Checking Improving TCP and Voice Performance using a 802.11e testbed

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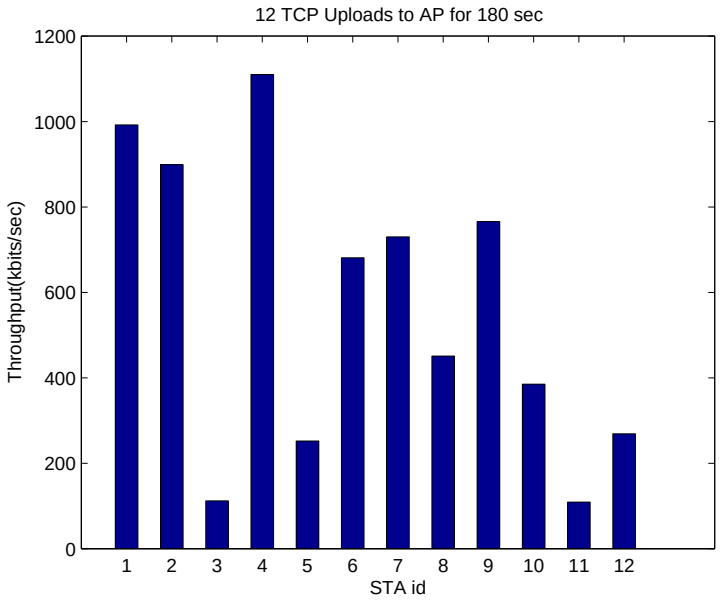
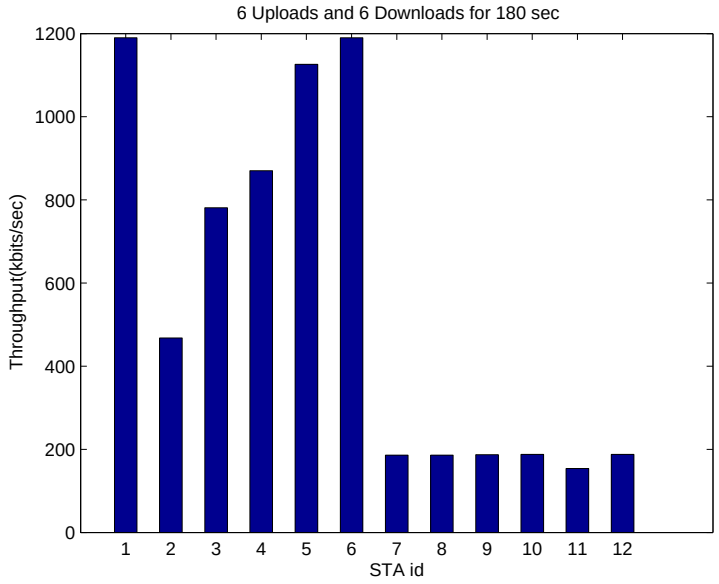
802.11b TCP Performance

12 uploads



6 up, 6 down



Have proposed fixes, want to test in practice.

802.11(e) Summary

- After TX choose rand$(0, \mathrm{CW} - 1)$.
- Wait until medium idle for DIFS$(50\mu s)$,
- While idle count down in slots $(20\mu s)$.
- TX when counter gets to 0, ACK after SIFS $(10\mu s)$.
- If ACK then $\mathrm{CW} = \mathrm{CW}_{\mathrm{min}}$ else $\mathrm{CW}* = 2$.

Ideally produces even distribution of packet transmissions.

In 11e have multiple queues. Each has own $\mathrm{CW}_{\mathrm{min}}$, DIFS(aka AIFS) and can have TXOP.

Why use a testbed?

- Can we believe ns?
  Bugs: aCCATime, virtual collisions.
- Can we believe the standard?
- Can we believe models?
- What are the practical issues?

Testbed setup

Number of identical stations (Linux) connection to AP (Linux hostap).

1× AP	Dell GX 280	2.8Ghz P4
12× STA	Soekris net4801	266Mhz 586
WLAN	D-Link DWL-G520	Atheros AR5212

