Voice and Data over 802.11

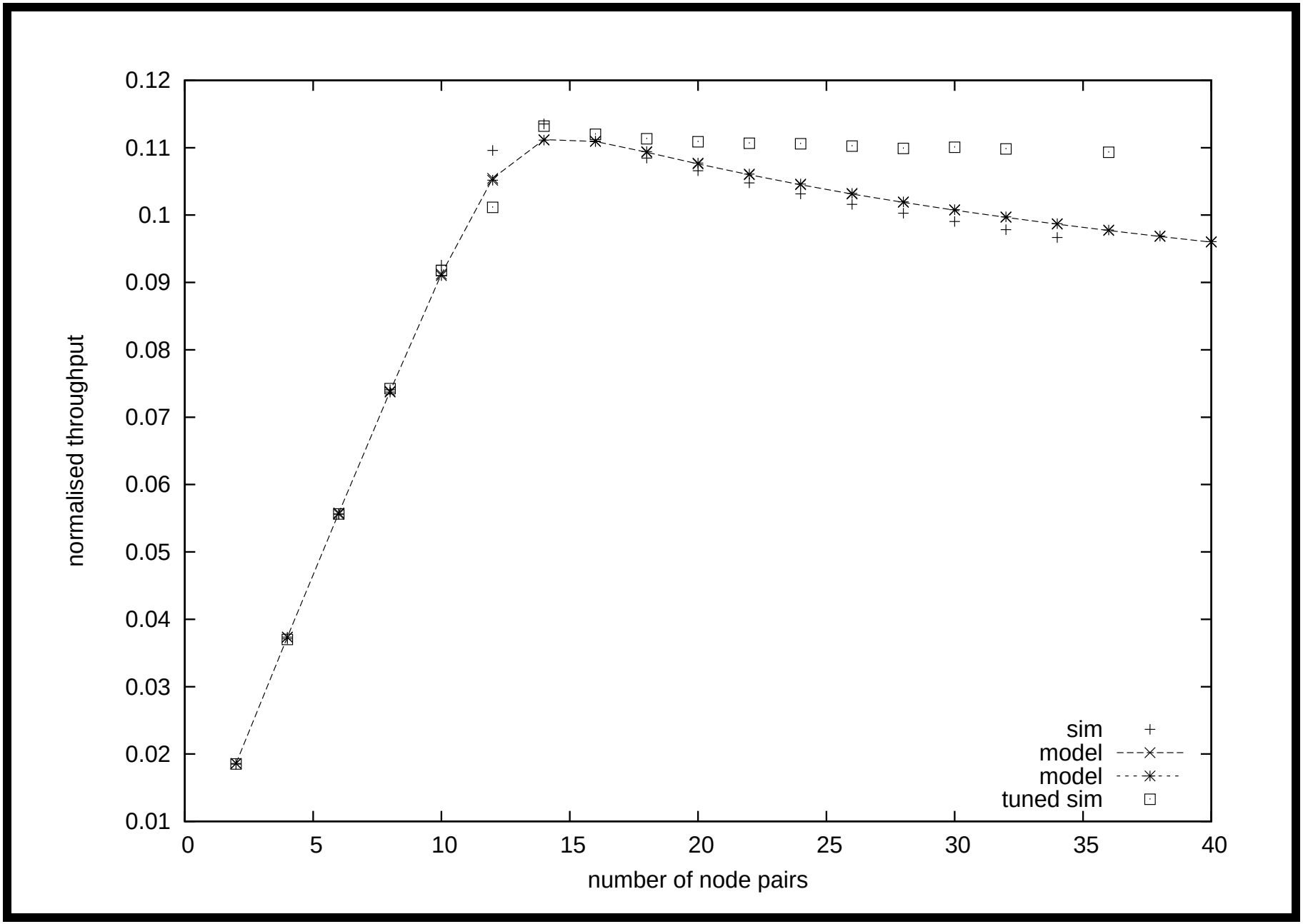
Hamilton Institute Wireless Group

