# Experimental Evaluation of TCP Performance and Fairness in an 802.11e Test-bed

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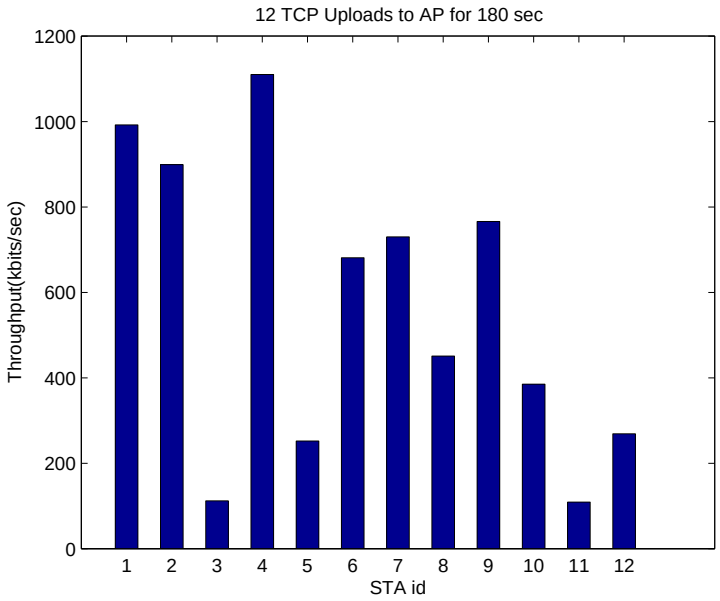
22nd August 2005

# 802.11b TCP Performance

12 uploads

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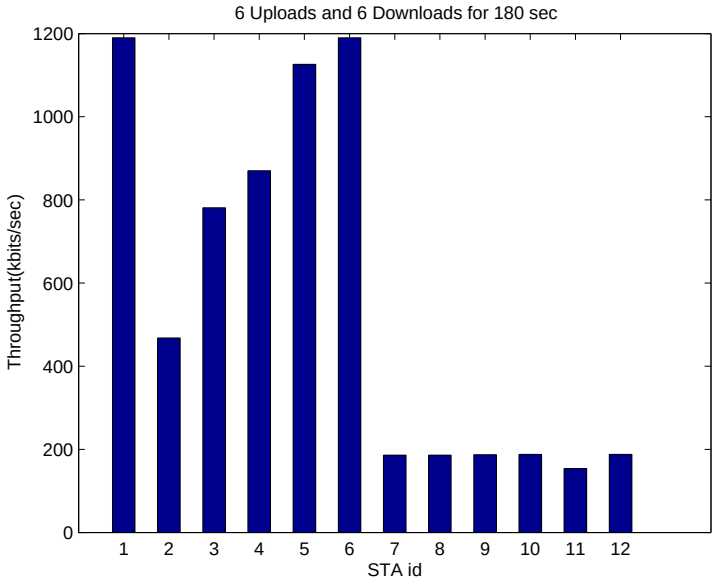



Have proposed fixes, want to test in practice.

# 802.11(e) Summary

- After TX choose rand$(0, \mathrm{CW}_{\min} - 1)$.
- 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 $\mathrm{CW} = \mathrm{CW}_{\min}$ else $\mathrm{CW}* = 2$.

Ideally produces even distribution of packet transmissions.

In 11e have multiple queues. Each has own $\mathrm{CW}_{\min}$, 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 |

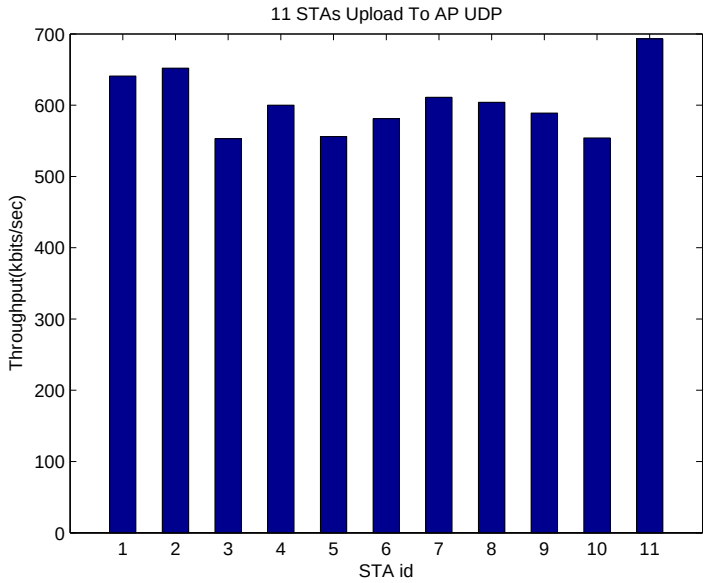
Cards have external antenna, PCI interface, Madwifi driver with local patches for 11e parameter setting.

MGEN and iperf used for traffic generation.