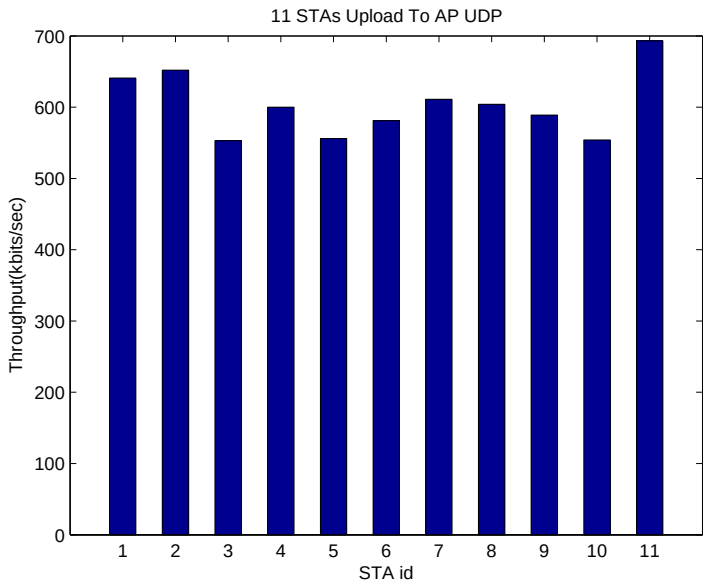
Cards have external antenna, PCI interface, Madwifi driver with local patches for 11e parameter setting.

MGEN and iperf used for traffic generation.

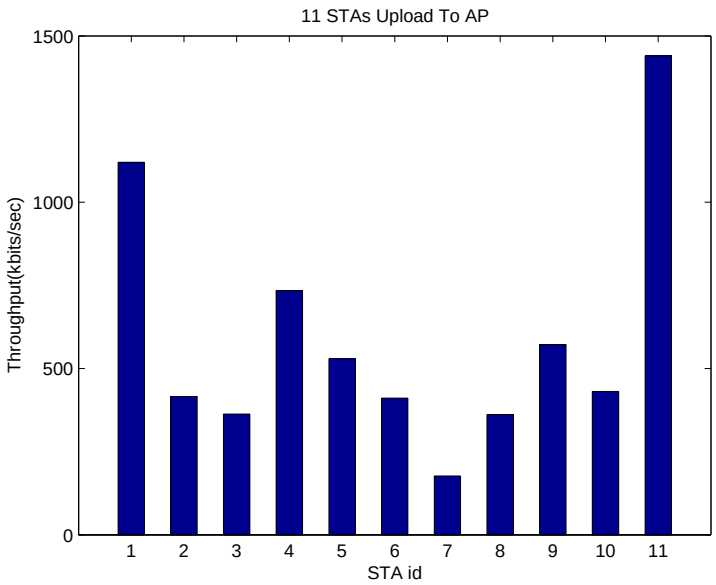

192.168.0.180&180
192.168.0.187
187
192.168.0.7&177

Practical Issue: Calibration

UDP up

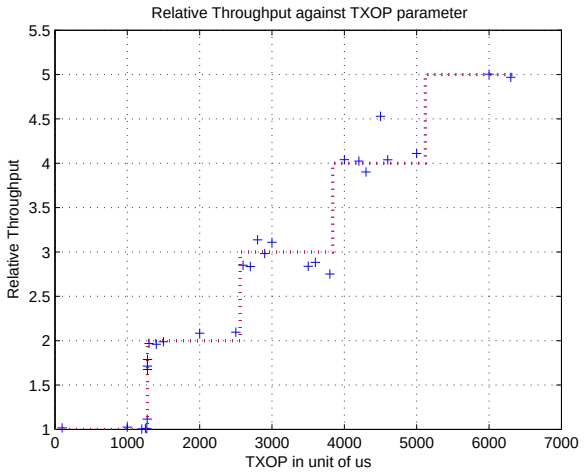


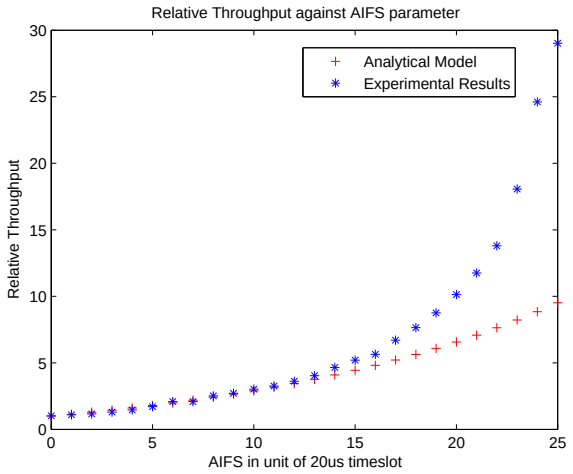
TCP up

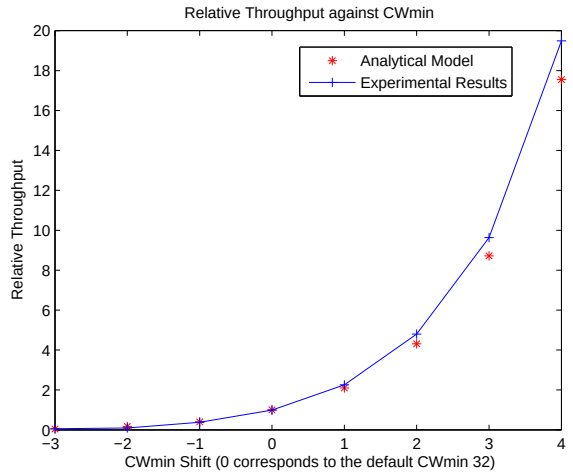


Small changes until well behaved.