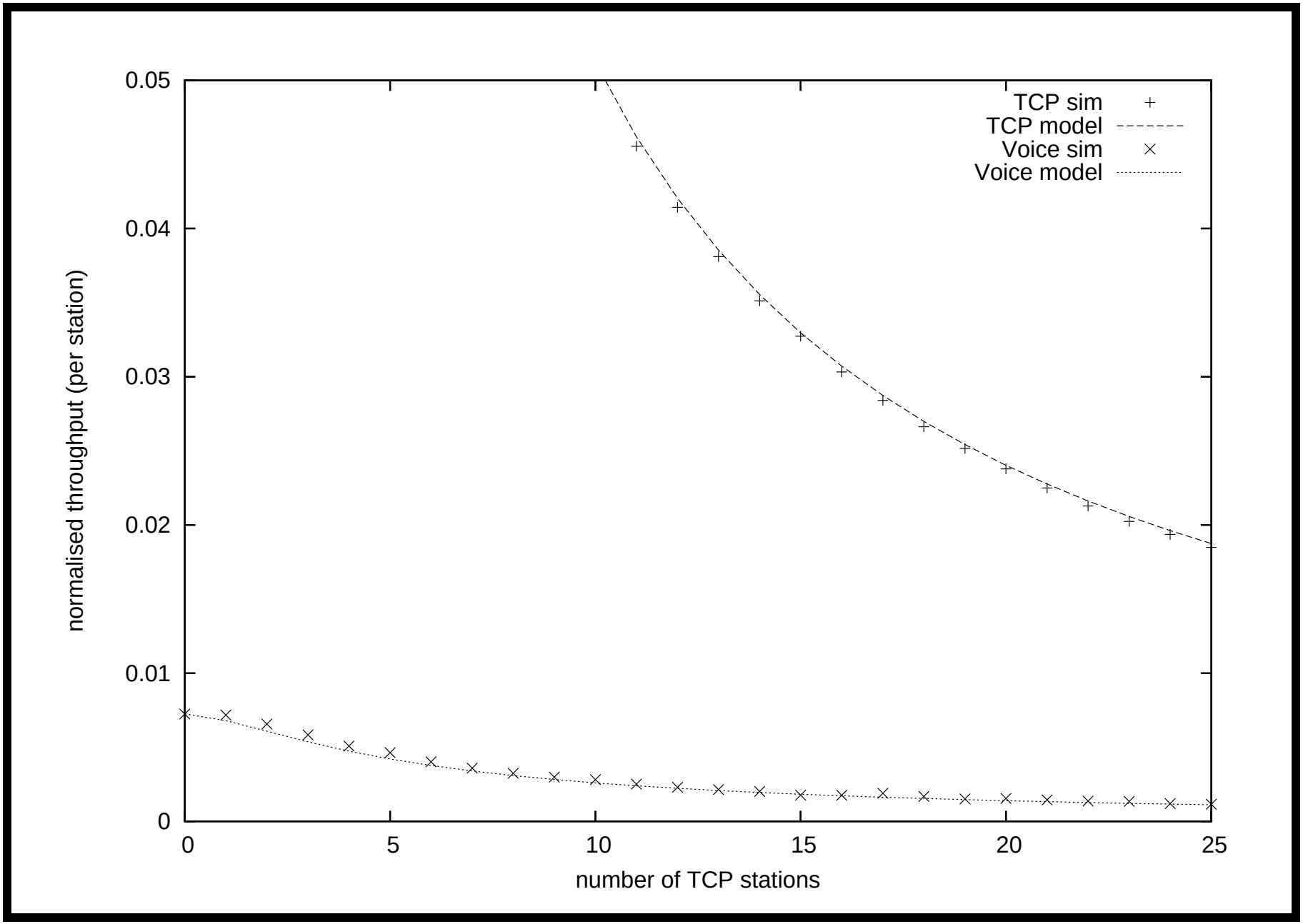
20 Jun 2005

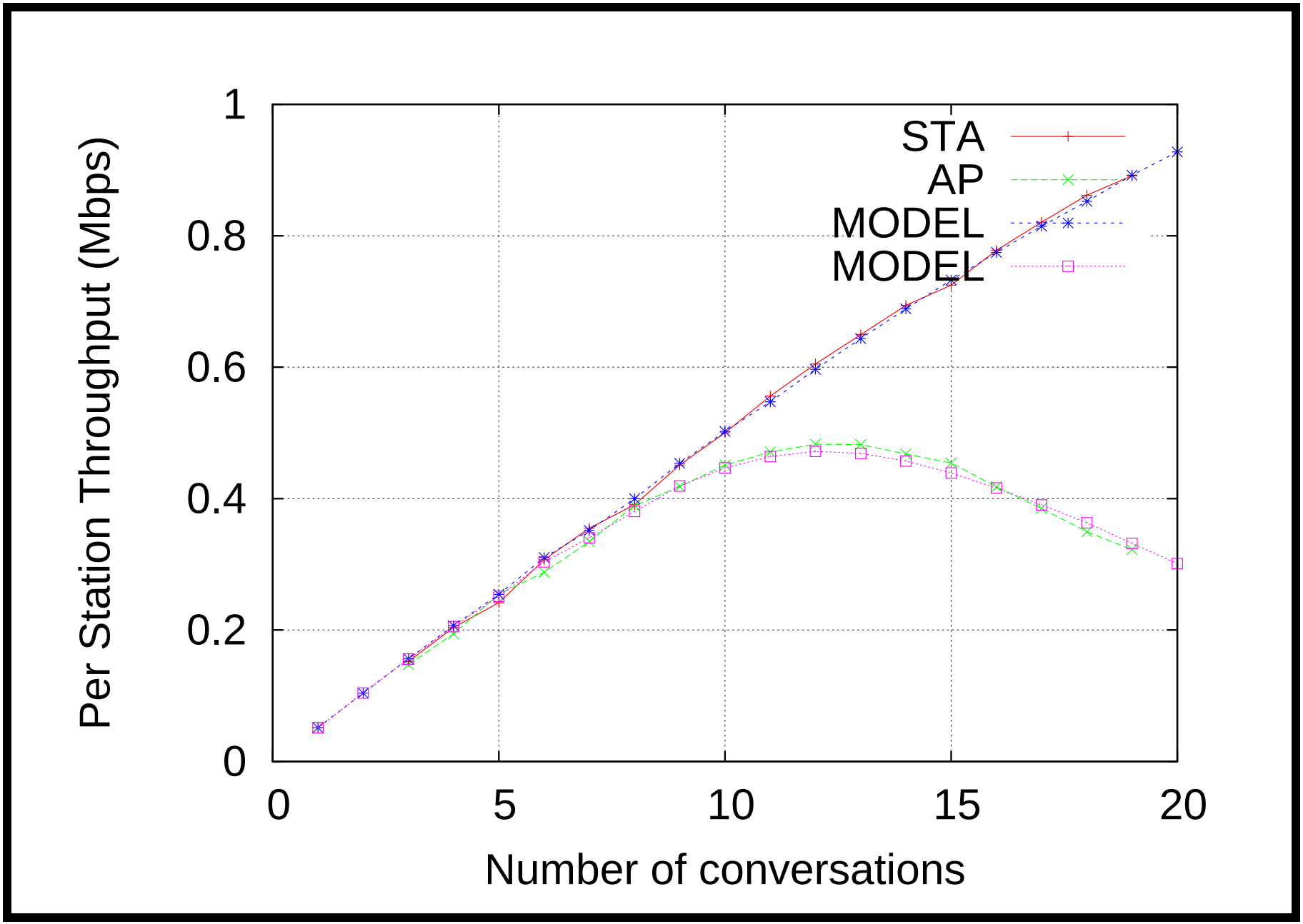
Completed voice work