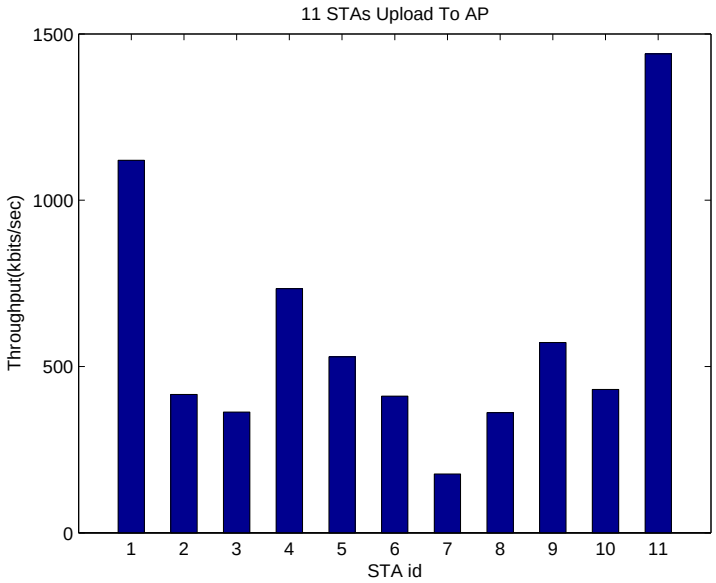
192.168.0.180&180
192.168.0.187
187
192.168.0.185
192.168.0.7&177

# Practical Issue: Calibration

UDP up

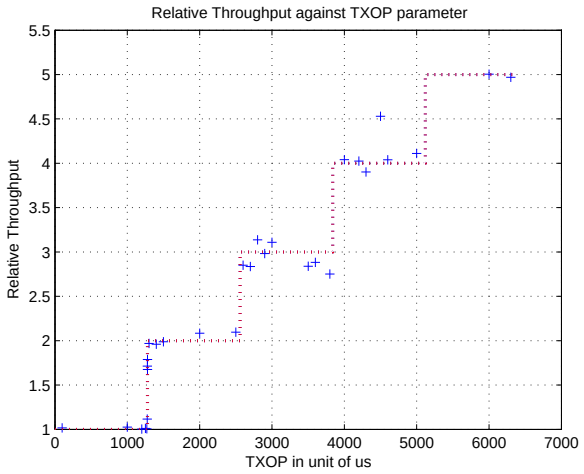


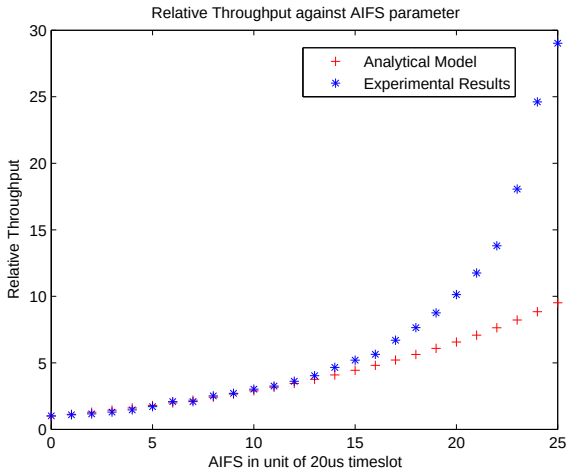

TCP up

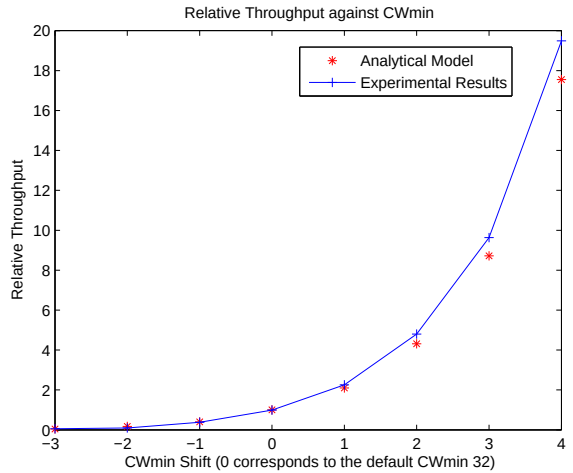



Small changes until well behaved.

# Validation




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

# Proposed settings

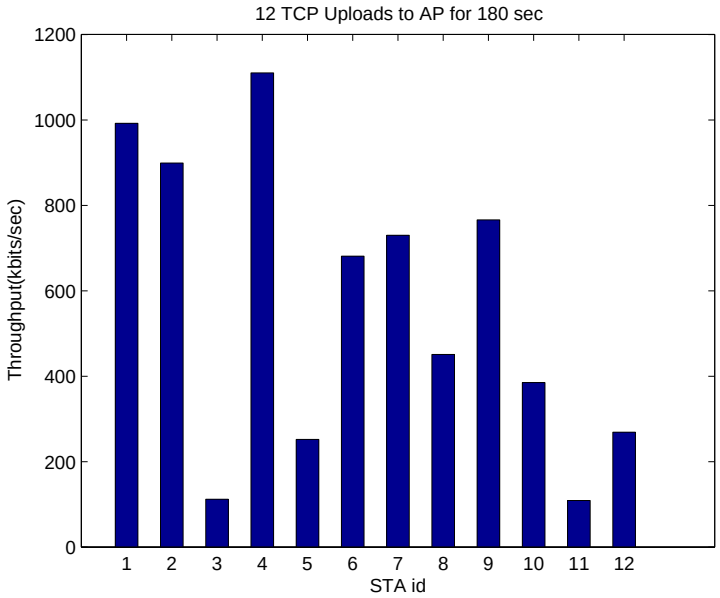
| | | AIFS (slots) | CWmin | TXOP (packets) |
|---|---|---|---|---|
| AP | Upload ACKs | 0 | 4 | 1 |
| | Download data | 4 | 32 | $n_d$ |
| wireless | Download ACKs | 0 | 32 | 1 |
| station | Upload data | 4 | 32 | 1 |