Validation







Measure relative performance of two saturated flows while varying TXOP, AIFS and $\mathrm{CW}_{\mathrm{min}}$. Compare to well-known models.

Proposed settings

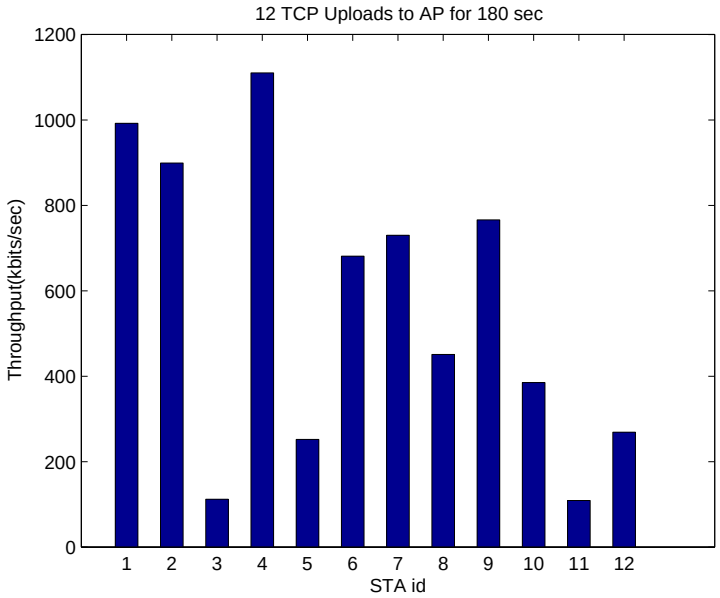
		AIFS (slots)	CWmin	TXOP (packets)
AP	Upload ACKs	0	4	1
	Download data	4	32	n_d
wireless	Download ACKs	0	32	1
station	Upload data	4	32	1

Derived using analytical modeling and ns.

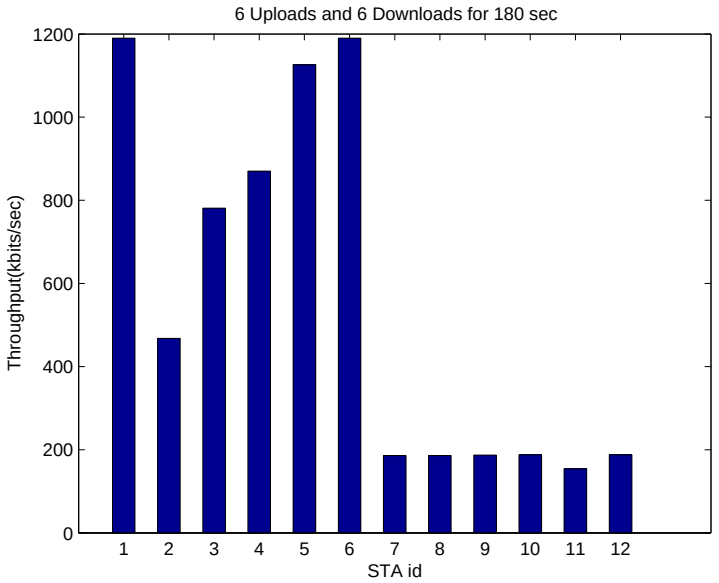
Will they work in practice?