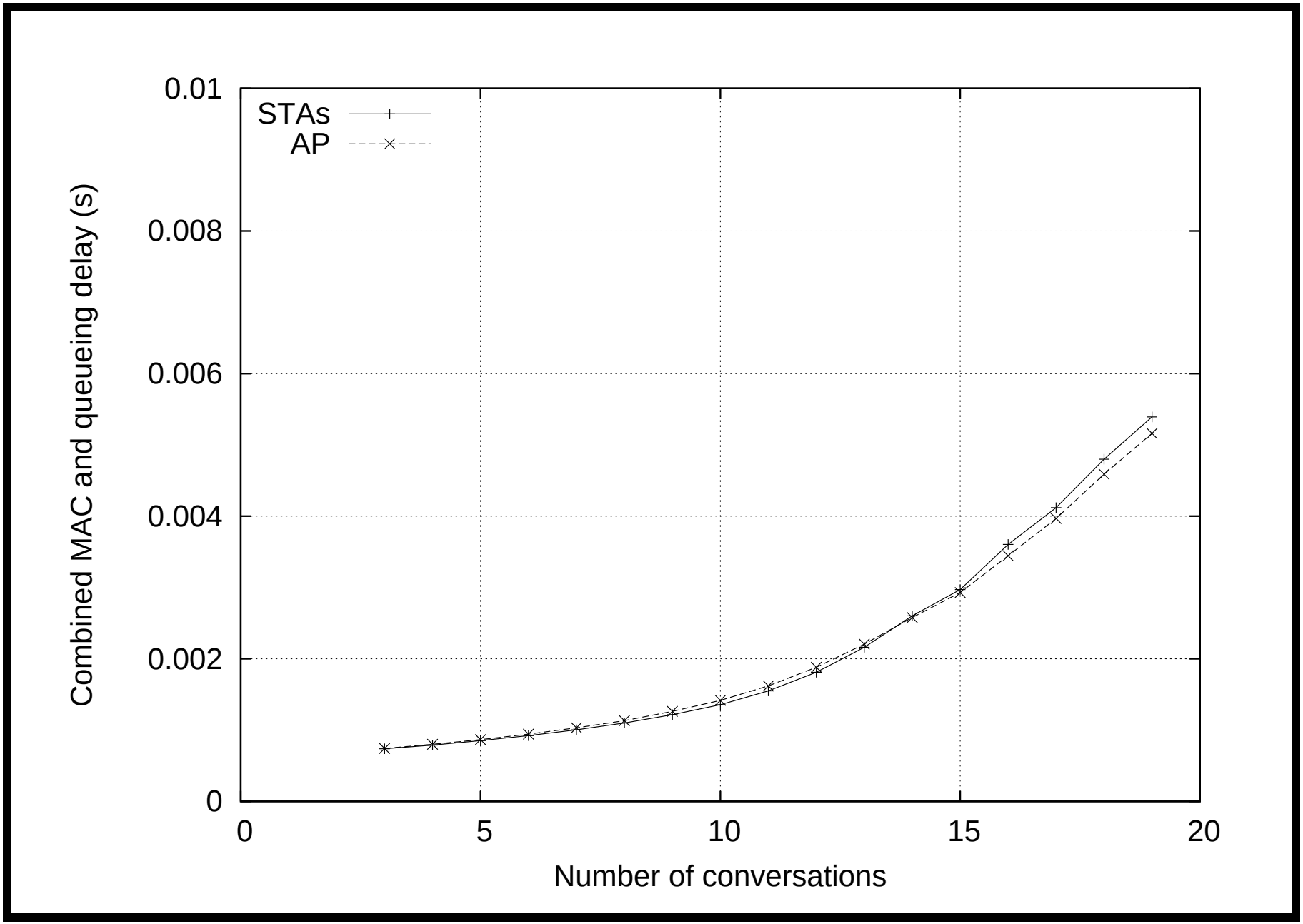
Extended Bianchi model to *nonsaturated* 802.11b. This enables:

