

TDMA WiFi implementation comparison

To test throughput, iperf utility under Ubuntu 12.04 is used.

Iperf is launched with settings to report throughput every 5 seconds.

To check throughput in UDP mode, bidirectional test is used with maximal bandwidth to have less than 0,1% drops and reordering

To check throughput in TCP mode, unidirectional test is used.

To align TCP throughput in CSMA/CA mode to TDMA mode, the sum of unidirectional throughputs is divided with node amount.

The command samples

```
iperf -c SERVER_IP_ADDRESS -i5 -t150 -r
```

```
iperf -c SERVER_IP_ADDRESS -i5 -t150 -u -d -bBANDWIDTH_IN_MB
```

Testbed is configured for 2, 3, 4 and 5 nodes in the network.

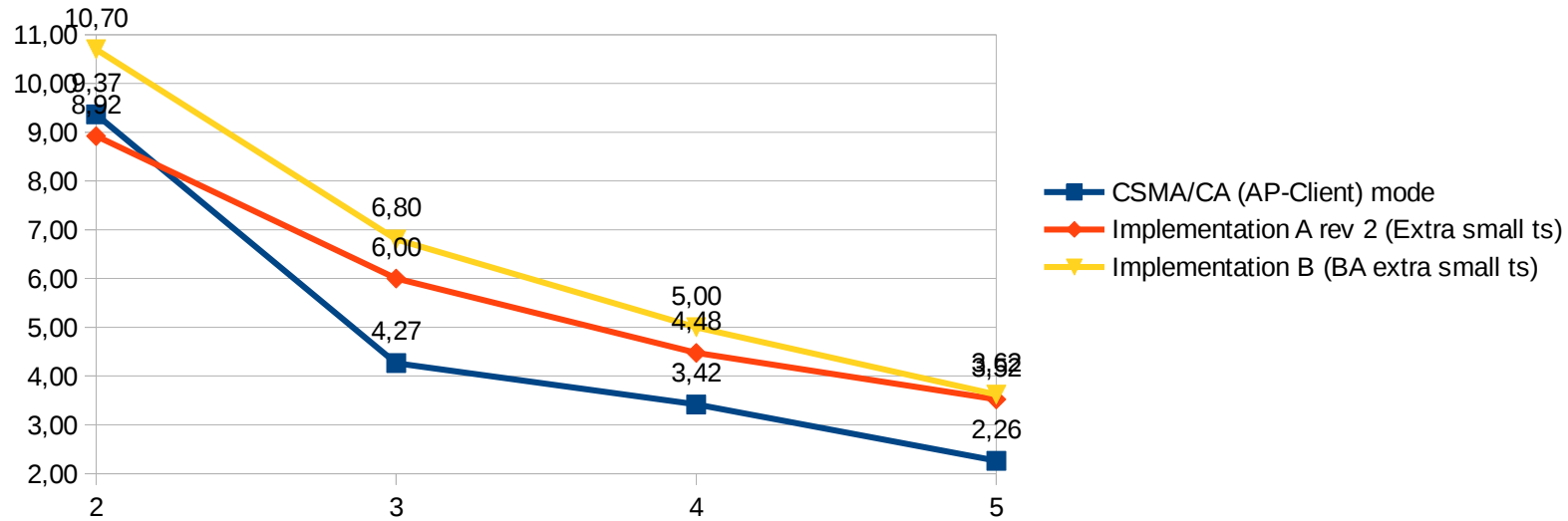
Board with AR9342 CPU and 64Mb of RAM. MIMO-2. Frequency 5180MHz. Automatic power settings.