Before

12 uploads

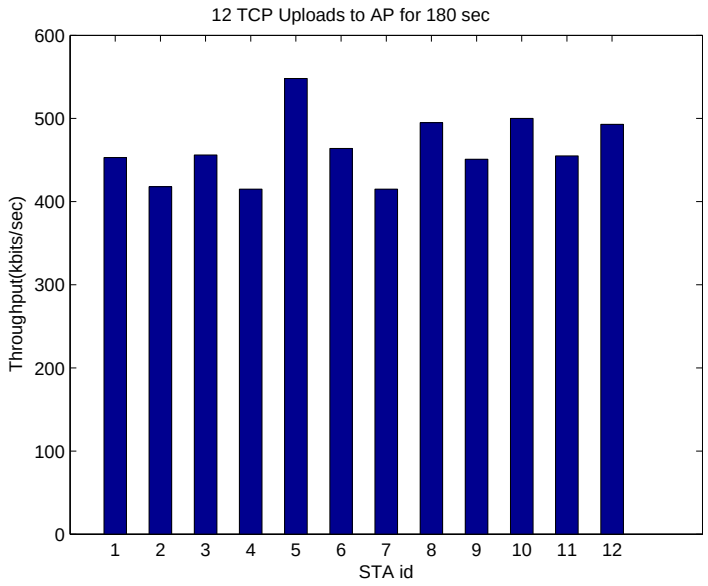


6 up, 6 down

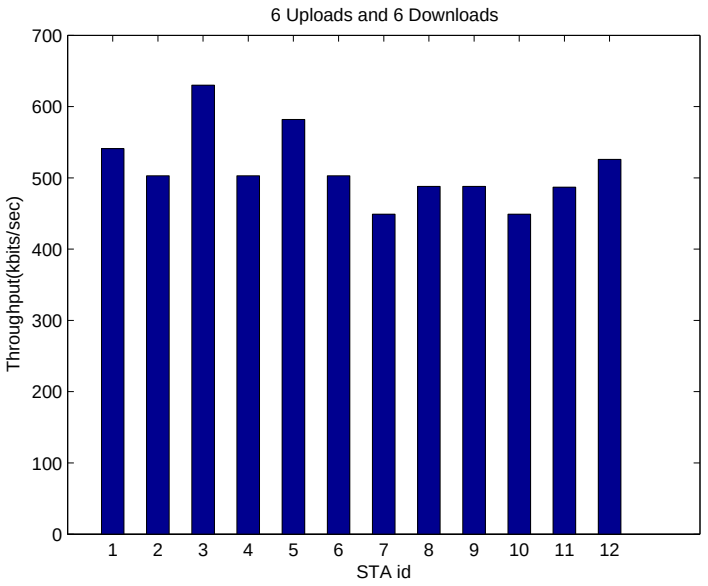


After

12 uploads



6 up, 6 down

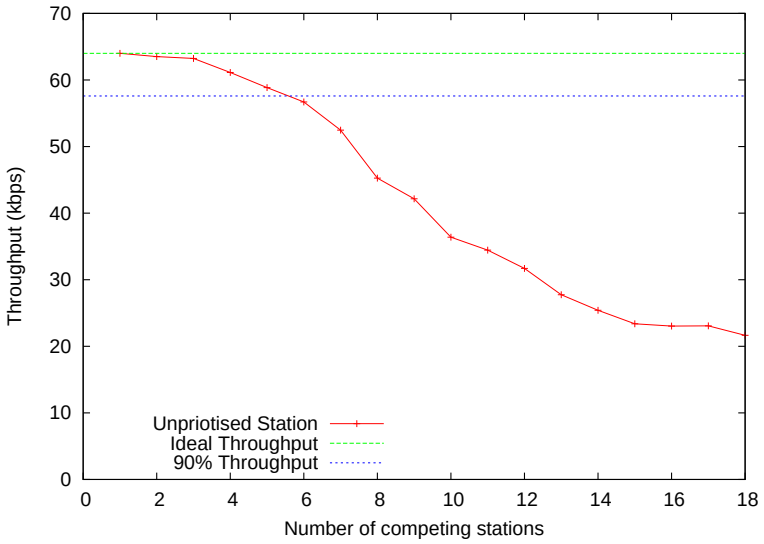


Voice

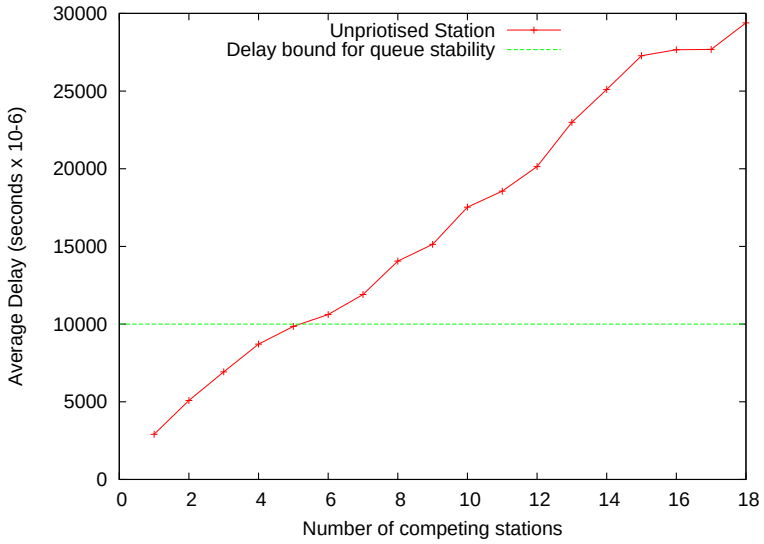
- Voice is quite different to TCP.
- Has a loss and delay requirement.
- Low rate vs. high rate.
- Aim to protect voice from saturated sources.
- AIFS is the obvious parameter.
- (simulation says 4, model says 6 to be safe).

