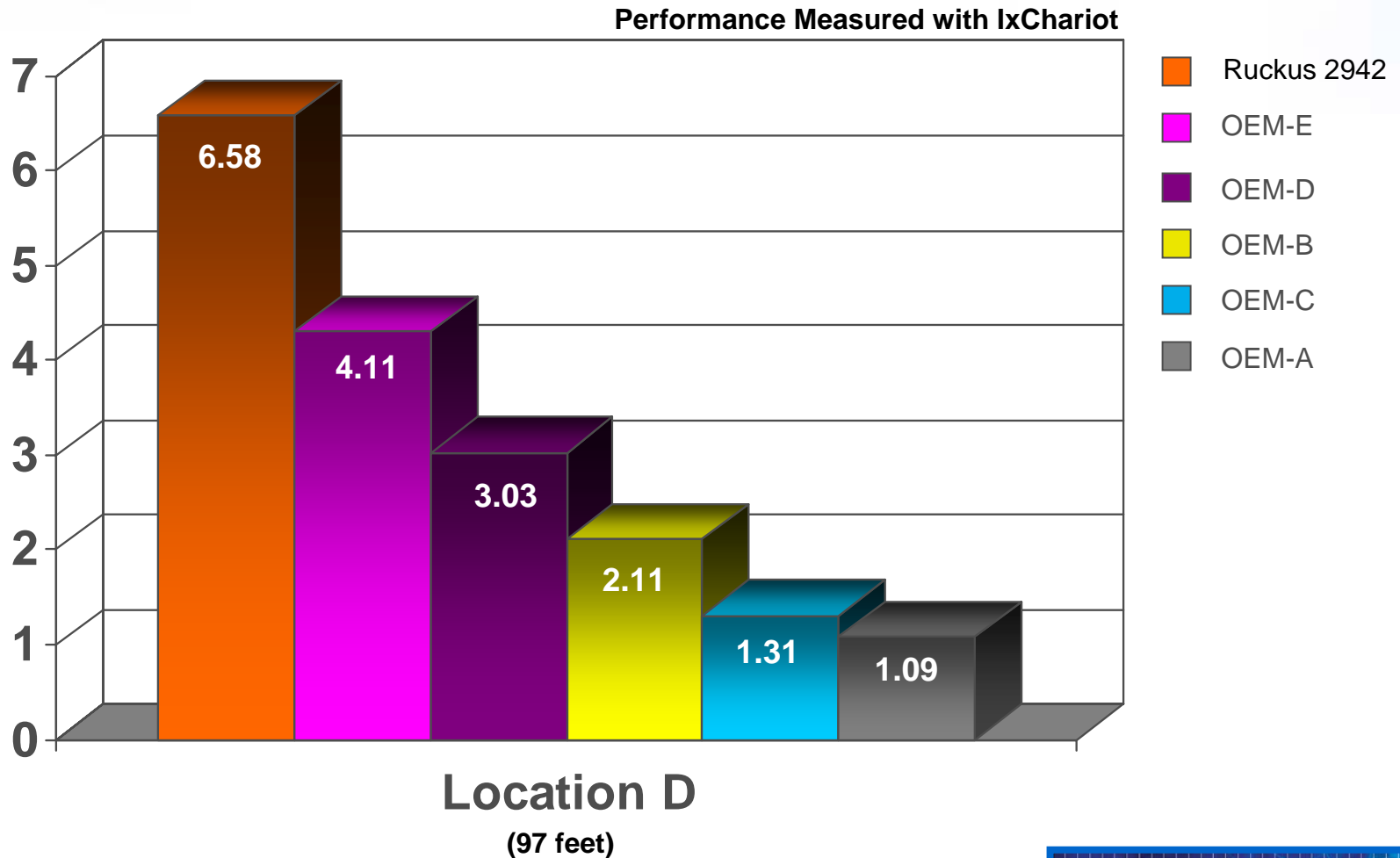
Interference simulated with Iperf



- AP to client
- Client rotated (0,90,180,270) at each location
- Test on Ch 1, Tx Power = +20dBm
- One minute runtime for all tests
- Most difficult location where all DUTs could render results

