AP Shut Out Neighborhood Effect

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Abstract

The problem of "Neighborhood Capture" was recognized in 09/0844r1 as a result of work carried out for 11s. In the case of OBSS the same phenomenon occurs for an AP in the middle of two APs that are hidden from each other. This paper looks at the actual throughput results in these situations and how to allow for it.

AP Shut out Neighborhood Effect

- **In the case of an AP that has two overlapping APs that are hidden from each other, the middle AP will wait while either of its neighbors is transmitting. The two outer, hidden APs, do not wait for each other and can transmit at the same time. The effect is that the middle AP may have difficulty getting on the medium if the total traffic requirement for ALL THREE APs is above a certain level.**

Investigation into AP Shut Out

- **A simulation program was written for up to five APs in a chain. The following can be set for each AP:**
  - EDCA parameters
  - Packet Size
  - Data rate, Mbps
  - PHY Rate, Mbps

  The relevant total Medium Time is calculated

- **The outputs are:**
  - Packets in, Packets out
  - Actual data rate
  - Maximum and Average Packet Delay

- **For the traffic to be acceptable, the criteria used was:**

  Average Delay < 2 times the SI of the packet
  - Where SI = reciprocal of Packets per Second = 1/pps
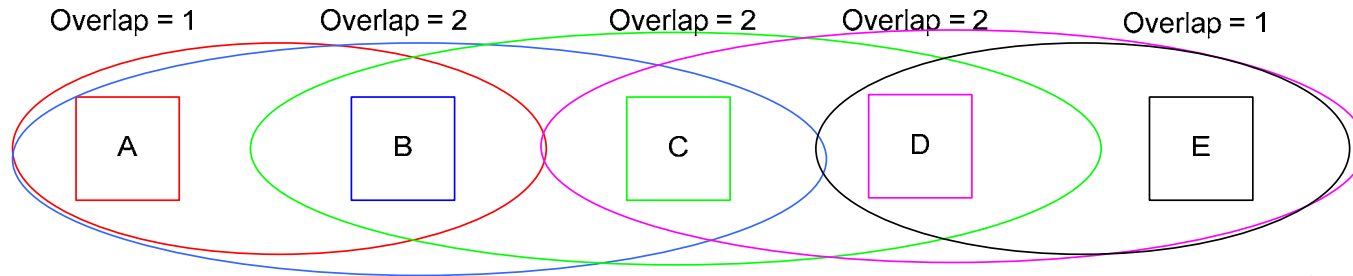 - And pps = requested data rate/packet length

Possible AP Shut Out - Scenarios
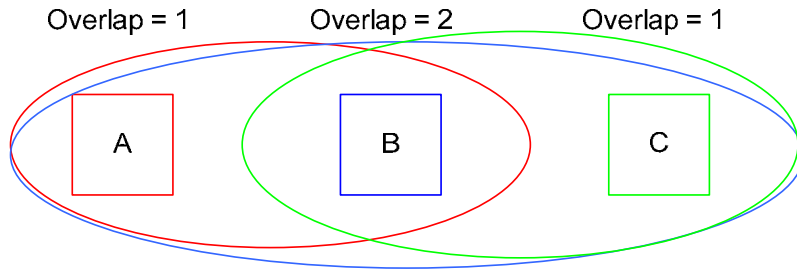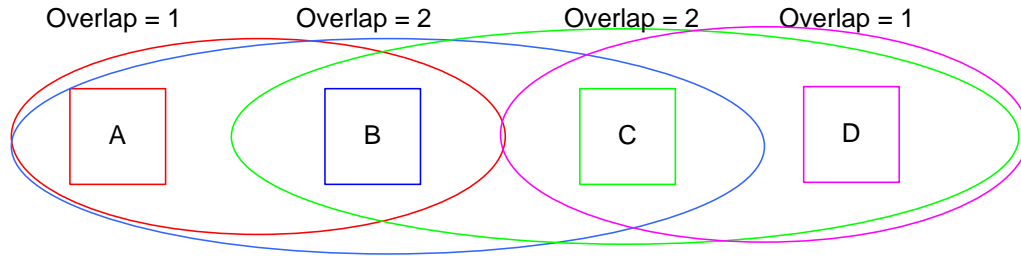
Result with 3 APs
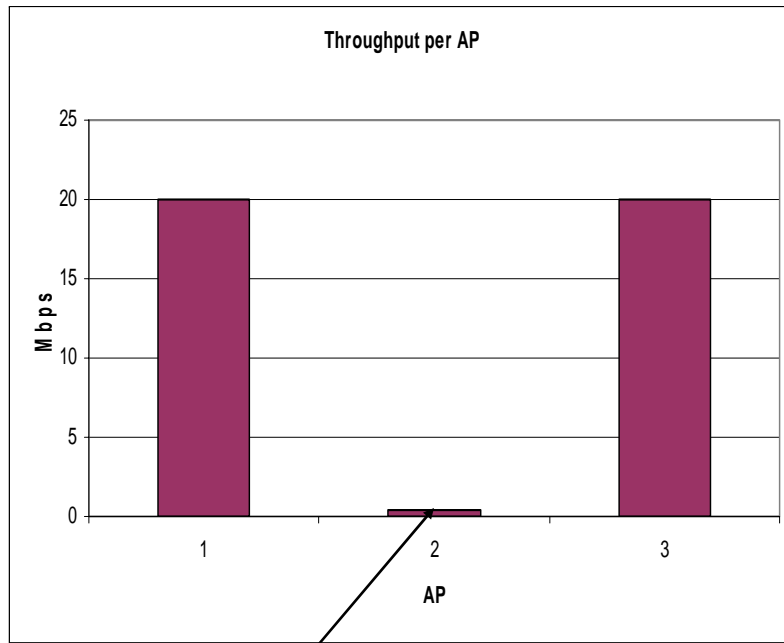
54Mbps, 20Mbps data per AP