Nodes in the network	Channel width	RSSI	Timeslot size	Directional Throughput				Network throughput		Throughput per node	
				BS->CPE		CPE-BS		TCP	UDP	TCP	UDP
				TCP	UDP	TCP	UDP				
2	5	40-42		9,23	9,10	9,50	9,90	18,73	19,00	9,37	9,50
2	10	41-45		18,10	18,00	19,90	18,90	38,00	36,90	19,00	18,45
2	20	43-50		40,10	35,60	42,30	44,20	82,40	79,80	41,20	39,90
3	5	42-43		7,75	5,77	5,05	9,44	12,80	15,21	4,27	5,07
3	10	43-46		13,36	13,78	15,41	17,89	28,77	31,67	9,59	10,56
3	20	45-51		28,30	28,80	30,90	36,90	59,20	65,70	19,73	21,90
4	5	41-47		4,37	5,35	9,30	8,38	13,67	13,73	3,42	3,43
4	10	47-51		11,51	9,01	14,46	18,10	25,97	27,11	6,49	6,78
4	20	48-56		33,53	23,60	34,73	45,10	68,26	68,70	17,07	17,18
5	5	41-47		5,61	5,20	5,70	5,80	11,31	11,00	2,26	2,20
5	10	45-51		10,10	8,79	12,10	15,90	22,20	24,69	4,44	4,94
5	20	46-54		27,80	21,50	30,10	35,80	57,90	57,30	11,58	11,46
2	5	26-34	31	9,14	8,00	8,70	8,00	17,84	16,00	8,92	8,00
2	10	31-34	18	17,20	17,00	17,30	17,00	34,50	34,00	17,25	17,00
2	20	46-54	10	29,20	27,00	29,20	27,00	58,40	54,00	29,20	27,00
3	5	35-38	31	9,10	8,00	8,90	8,00	18,00	16,00	6,00	5,33
3	10	31-33	18	18,20	17,00	19,10	17,00	37,30	34,00	12,43	11,33
3	20	41-44	10	27,00	24,00	24,20	23,00	51,20	47,00	17,07	15,67
4	5	35-38	31	9,10	8,00	8,80	8,00	17,90	16,00	4,48	4,00
4	10	24-35	18	18,00	17,00	18,10	17,00	36,10	34,00	9,03	8,50
4	20	41-33	10	26,10	22,00	24,00	22,00	50,10	44,00	12,53	11,00
5	5	41-47	31	9,01	8,00	8,60	8,00	17,61	16,00	3,52	3,20
5	10	45-51	18	17,10	16,00	17,10	16,00	34,20	32,00	6,84	6,40
5	20	46-54	10	25,60	22,00	24,10	22,00	49,70	44,00	9,94	8,80
2	5	31-34	14	10,70	9,00	10,70	9,00	21,40	18,00	10,70	9,00
2	10	31-34	9	20,40	18,60	20,50	18,20	40,90	36,80	20,45	18,40
2	20	48-51	6	36,90	34,00	37,20	35,00	74,10	69,00	37,05	34,50
3	5	31-34	14	10,30	9,00	10,10	9,00	20,40	18,00	6,80	6,00
3	10	31-33	9	19,30	18,00	19,20	18,00	38,50	36,00	12,83	12,00
3	20	41-44	6	36,60	32,00	35,80	32,00	72,40	64,00	24,13	21,33

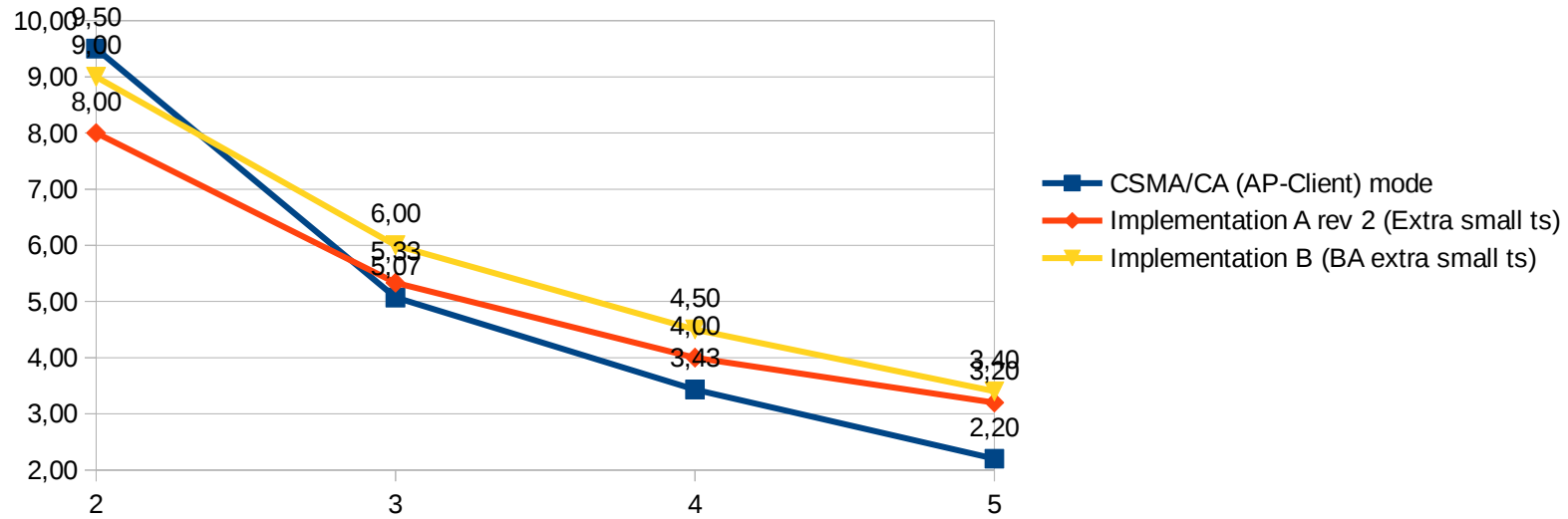
4	5	31-34	14	10,10	9,00	9,90	9,00	20,00	18,00	5,00	4,50
4	10	31-33	9	19,10	18,00	19,00	18,00	38,10	36,00	9,53	9,00
4	20	41-44	6	36,50	32,00	35,20	32,00	71,70	64,00	17,93	16,00
5	5	41-47	14	9,20	9,00	8,90	8,00	18,10	17,00	3,62	3,40
5	10	45-51	9	18,50	17,00	18,30	17,00	36,80	34,00	7,36	6,80
5	20	46-54	6	35,20	31,00	33,20	31,00	68,40	62,00	13,68	12,40