Unprioritised Voice

Throughput



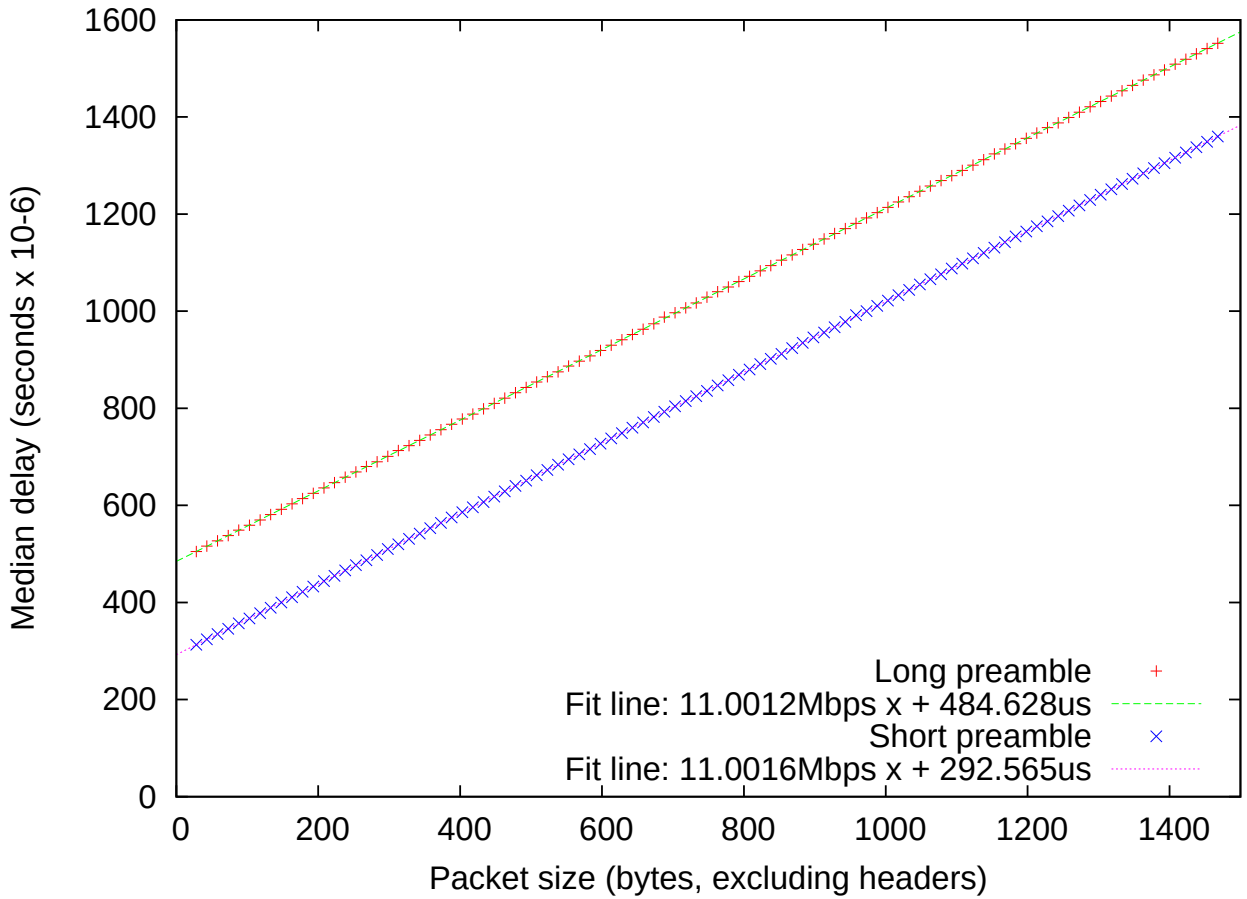
Delay

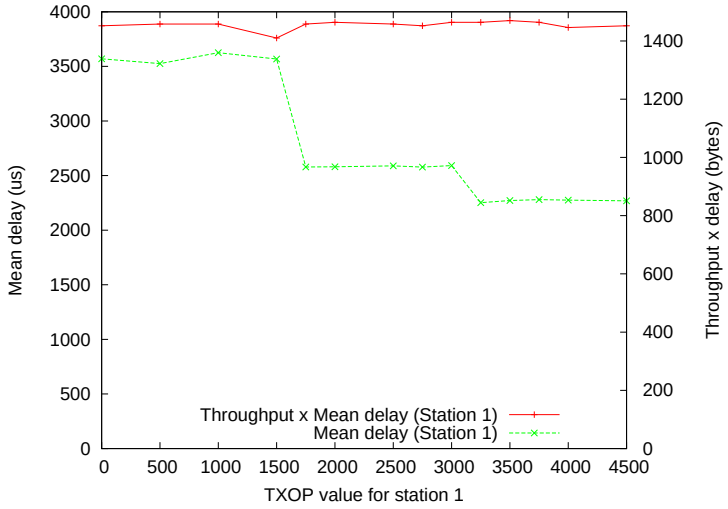


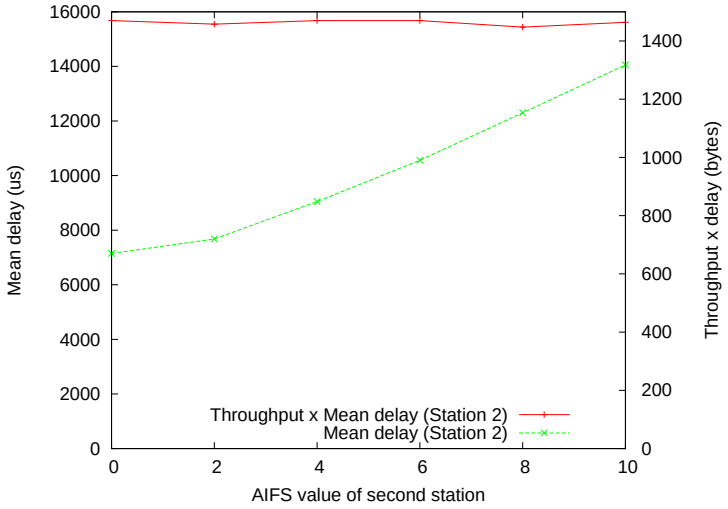
Measuring Delay

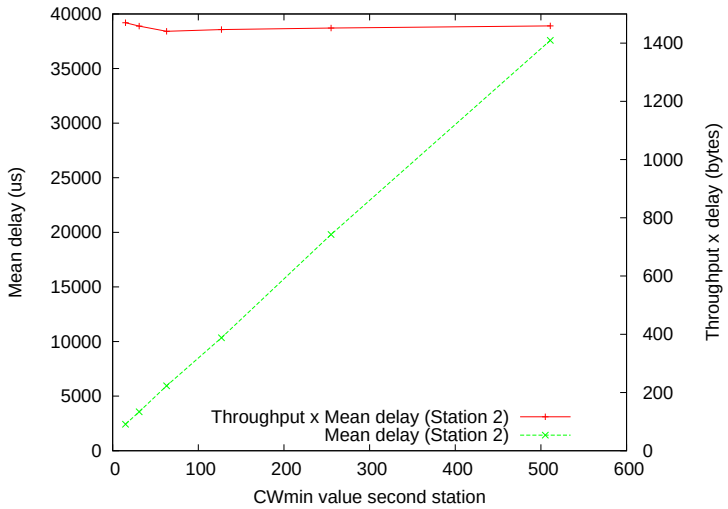
- Want to measure one-way MAC delay.
- Tried NTP for a laugh.
- Tried simultaneously observable broadcasts.
- Transmission not complete until MAC ACK.
- Hardware supports interrupt after ACK.

Validation


Median delay (seconds x 10-6)
1600
1400
1200
1000
800
600
400
200
0
0
200
400
600
800
1000
1200
1400
Packet size (bytes, excluding headers)
Long preamble
Fit line: 11.0012Mbps x + 484.628us
Short preamble
Fit line: 11.0016Mbps x + 292.565us