54Mbps, 15Mbps data per AP

Throughput per AP

Throughput per AP

The middle AP is shut out
by its neighbors
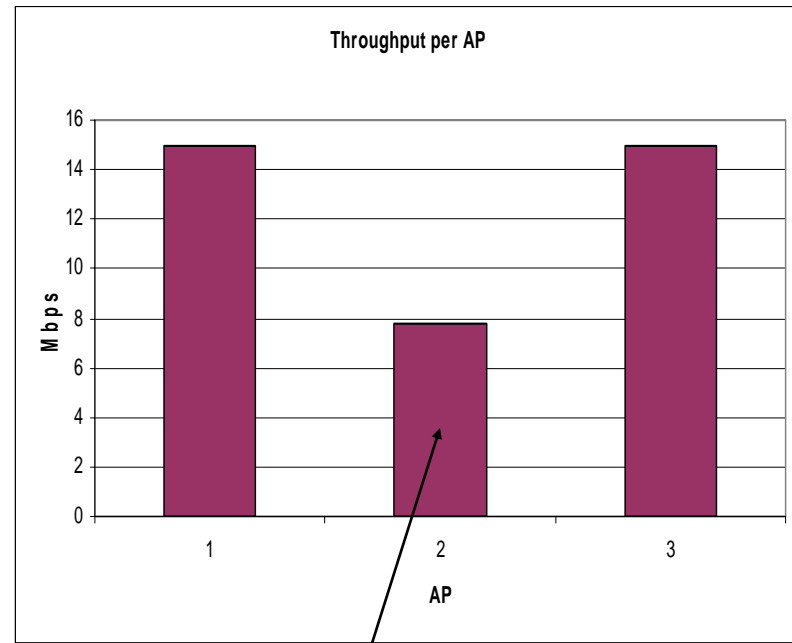
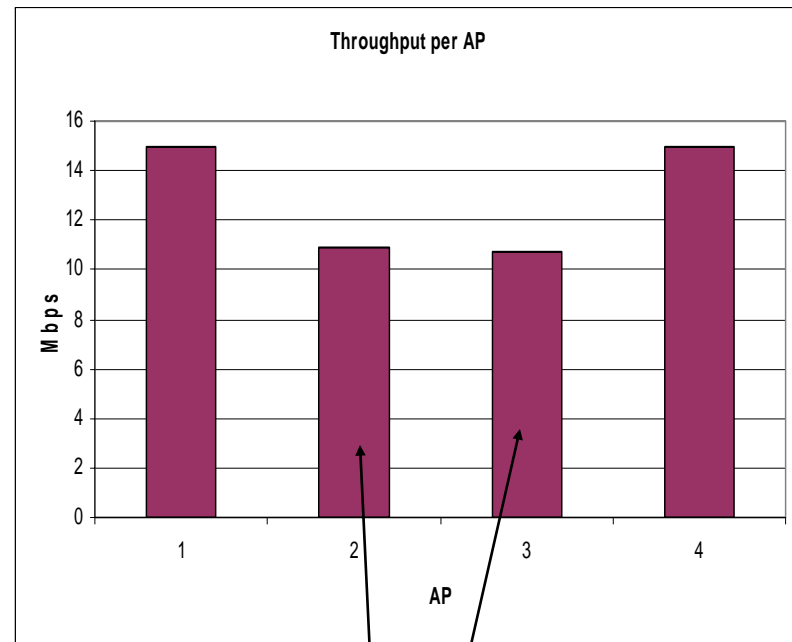The middle AP is partitailly shut out
by its neighbors