- theoretical justification of maximum number of voice calls, confirming experimental and back-of-envelope calculations;
- practical optimisation of parameters such as CWmin;
- consideration of heterogeneous demands.


0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
normalised throughput
0
5
10
15
20
25
30
35
40
number of node pairs
sim
model
model
tuned sim


0.05
0.04
0.03
0.02
0.01
0
normalised throughput (per station)
0
5
10
15
20
25
number of TCP stations
TCP sim
TCP model
Voice sim
Voice model


Per Station Throughput (Mbps)
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
Number of conversations
STA
AP
MODEL
MODEL


0.01
0.008
0.006
0.004
0.002
0
Combined MAC and queueing delay (s)
STAs
AP
0
5
10
15
20
Number of conversations

- Within capacity, voice alone should work OK.
- Capacity can't be significantly increased by tuning CWmin.
- Mixing voice and (saturated) data looks like bad news.
- Access point crunch?

Can 802.11e help?

802.11e EDCF allows the adjustment of several parameters:

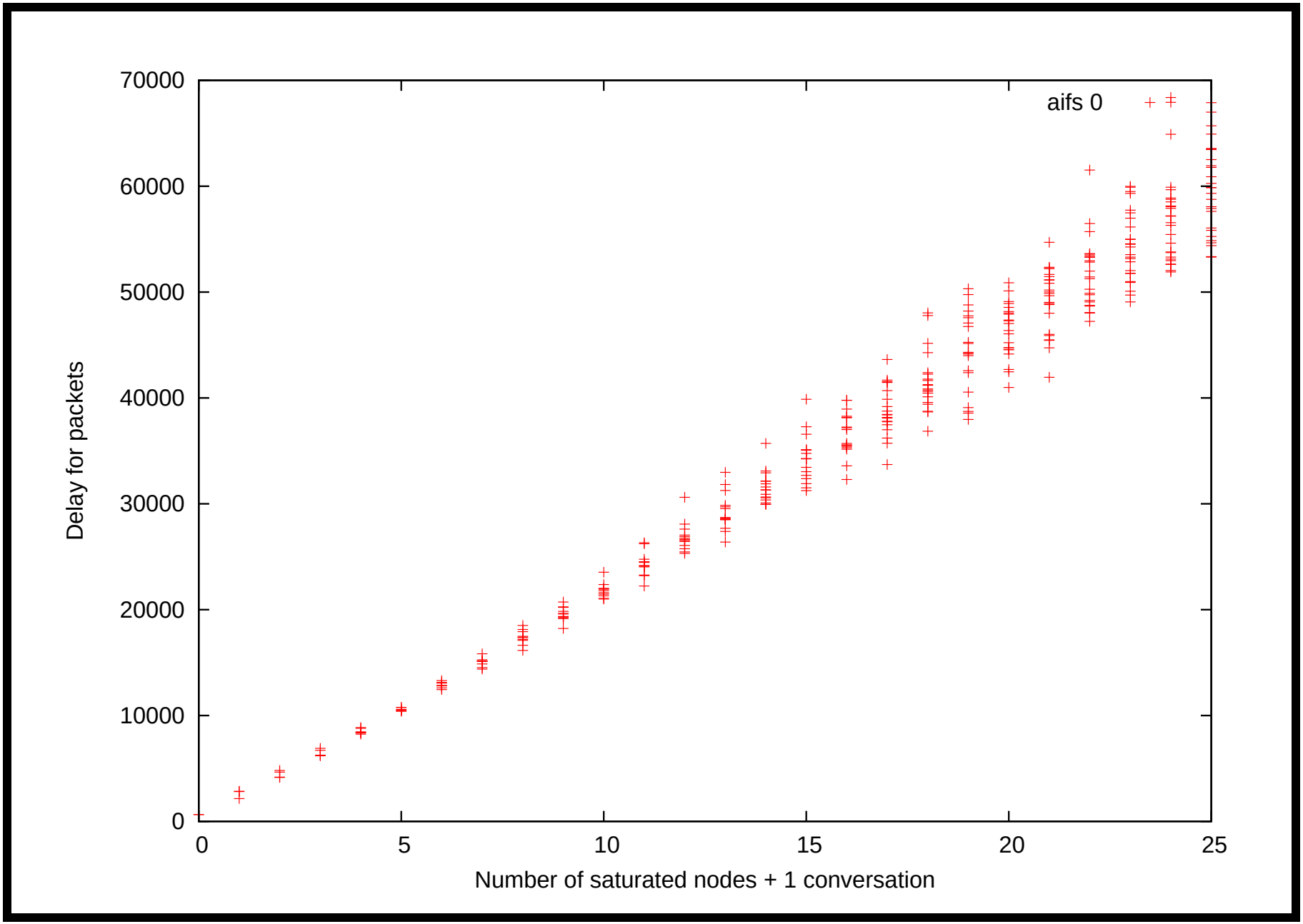
- CWmin
- AIFS
- TXop

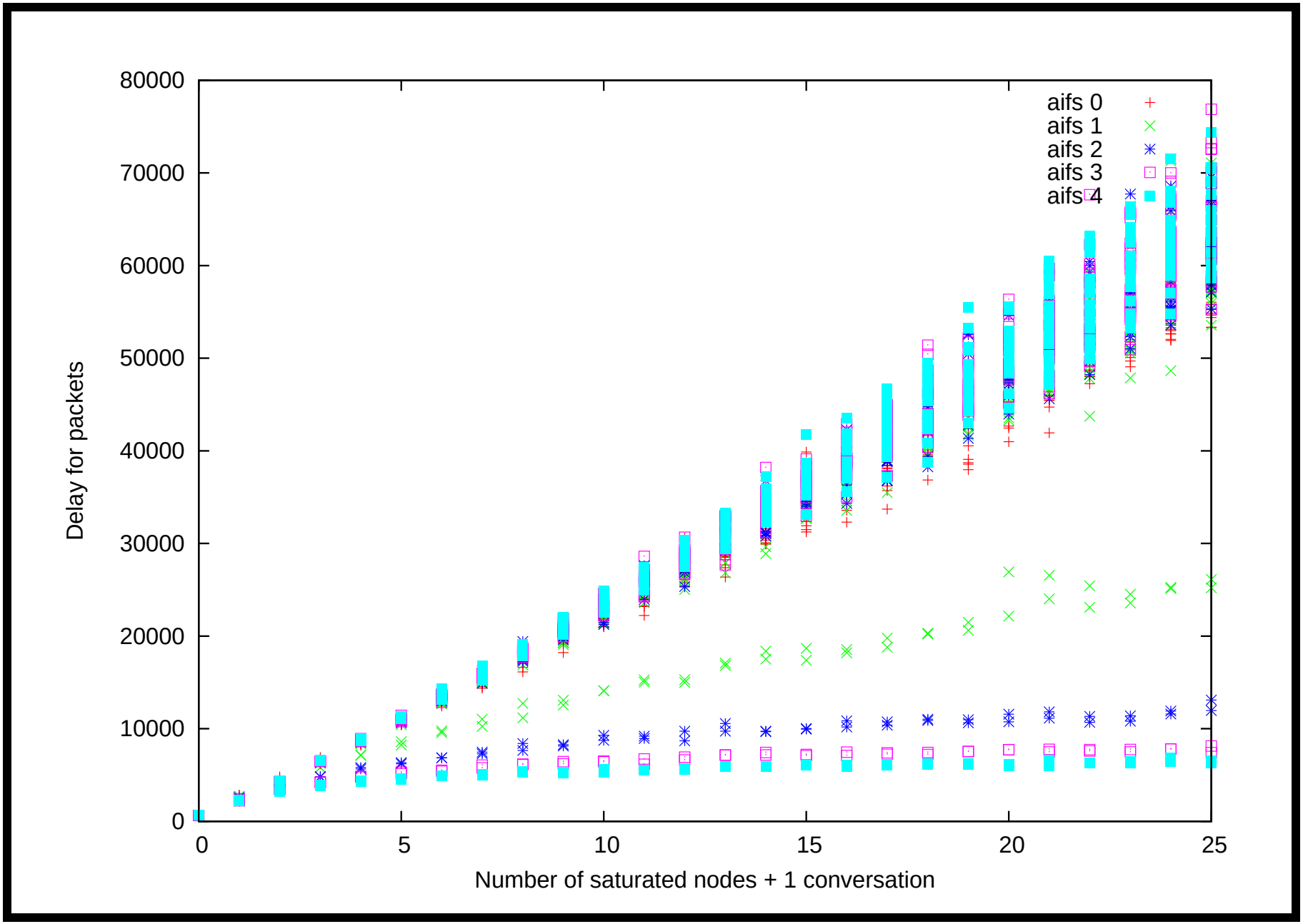
How can these be used improve voice performance?