Derived using analytical modeling and ns.

Will they work in practice?

# Before

12 uploads

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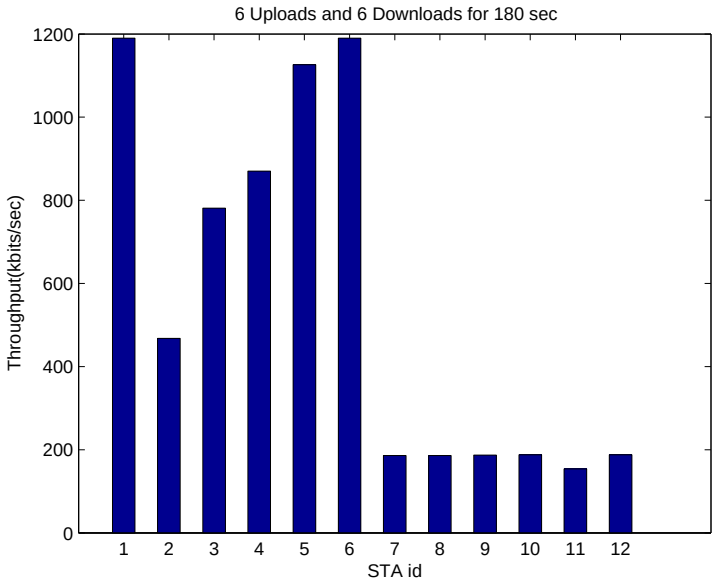
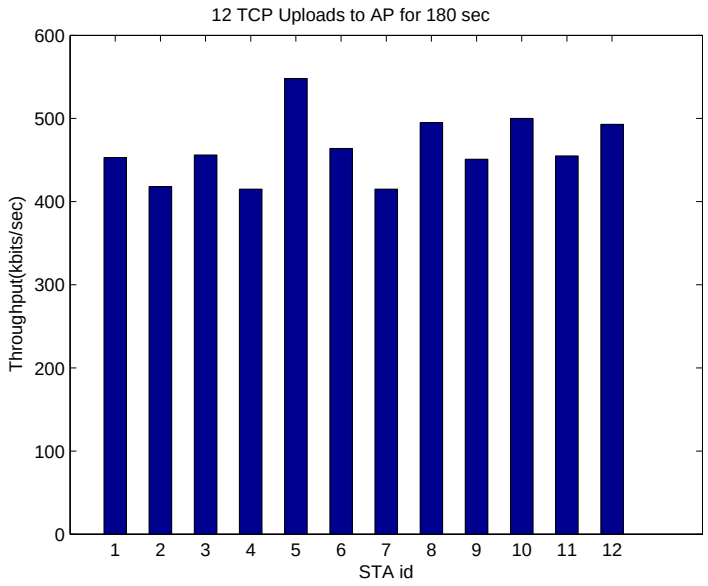


# After

12 uploads

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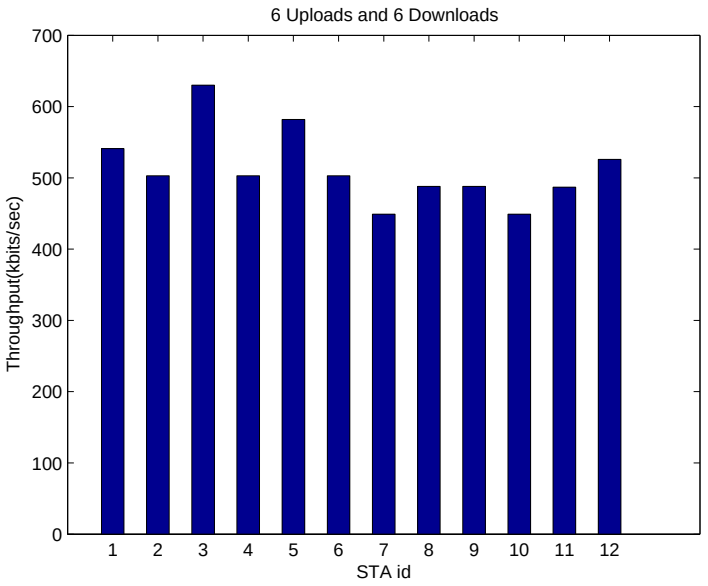

# Conclusions

- 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.
- Now looking at mixed voice/data networks.