Title: An Adaptive Queue Management Method for Congestion Avoidance in TCP/IP Networks

Presented By:

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Outline

- Background
- Network Power
- Simulation Topology
- Weakness of RED - Motivation
- Algorithm
- Simulations & Comparisons RED Vs READ
- READ Tuning
- Conclusions and Future Work

Background (1)

Goals:

- **Show drawbacks of RED with ECN**
- **Propose new AQM: Random Early Adaptive Detection**

Background (2)

- TCP congestion control
- Congestion Control vs. Avoidance
- RED
- ECN

Background (3)

ECN:

- **Binary feedback scheme**
- **Router sets a bit in packet to “mark” instead of drop**
- **ACK mirrors the marking back to receiver**

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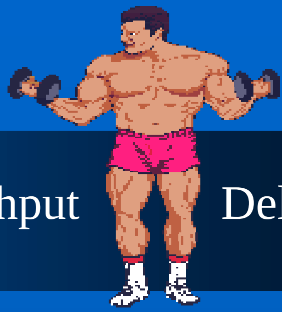
What's Power??



Throughput optimized N/W

-Great throughput- Takes 15minutes to view a web page.

Delay optimized N/W

-Low Delays – But the web page is missing a lot of information…..

$$\text{Power} = \frac{\text{Throughput}^{\propto}}{\text{Response Time}}$$

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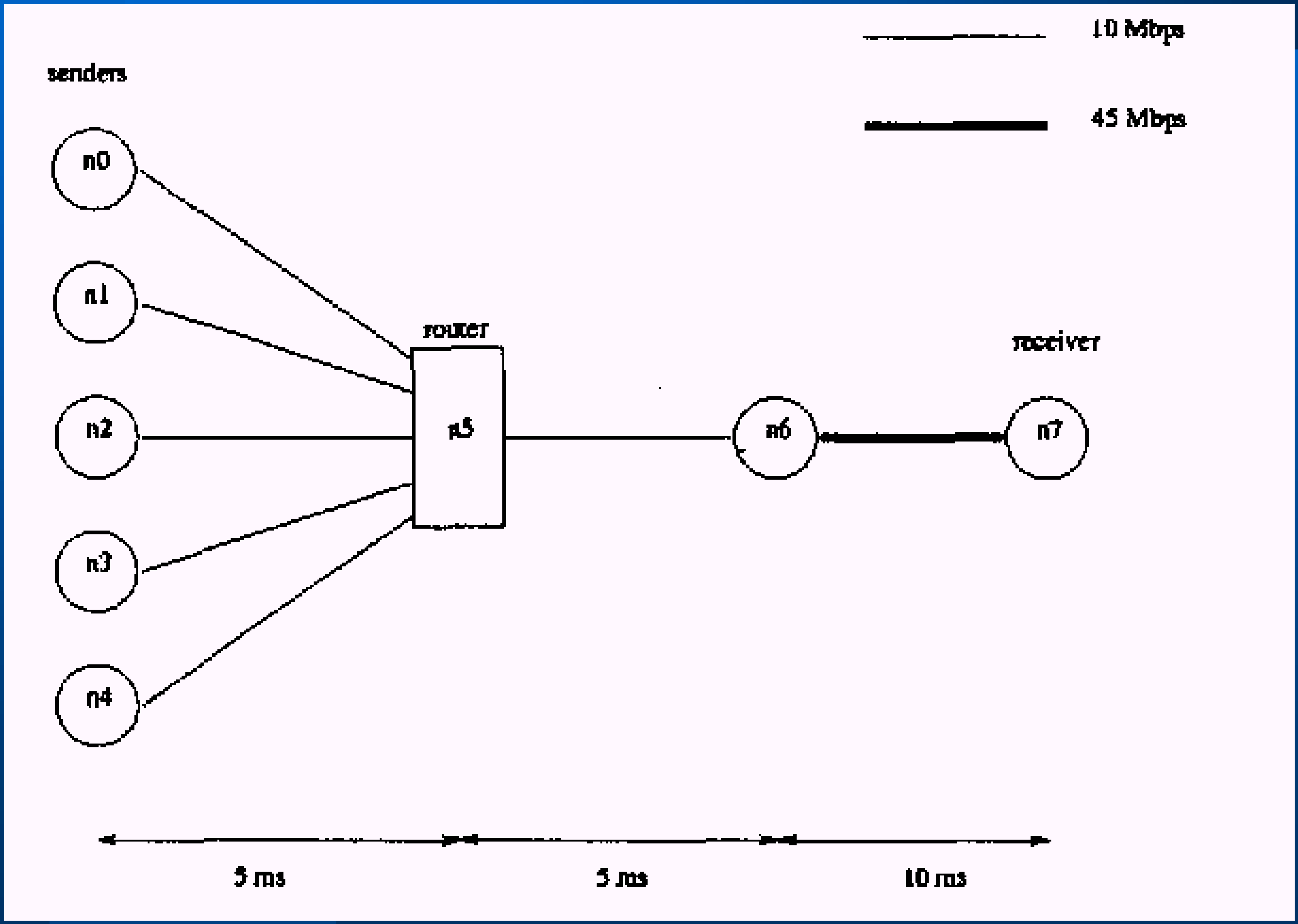
Simulation Topology