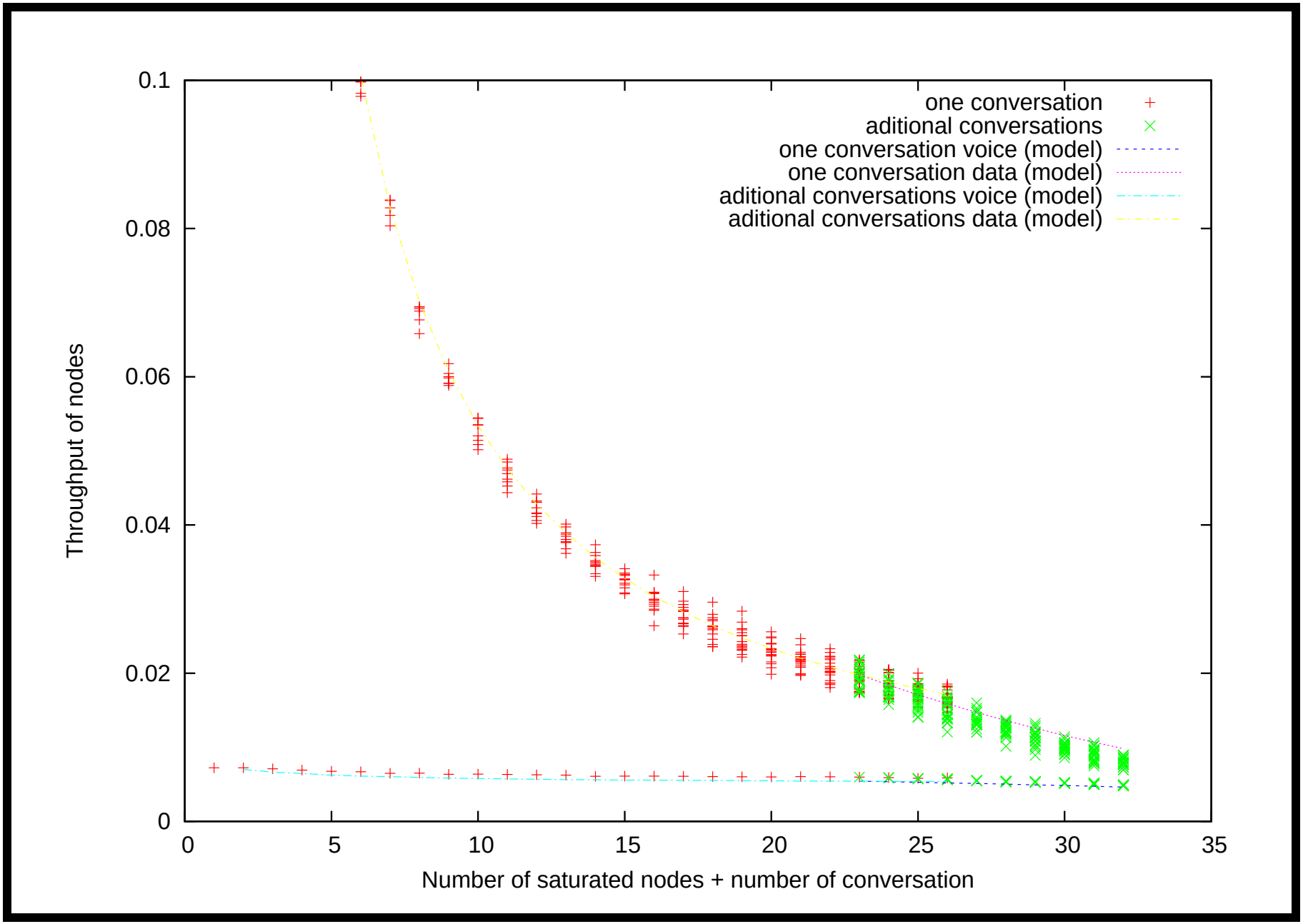
Modelling

- Different CWmin values are relatively easy to model/understand.
- AIFS is more subtle. Strongly load dependant.
- TXop can be easily modelled under certain buffering assumptions.
- Combined nonsaturated 802.11b model with a saturated 2-class 802.11e model of Battiti.