CSMA/CA (AP-Client) mode
CSMA/CA (AP-Client) mode
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CSMA/CA (AP-Client) mode
Implementation A rev 2 (Extra small ts)
Implementation A rev 2 (Extra small ts)
Implementation A rev 2 (Extra small ts)
Implementation A rev 2 (Extra small ts)
Implementation B (BA extra small ts)
Implementation B (BA extra small ts)
Implementation B (BA extra small ts)
Implementation B (BA extra small ts)

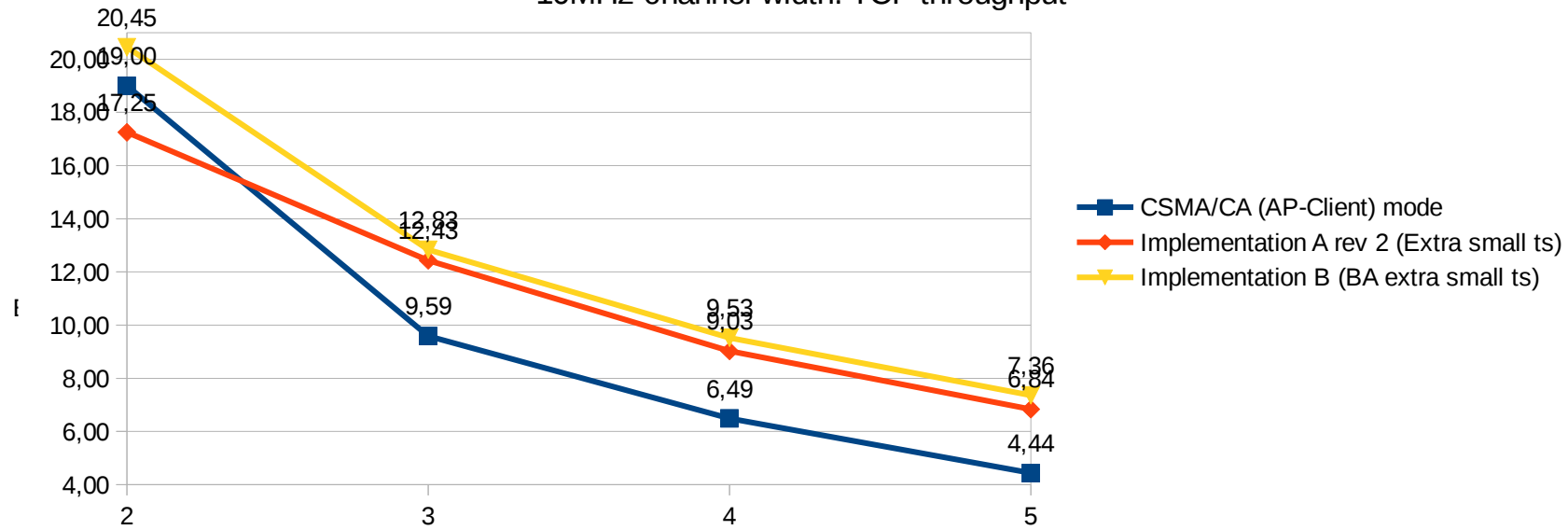
5MHz cahnnel width. TCP throughput per node