Bottleneck

Queue Size = 60 pkts

Pkt Size = 512 bytes

$MIN_{th} = 15$

$MAX_{th} = 45$

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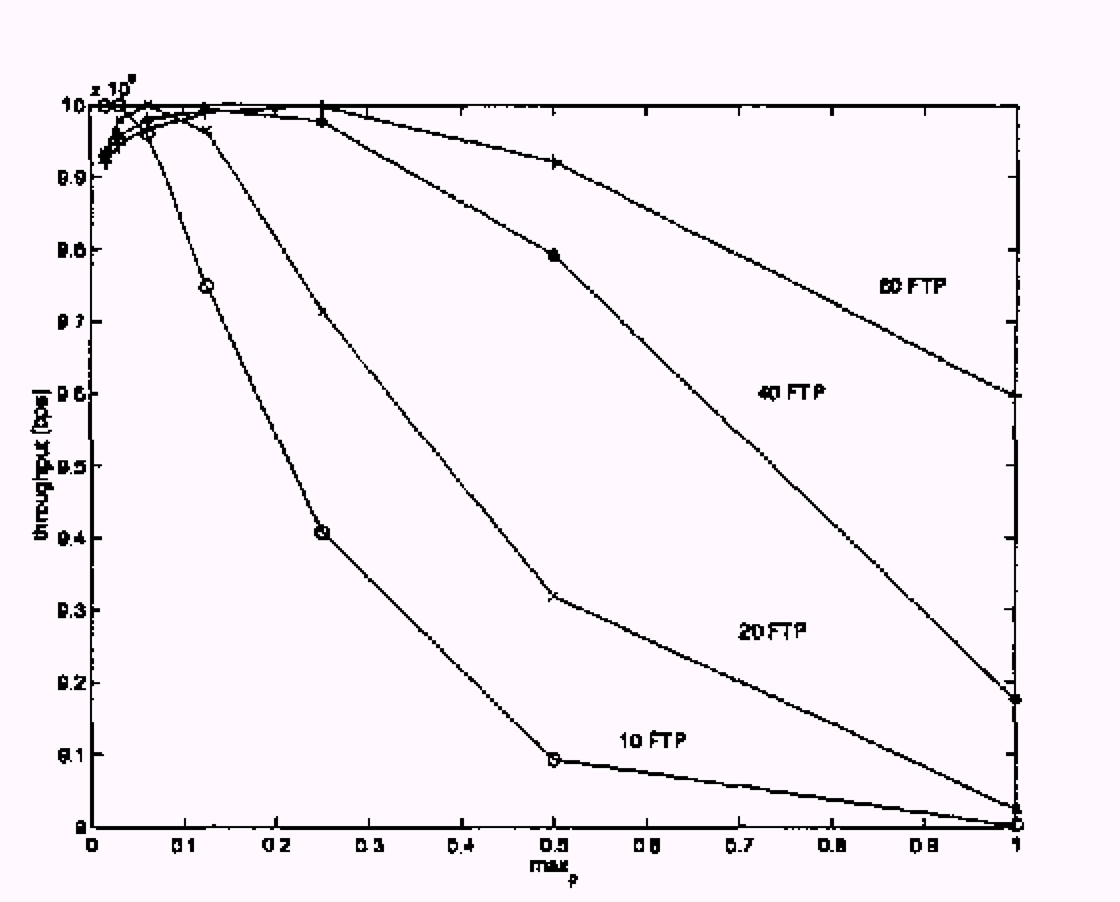
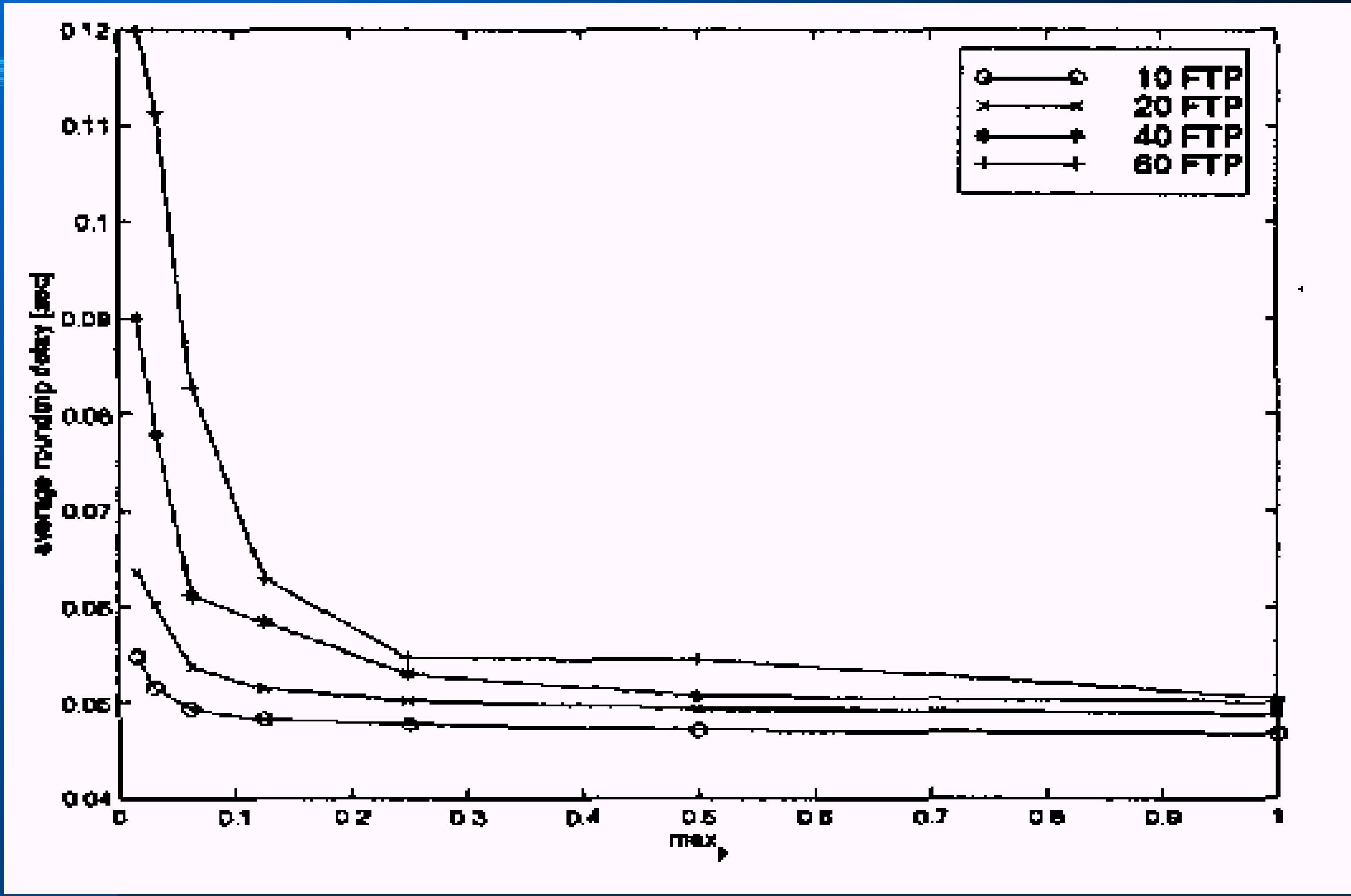
Weakness of RED - Motivation