Modelling supports notion that AIFS has little impact in low loads but should be dramatic for heavy loads.


aifs 0
Delay for packets
Number of saturated nodes + 1 conversation
0
10000
20000
30000
40000
50000
60000
70000
0
5
10
15
20
25

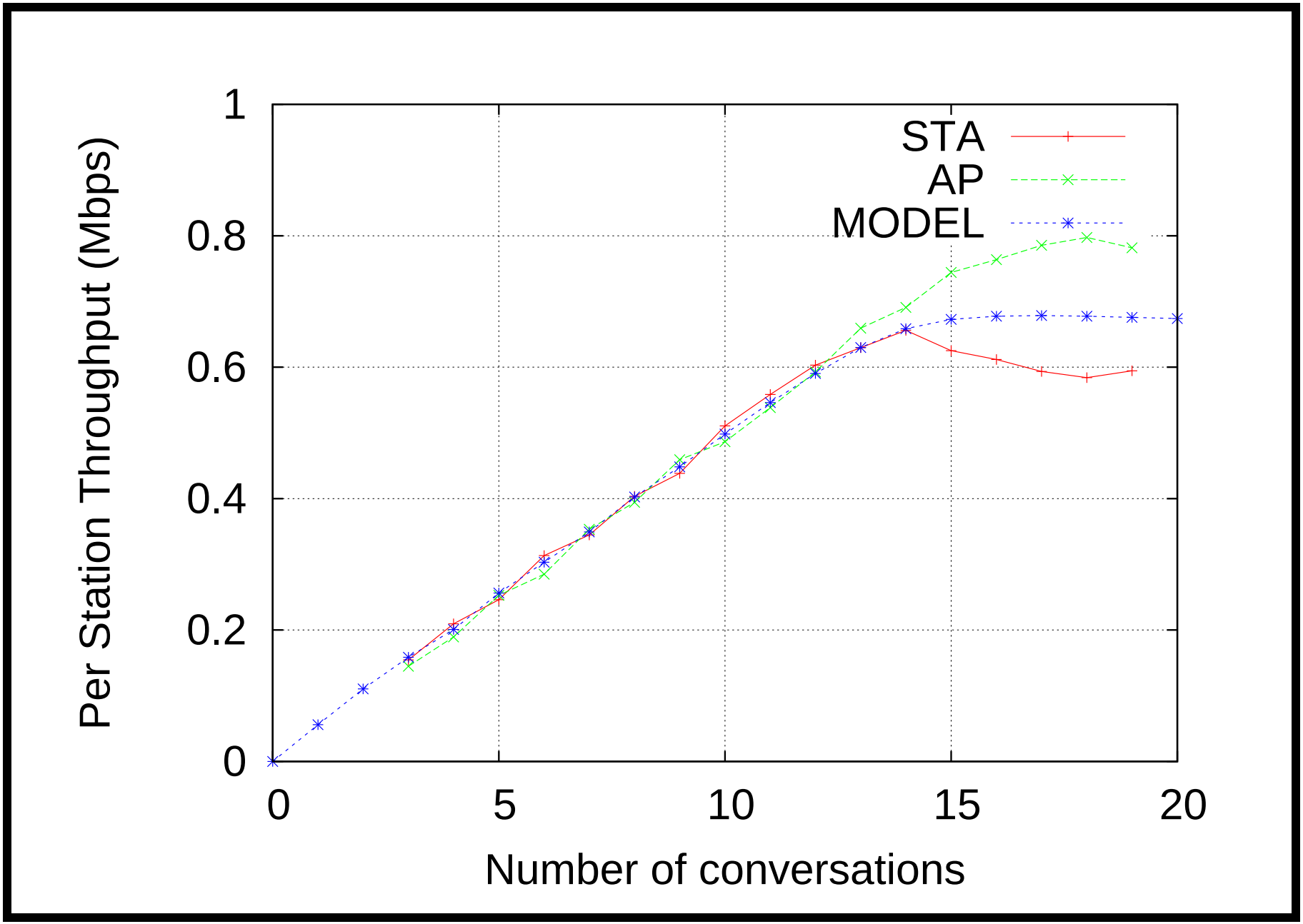

80000
70000
60000
50000
40000
30000
20000
10000
0
Delay for packets
0
5
10
15
20
25
Number of saturated nodes + 1 conversation
aifs 0
aifs 1
aifs 2
aifs 3
aifs 4


0.1
0.08
0.06
0.04
0.02
0
0
5
10
15
20
25
30
35
Throughput of nodes
Number of saturated nodes + number of conversation
one conversation
aditional conversations
one conversation voice (model)
one conversation data (model)
aditional conversations voice (model)
aditional conversations data (model)

To operate voice and data:

- Increase AIFS of data by 4 to protect voice.
- If voice capacity is small, use CWmin = 16, else CWmin = 32.
- Use admission control to prevent voice swamping data.