4 AP Case

54Mbps, 20Mbps data per AP
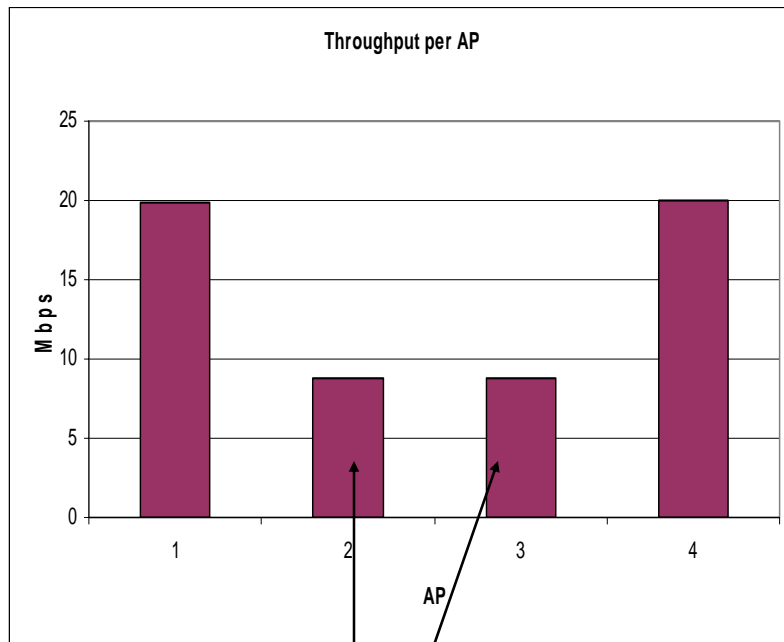
54Mbps, 15Mbps data per AP