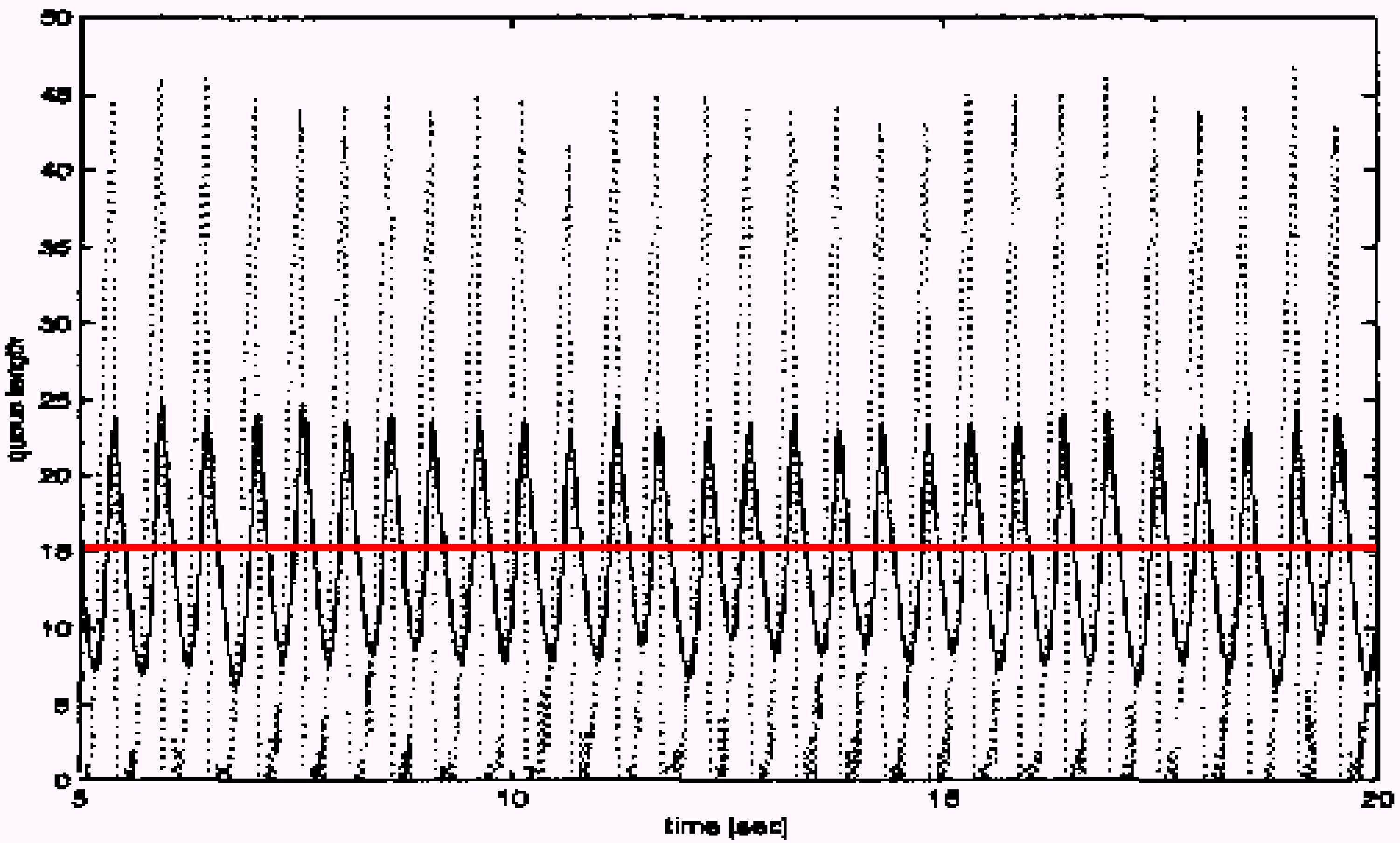


Weakness of RED - Motivation



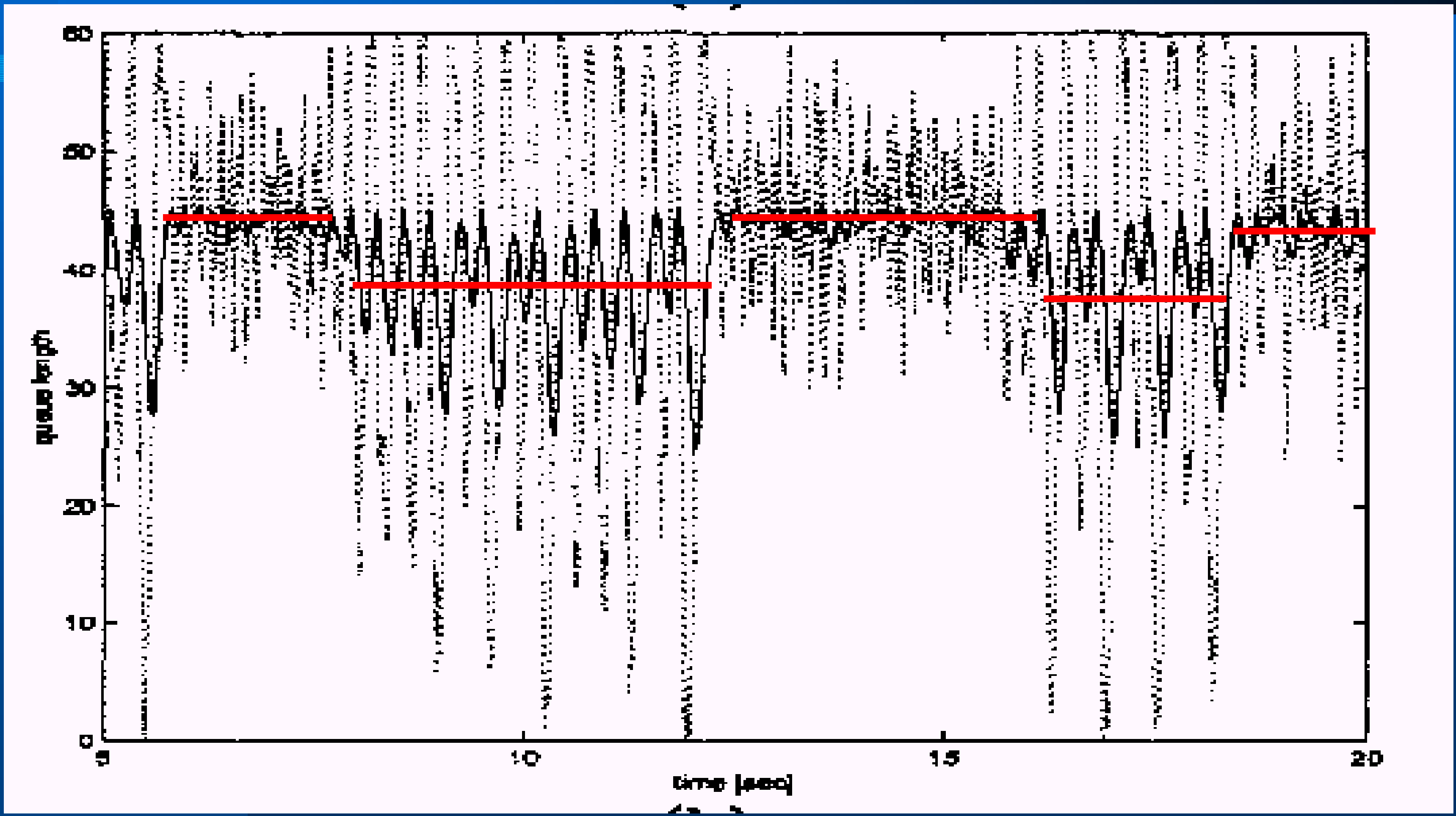
Weakness of RED - Motivation

10 flows



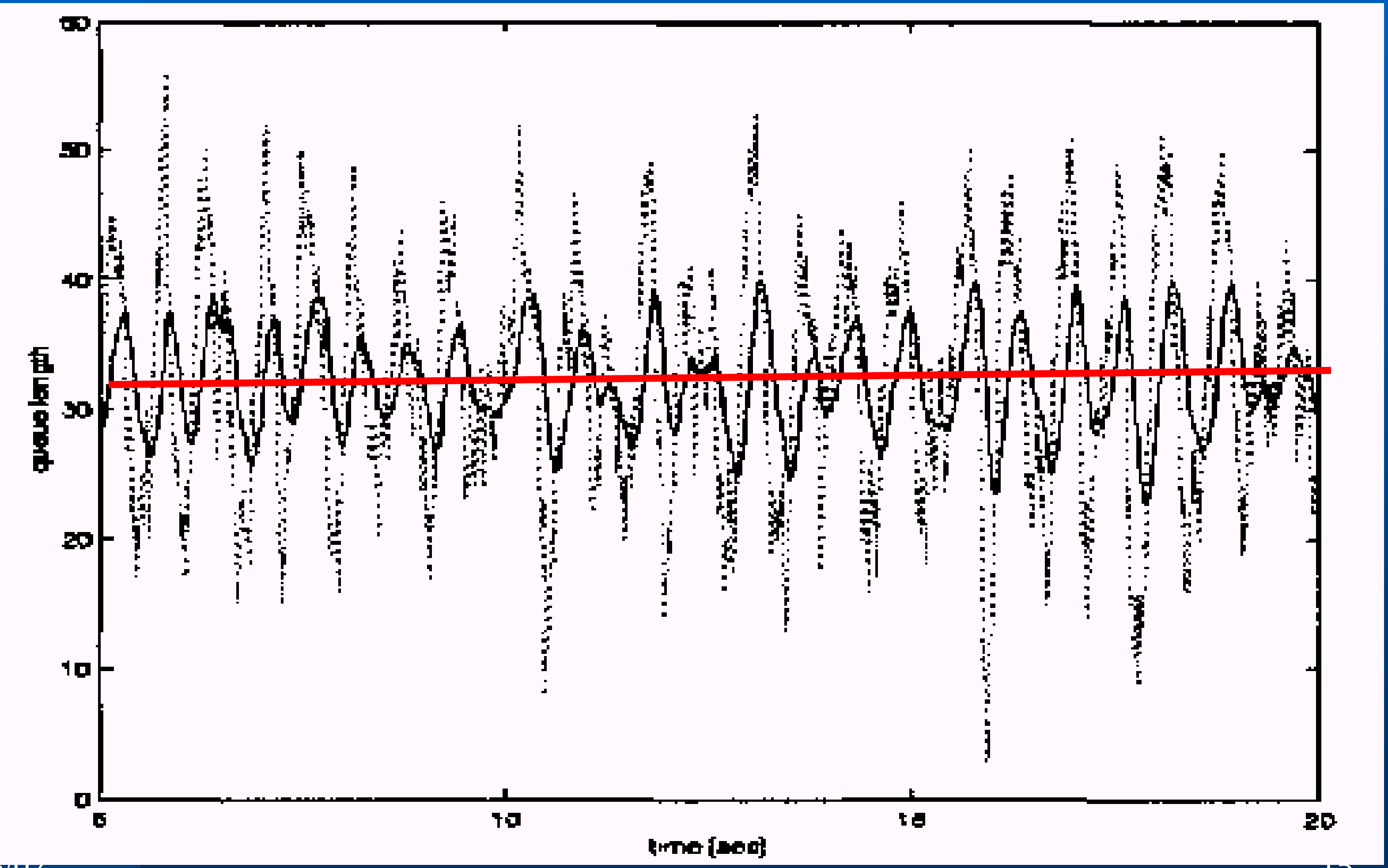
Weakness of RED - Motivation

60 flows



Weakness of RED - Motivation

20 flows