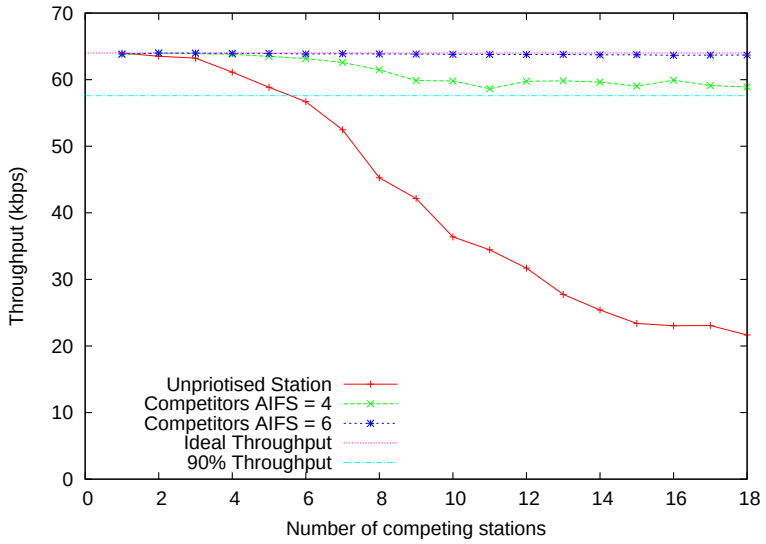




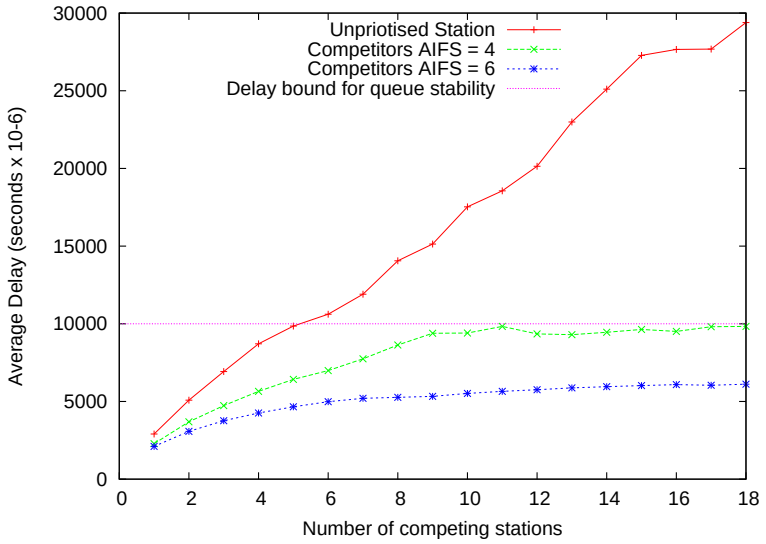
Measure relative performance of two saturated flows while varying TXOP, AIFS and CW_{min}. Check Throughput * delay has expected value.