Middle APs partially shut out

Middle APs partially shut out
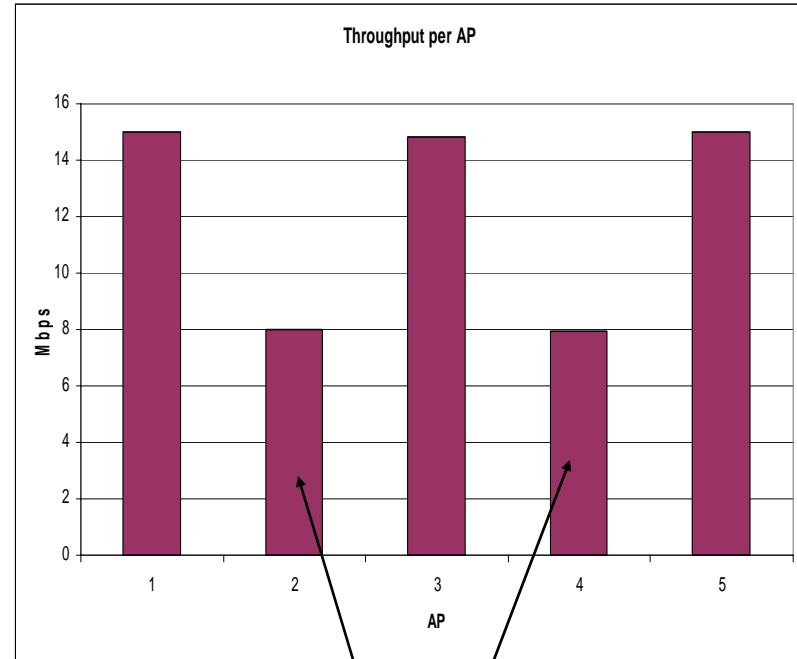
5 AP Case

54Mbps, 20Mbps data per AP

54Mbps, 15Mbps data per AP
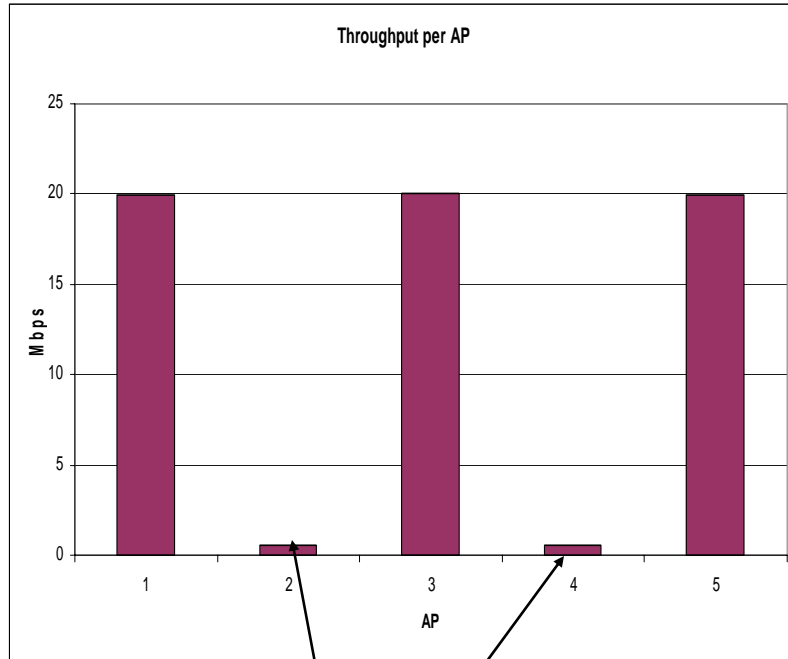
Middle APs shut out