TXop can also be used to improve access point crunch.


Per Station Throughput (Mbps)
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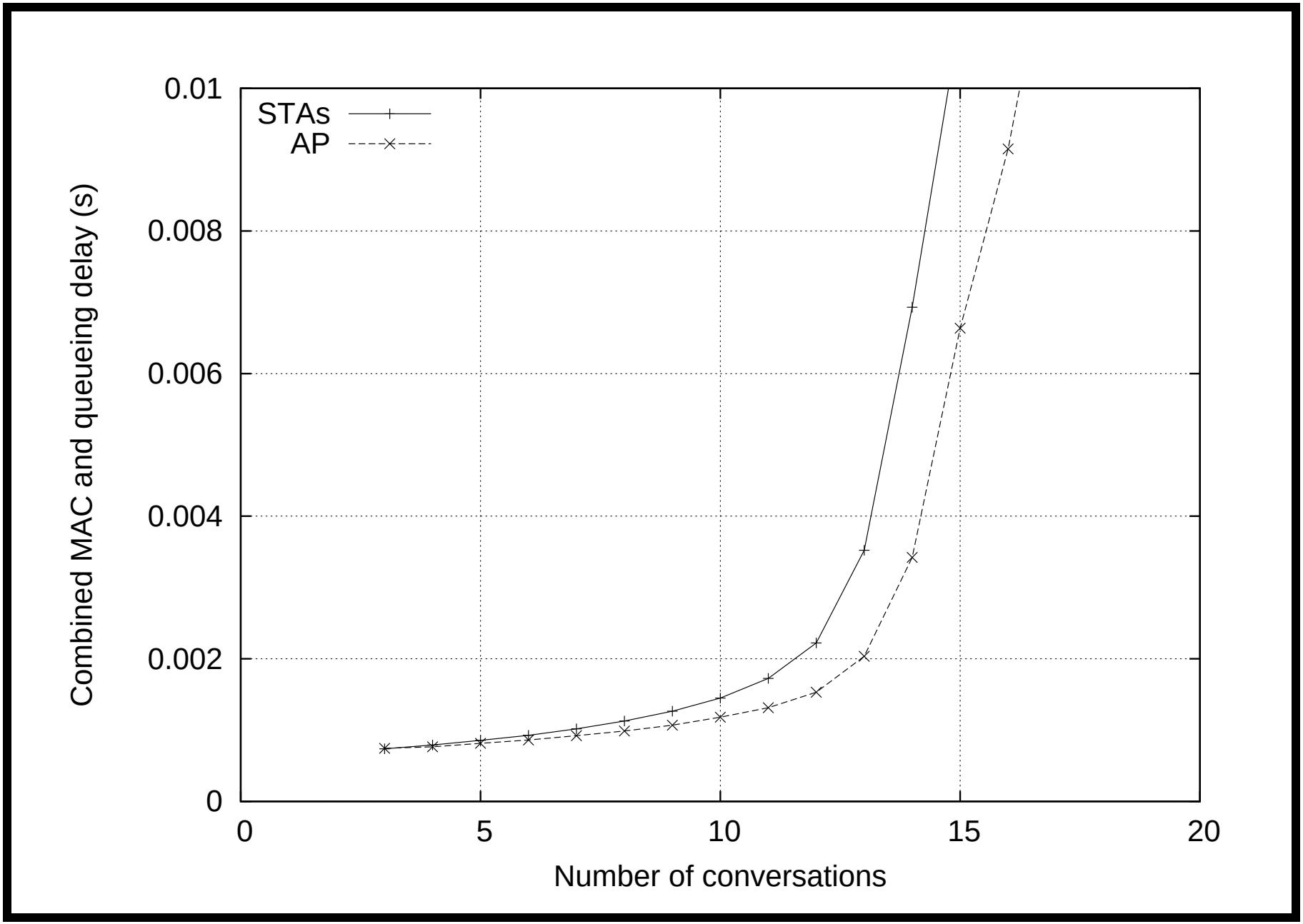
0.8
0.6
0.4
0.2
0
0
5
10
15
20
Number of conversations
STA
AP
MODEL


STAs
AP
Combined MAC and queueing delay (s)
0.01
0.008
0.006
0.004
0.002
0
0
5
10
15
20
Number of conversations

Further work

- Writing up use of model for parameter selection.
- Adjustment of CWmin, AIFS and TXop can be tuned on Atheros based wireless cards using minor changes to the Linux/FreeBSD driver ('madwifi'). Results being validating results on small wireless network here.