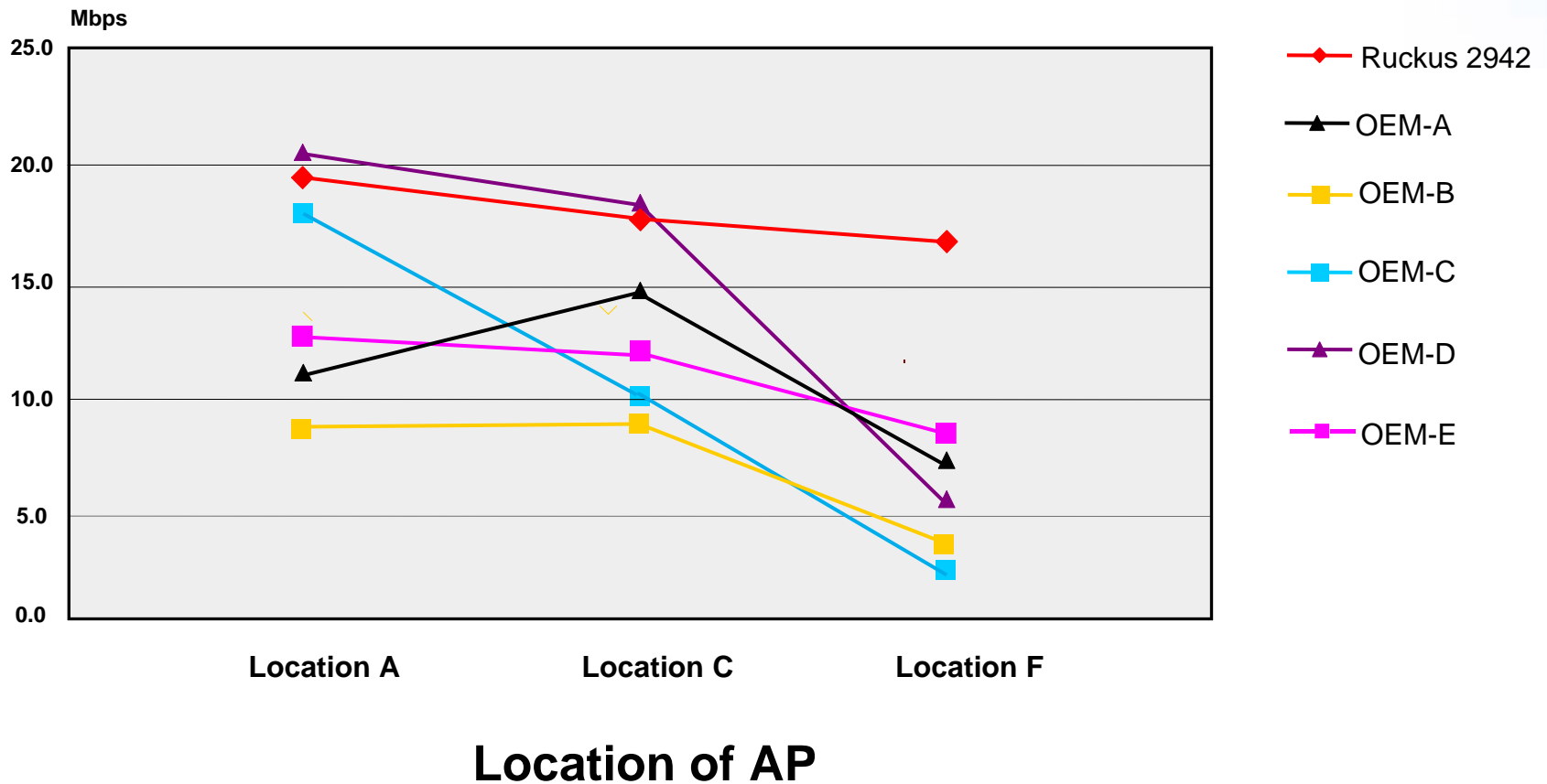
Single Client Throughput with Interference