Middle APs partially shut out

3 AP Case

54Mbps, 9.2Mbps data

- **Find highest traffic data rate for average delay < 2 x SI**
- **Answer 9.2Mbps each**
- **Total Medium Time for APs 1,2,3 is 680612us**
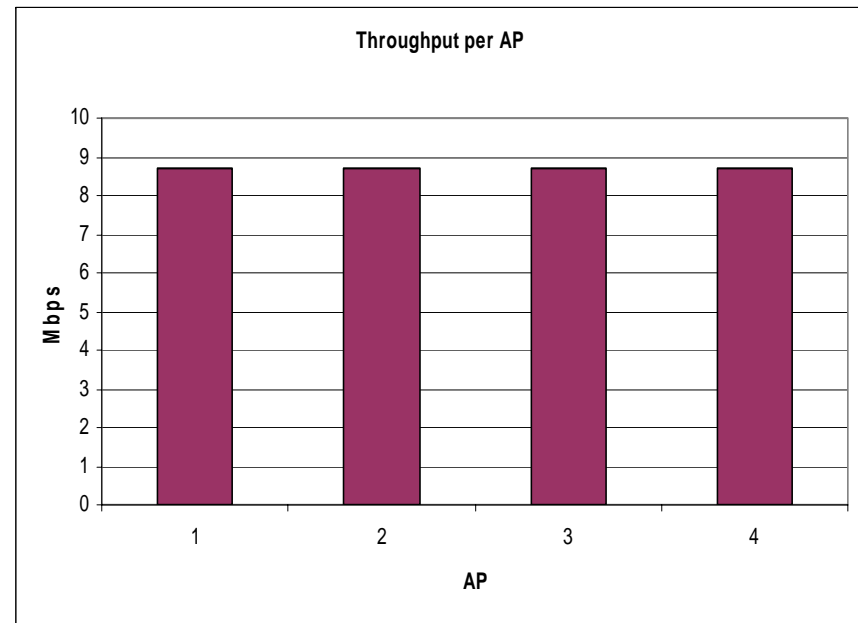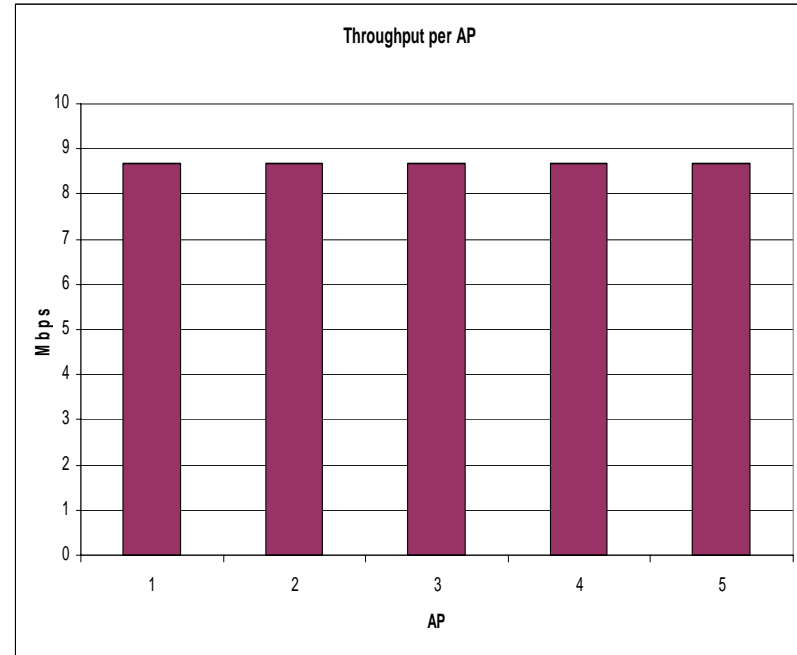- **Overhead = 1.47**
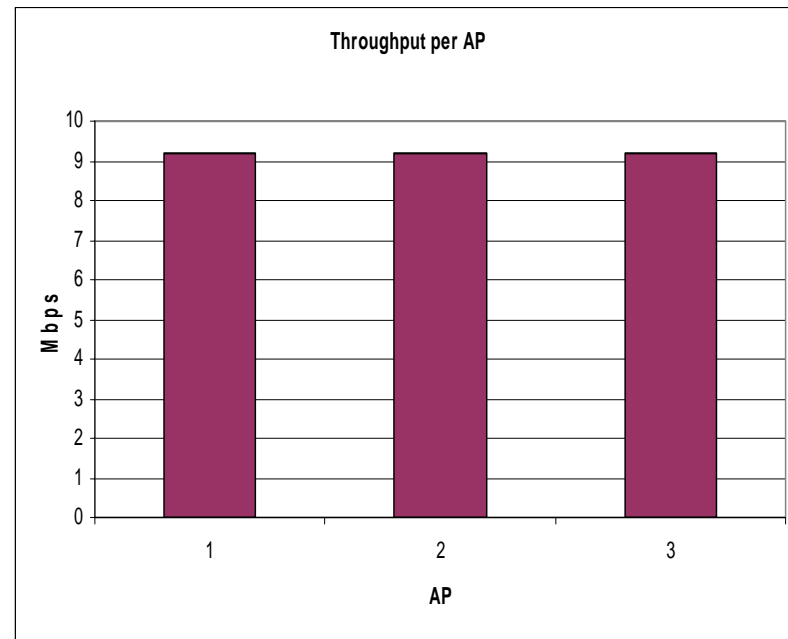
4 AP Case

54Mbps, 8.7Mbps data

- **Find highest traffic data rate for average delay < 2 x SI**

- **Answer 8.7Mbps each**

- **Total Medium Time for APs 1,2,3 and 2,3,4 is 643622us**

- **Overhead = 1.55**

Throughput per AP

5 AP Case

54Mbps, 8.7Mbps data

- **Find highest traffic data rate for average delay < 2 x SI**

- **Answer 8.7Mbps each**

- **Total Medium Time for APs 1,2,3 and 2,3,4 and 3,4,5 is 643622us**

- **Overhead = 1.55**

Throughput per AP

(bar chart: Mbps vs AP, five bars each at approximately 8.65 Mbps for APs 1–5)

Results

# APs	54Mbps		130Mbps, A-MPDU		104Mbps A-MPDU		130Mbps	
	per AP	O'Head	per AP	O'Head	per AP	O'Head	per AP	O'Head
3	9.2	1.47	30	1.39	23.5	1.43	14.3	1.55
4	8.7	1.55	28.5	1.46	23	1.46	13.5	1.56
5	8.7	1.55	28.5	1.46	23	1.46	13.5	1.56

EDCA BW Recommended is
3 streams = 1.5 4+ streams = 1.55

Conclusions and Recommendations

- **Conclusions**
  - To prevent middle AP shut out, the sum of the traffic from all three APs must be used
  - The overhead factor required for the sum of the Medium Times is similar to the EDCA BW Factor
- **Recommendations**
  - Each AP advertises it own traffic
  - Each AP advertises the sum of the traffic of all APs it can see
  - Each AP uses the maximum traffic sum of any overlapping AP
  - The EDCA BW Factor is used