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Random Early Adaptive Detection

Exponentially Weighted Moving Averages

$$Avg_{t+1} = (1-w_q)\ avg_t + w_q\ q_t$$

Old weighted average

Instantaneous queue

$$Sl_{t+1} = (1-w_{sl})\ sl_t + w_{sl}\ (avg_{t+1} - avg_t)$$

Old weighted slope

Instantaneous slope

Random Early Adaptive Detection

At each change of MIN

$$\text{level} = \frac{(MAX + MIN)}{2}$$

if(level > buffer * 0.52)

$$p = p + INC \qquad INC = 0.02$$

if(level < buffer * 0.48)

$$p = p - DEC \qquad DEC = 0.002$$

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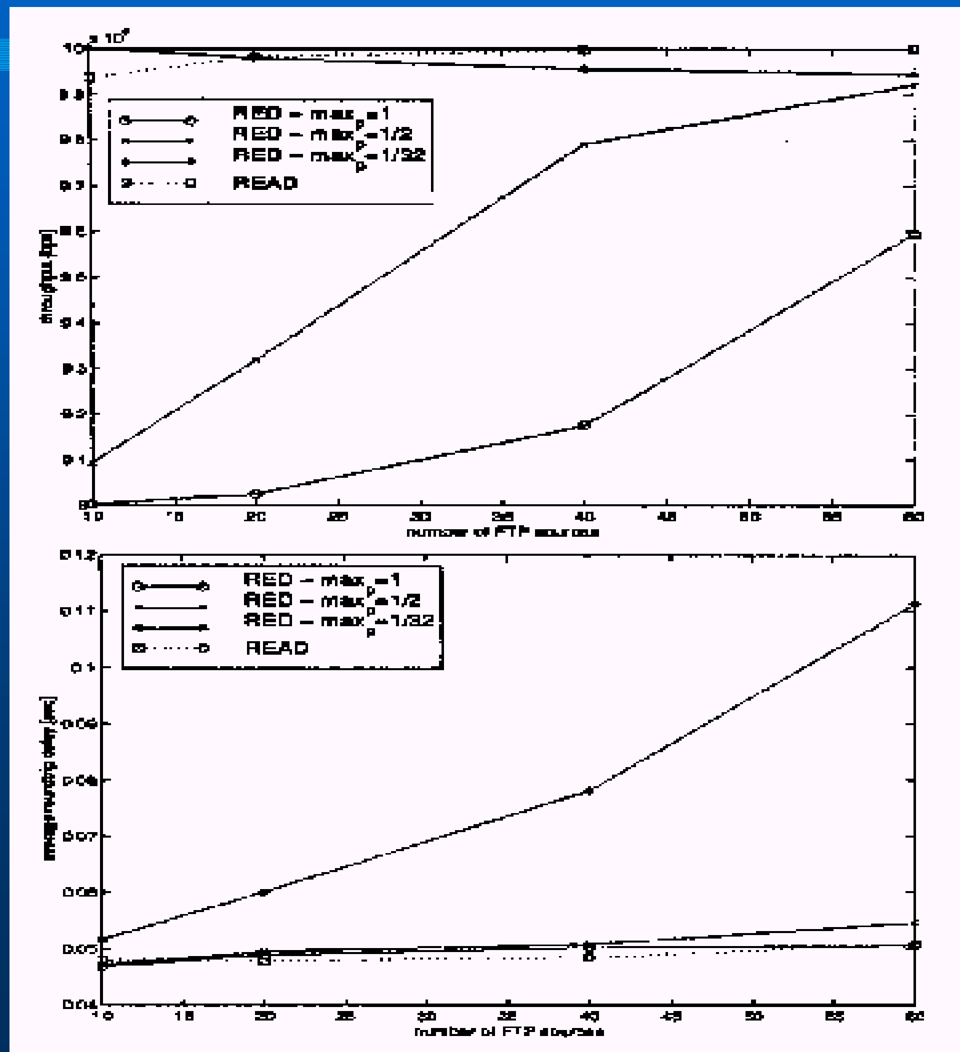
Fig 5: Throughput Vs. Delay