Test 2 Results: 802.11g Centrino Client to AP in Location A



Aggregate Downlink Throughput

Test 3 Results: TCP Downlink to 20 Clients in Most Difficult Locations



MOS and R-Values

- **What's MOS? (mean opinion score)**

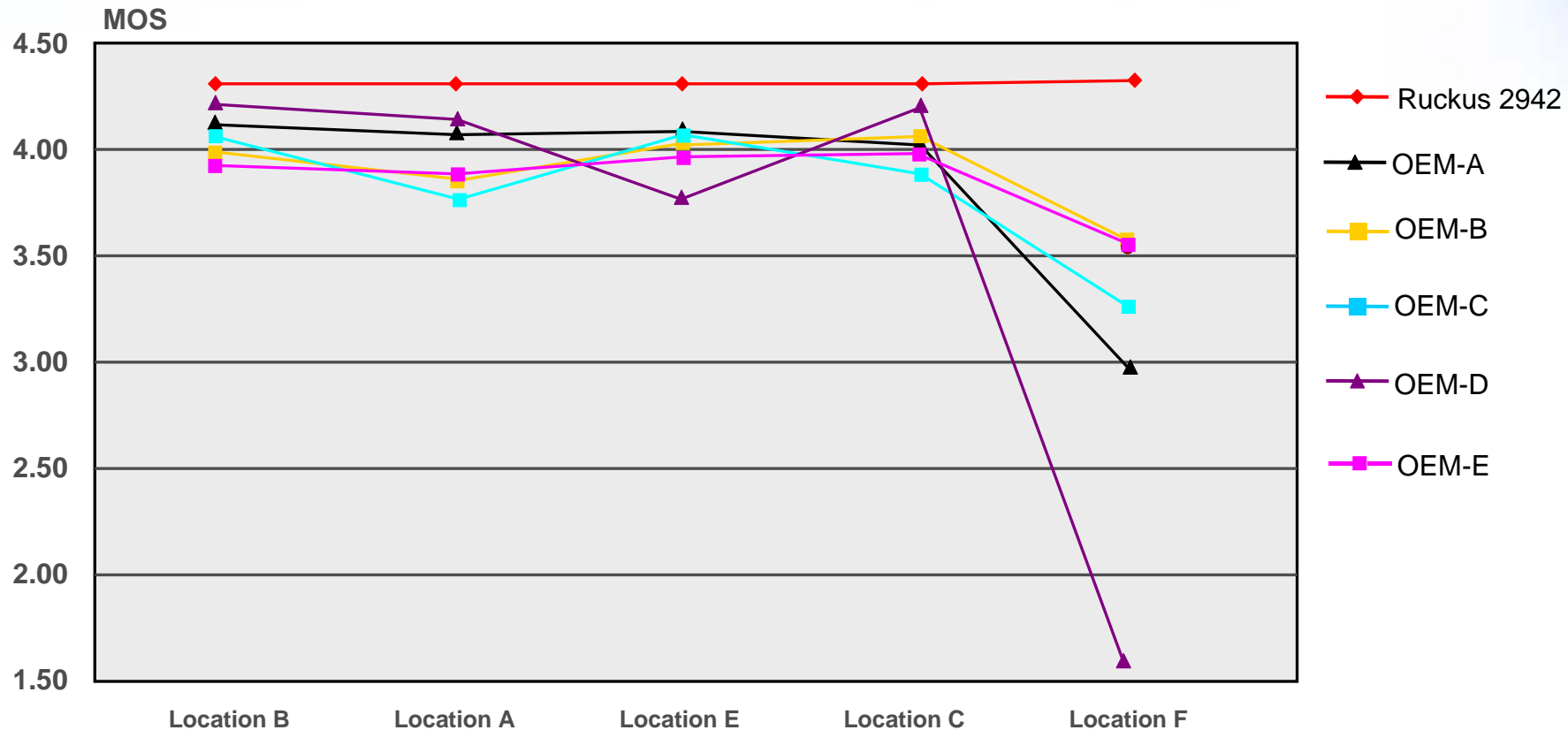
- A standard IxChariot tests that measures of the quality of human speech at the destination end of the circuit
- Includes measurements of 1) latency, 2) packet Loss, 3) Jitter
- MOS scale defined by the ITU (scale 1 to 5)
 - MOS 4.0 – 5.0 Good
 - MOS 3.6 – 4.0 Acceptable
 - MOS <3.6 unacceptable

- **What's R-Value?**

- An ITU specification (G.107) that calculates voice quality
- computed directly from measurements of packet loss, jitter and delay
- Anything above 75 is considered toll quality