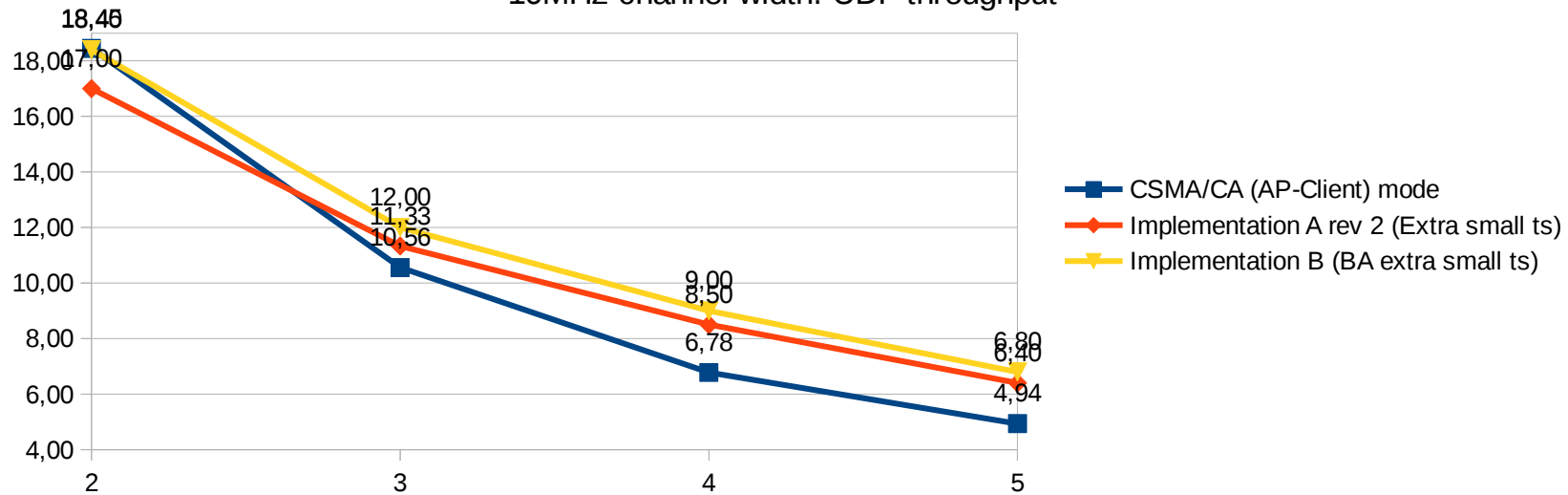
5MHz channel width. UDP throughput



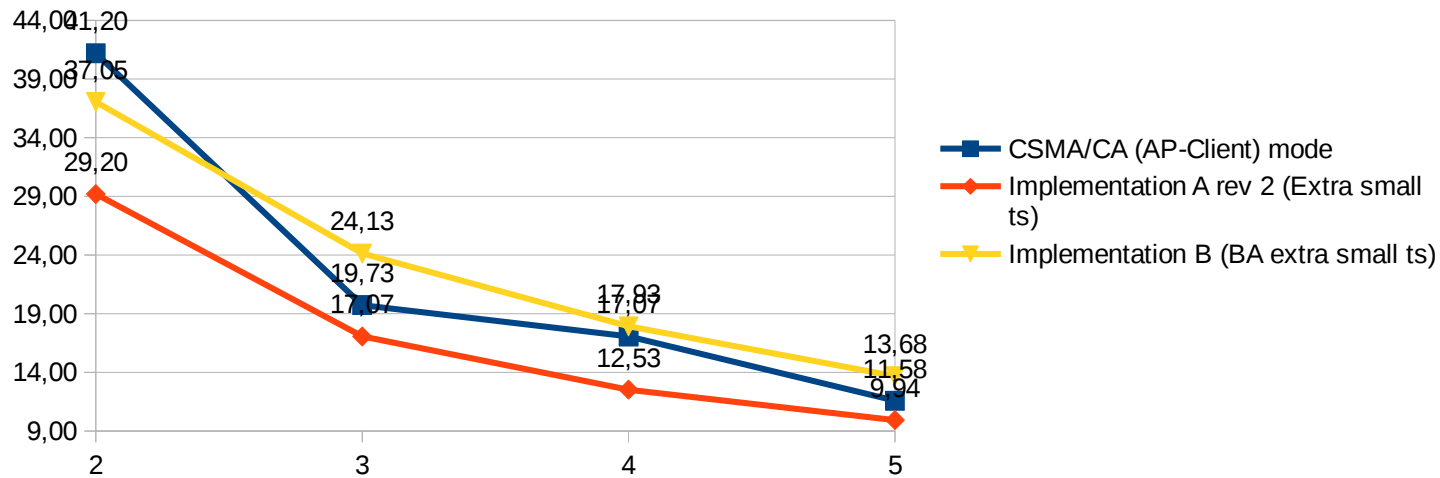
10MHz channel width. TCP throughput



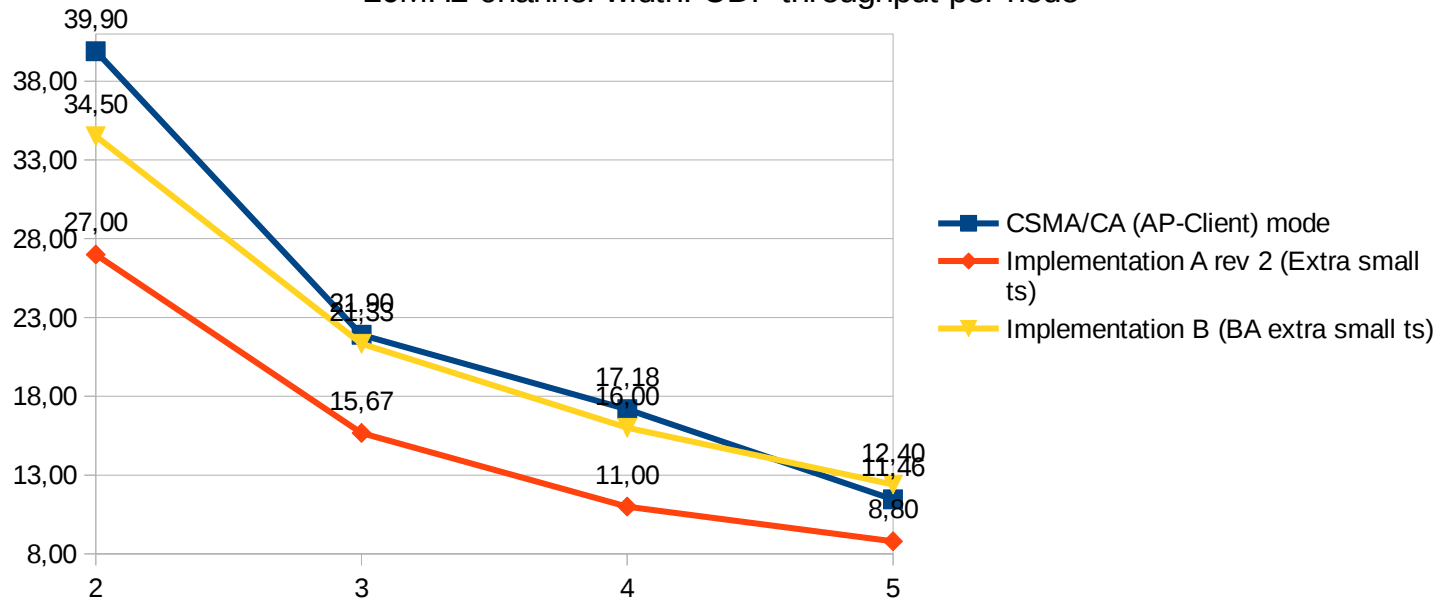
10MHz channel width. UDP throughput



20MHz channel width. TCP throughput per node



20MHz channel width. UDP throughput per node



Conclusion

The tests show:

- the TDMA implementations have best TCP and UDP throughput from the 3 nodes

In the network for 5 and 10MHz channel widths.

- TDMA with bulk acknowledgements has best throughput for TCP and 2 nodes in the network for 5 and 10MHz channels.

- TDMA with bulk acknowledgements has similar to the CSMA/CA mode throughput for 3 and 4 nodes in network and 20MHz channel width.

- TDMA with individual acknowledgements has similar throughput from 5 nodes in the network.

- TDMA with individual acknowledgements is more suitable and has better throughput in the network with more than 5 nodes

For all channel widths.