READ Vs. RED (1)

RED:

- Lower Drop probability = Higher Throughput & Higher Delay
- Higher Drop probability = Lower Delay & Lower Throughput

READ:

- Always Lower Delay and Higher Throughput

Fig 6: Power (alpha=1)

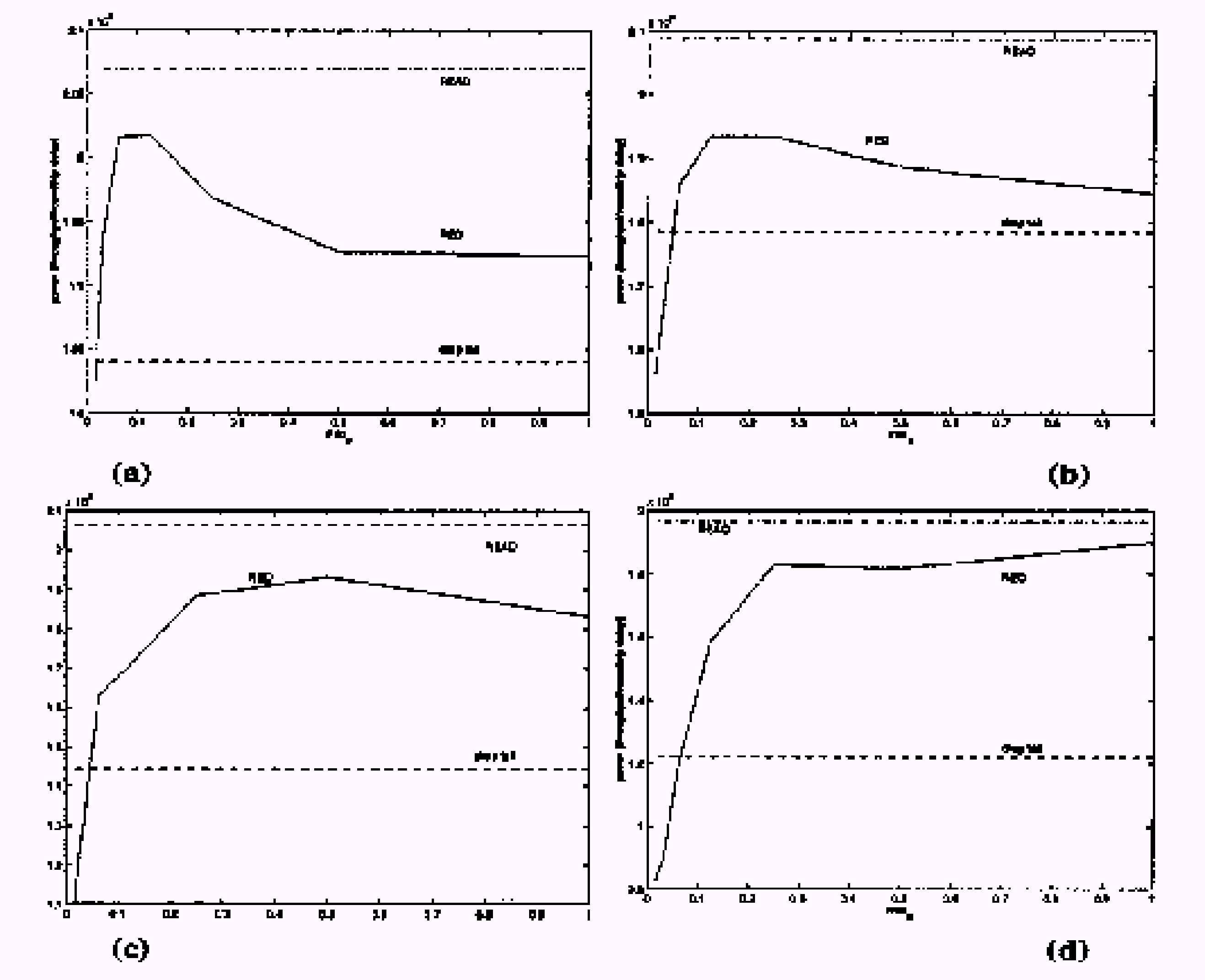
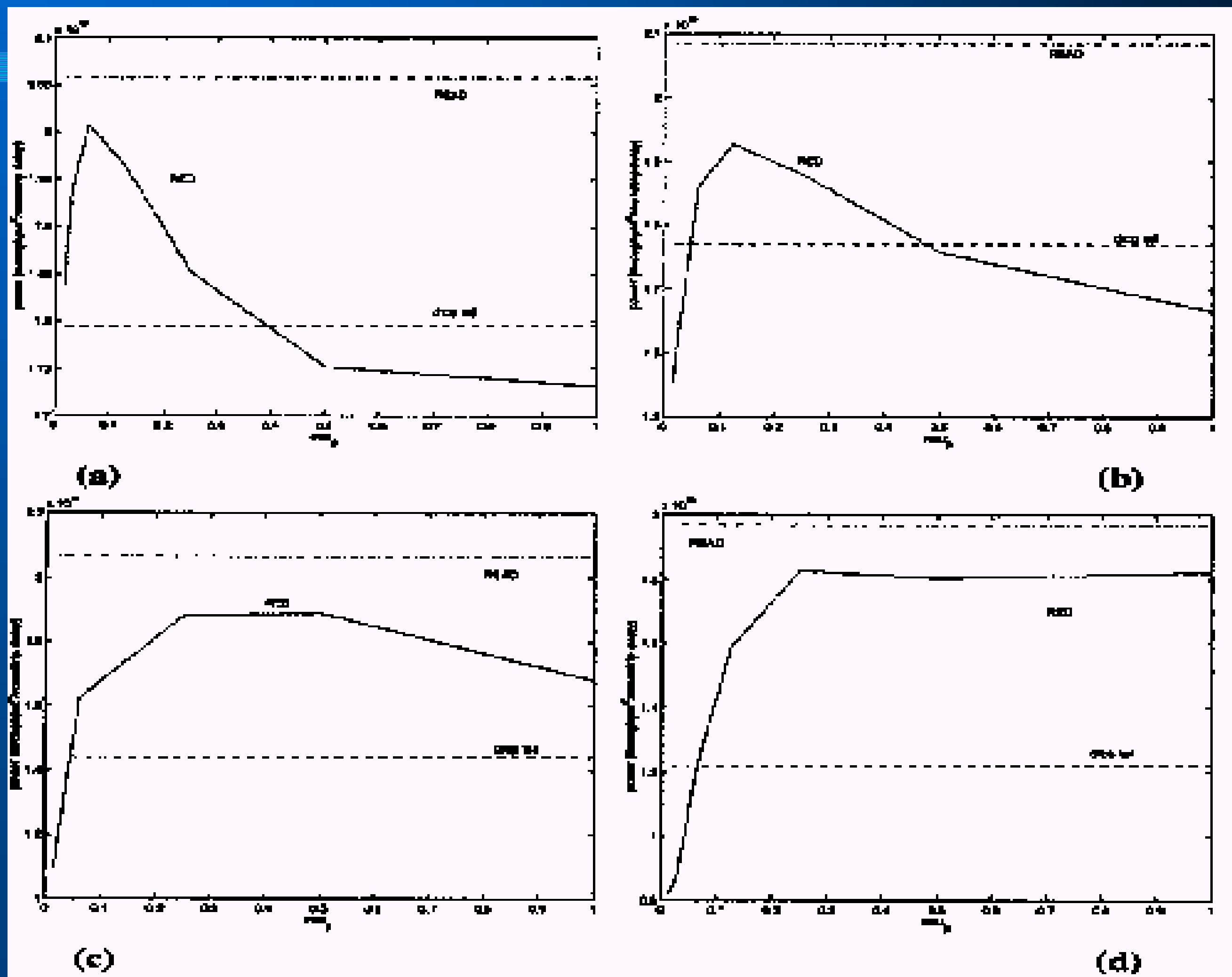