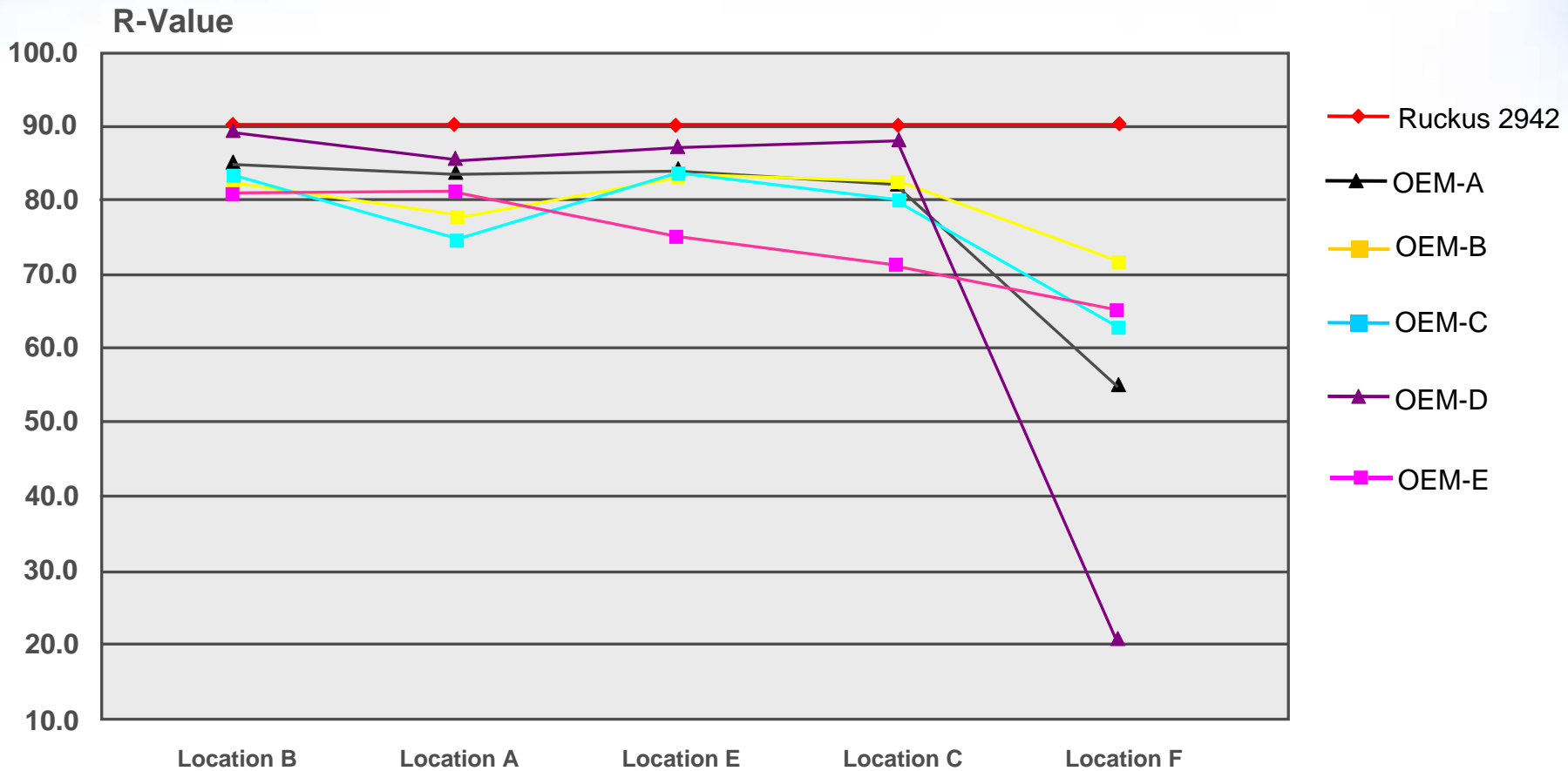
VoIP over Wi-Fi Performance

Test 4: MOS Values, VoIP Traffic to 19 Clients with Background Data



VoIP over Wi-Fi Performance

Test 4: R-Values, VoIP Traffic to 19 Clients with Background Data



Ruckus ZoneFlex Summary

- Delivered the most consistent Wi-Fi performance across all combined locations
- Demonstrated superior support for delay-sensitive apps like VoFi
- Performed the best for most difficult (eg. farthest) and challenging (obstacles) locations
- Exhibited the best performance in the presence of interference