AIFS Impact

Throughput

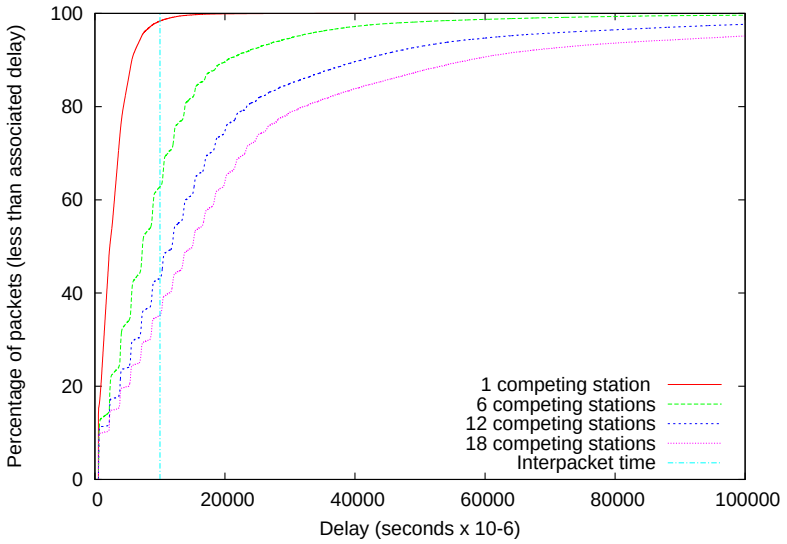


Delay

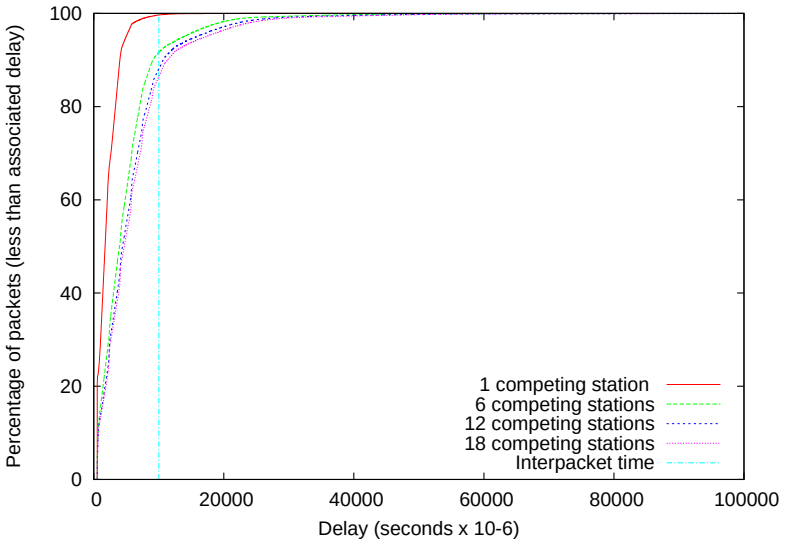


Delay Distribution

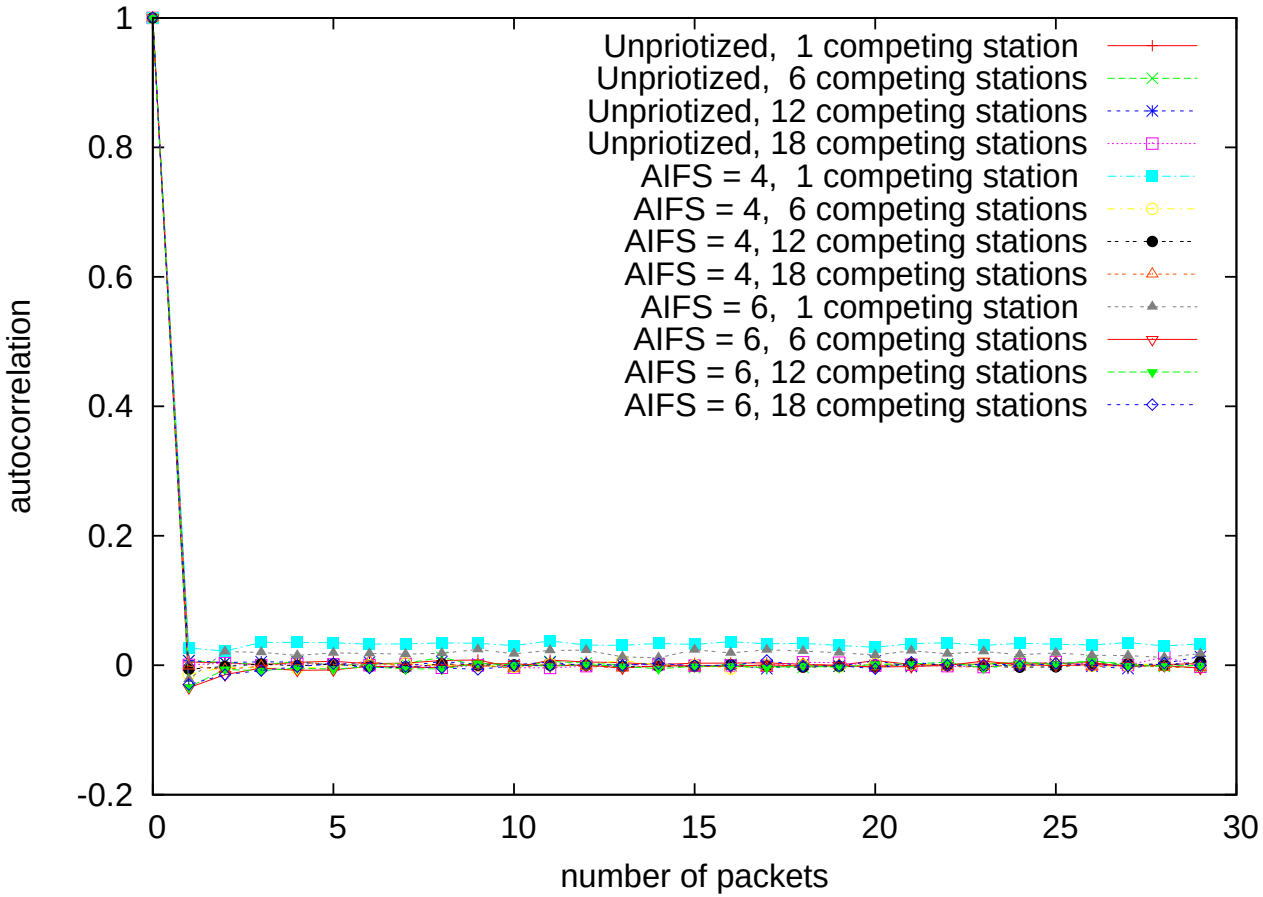
AIFS 0



AIFS 6



Autocorrelation



Conclusions

- Small operational testbed.
- Hardware seems to behave as expected.
- Radio issues can be amplified by other issues.
- 11e can be used to combat MAC/TCP issues.
- 11e can be used to help voice out.
- Further looking at mixed voice/data and voic only networks.