Fig 7: Power (alpha = 2)



READ Vs. RED (2)

RED:

- Performance varies with maxp and number of flows
- Performs worse than Drop Tail under certain conditions

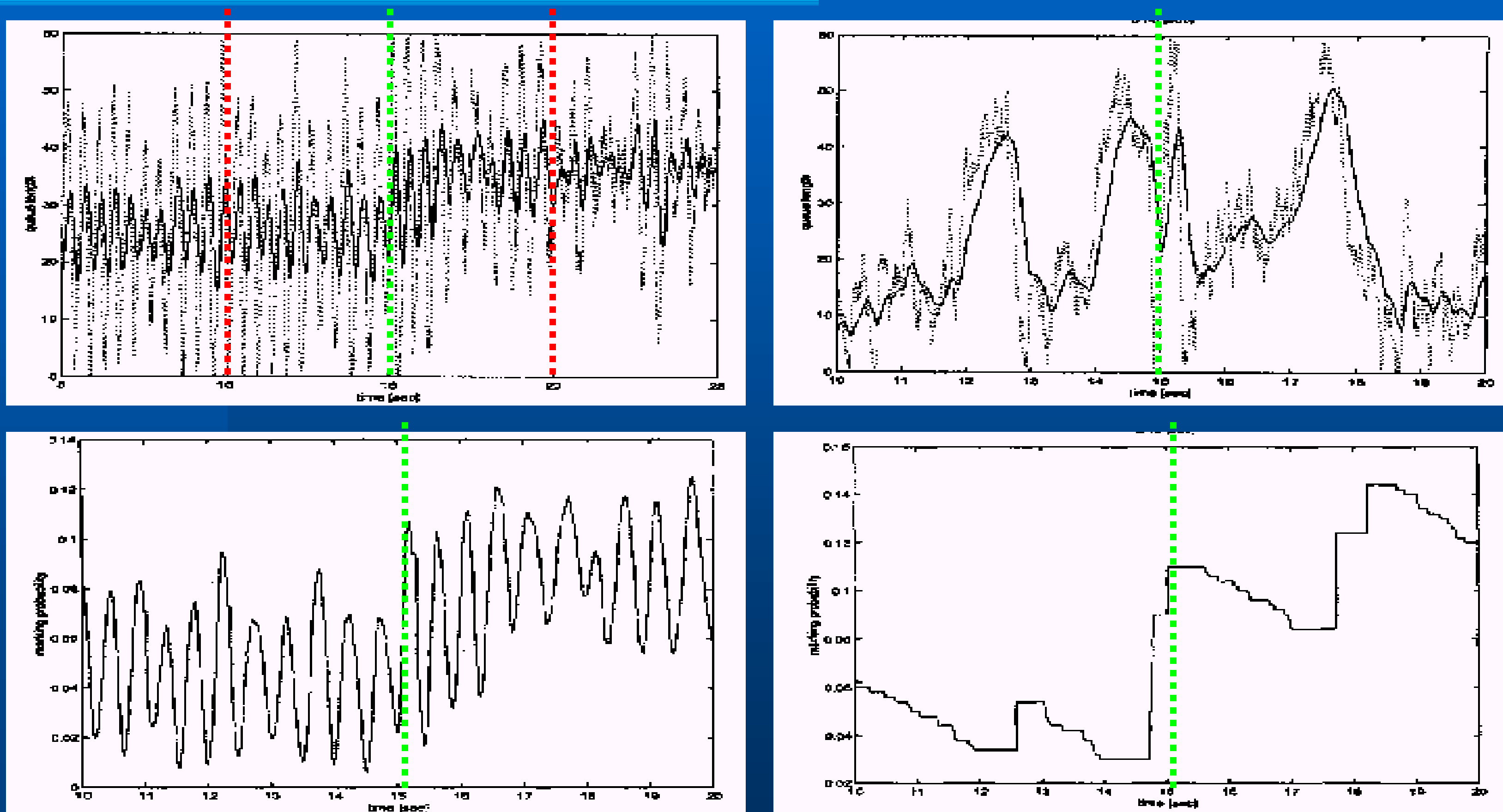
READ:

- Always performs better than RED and Drop Tail

Table 1: Throughput For Mixed Traffic

Number of FTP Connections	Number of Telnet Connections	RED total throughput	RED Telnet roundtrip delay	READ total throughput	READ Telnet roundtrip delay
10	10	9824938	0.0481	9951914	0.0539
30	10	9999701	0.0551	9999428	0.0519
50	10	9983044	0.0997	9995878	0.0499

Fig 8 & 9: Adaptation to Changes in Network Conditions



READ Vs. RED (3)

RED:

- **Large variation in instantaneous and average queue size**
- **Large variation in marking probability**
- **Marking probability varies with queue size**

READ:

- **Less variation in marking probability and queue size**
- **Large, periodic fluctuations**

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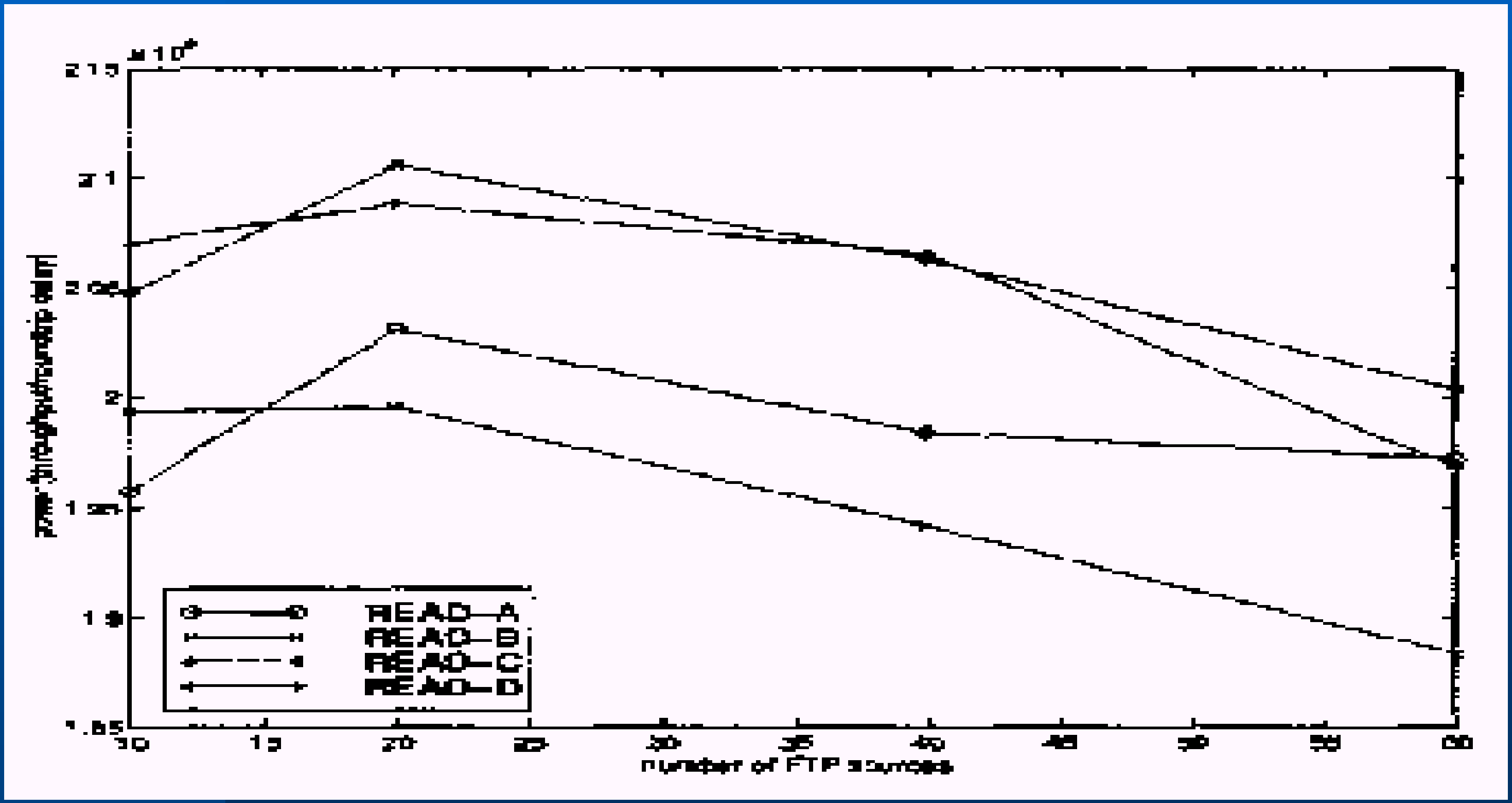
Fig 10: READ Tuning



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Conclusions and Future Work

Conclusions:

- **RED can fail & too aggressive**
- **READ – reliable CA; higher power levels**

Current & Future Work:

- **Examine different increase/decrease algorithms**
- **READ with different Network Topologies**