antcor
ADVANCED NETWORK TECHNOLOGIES

Antcor Polling Optimizer Overview

Outline

- 802.11 Limitations in Outdoor Environment
- Apollo MAC Overview
- Benchmarks
- Future Work

802.11 Limitations (1/2) - Outdoor

- Protocol designed for Indoor use
- Hidden Node - RTS/CTS results in throughput degradation, without eliminating the problem.
- 802.11 Ack mechanism inefficient / not suitable for outdoor environments.
- Further collisions due to short slot time.

802.11 Limitations (2/2) - QoS

- No support for QoS at MAC Layer
- Probabilistic Medium Access
  - No QoS guarantees
  - Leads to unfair throughput distribution even without Hidden Node problems
  - Uplink/Downlink problem
- 802.11e, WMM insufficient, not a viable solution for hard QoS

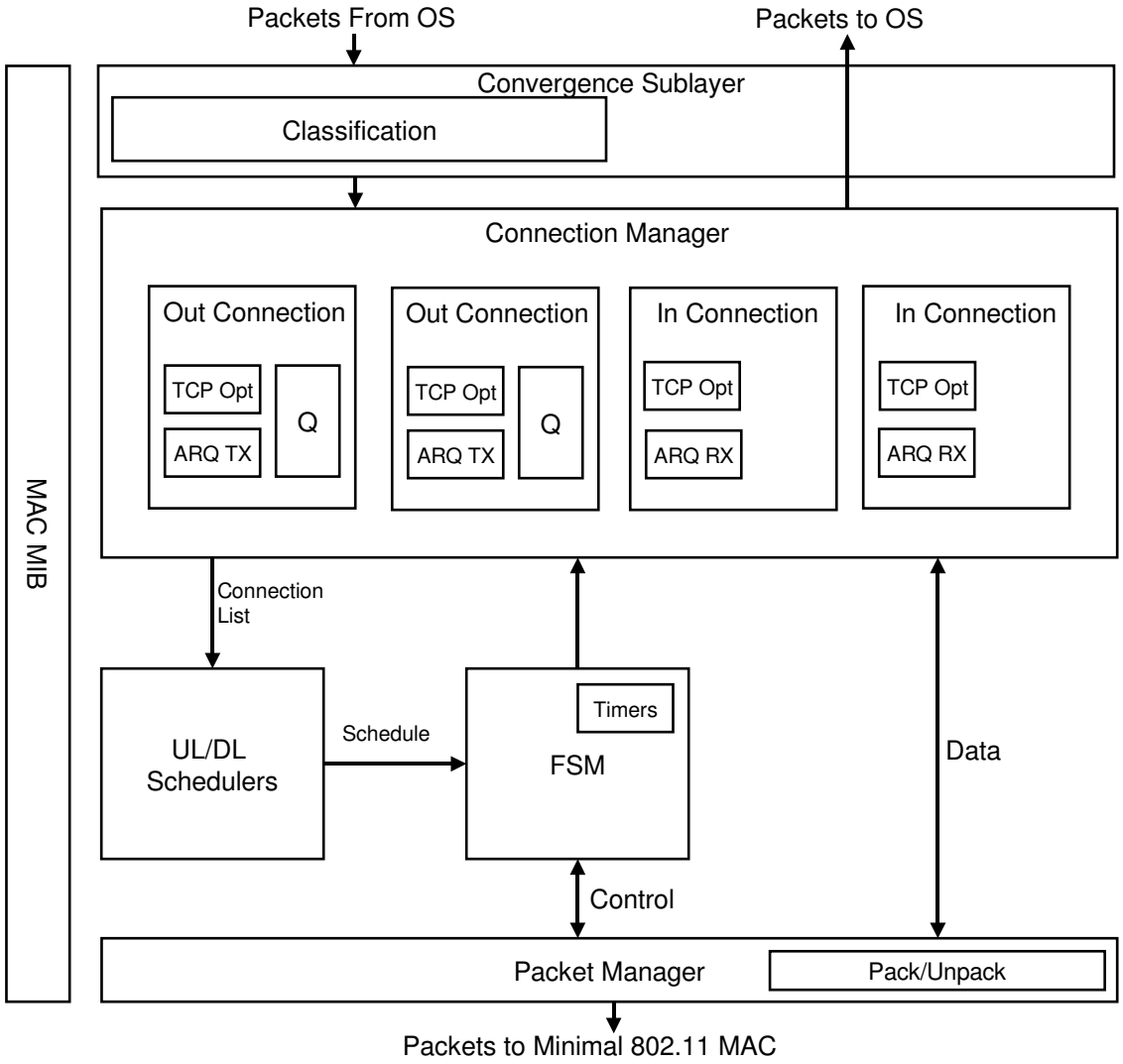
Polling MAC Concept (1/2)

- Goals
  - Design a MAC protocol suitable for use in outdoor environments
  - Deterministic Medium Access
  - Integrate a sophisticated QoS architecture at the MAC layer
  - Low cost, use existing off-the-self 802.11 hardware

Polling MAC Concept (2/2)

- Polling Definition
  - Base Station (AP) allocates the medium to Subscriber Stations (Clients) by granting them access.
  - SS can not access the medium without a grant from the BS.
- BS allocates available resources according to a scheduling algorithm
  - Scheduler determines which SS will be granted access and for how long.
  - Forms the basis for the QoS architecture

Apollo Overview (1/5)



Apollo Overview (2/5)

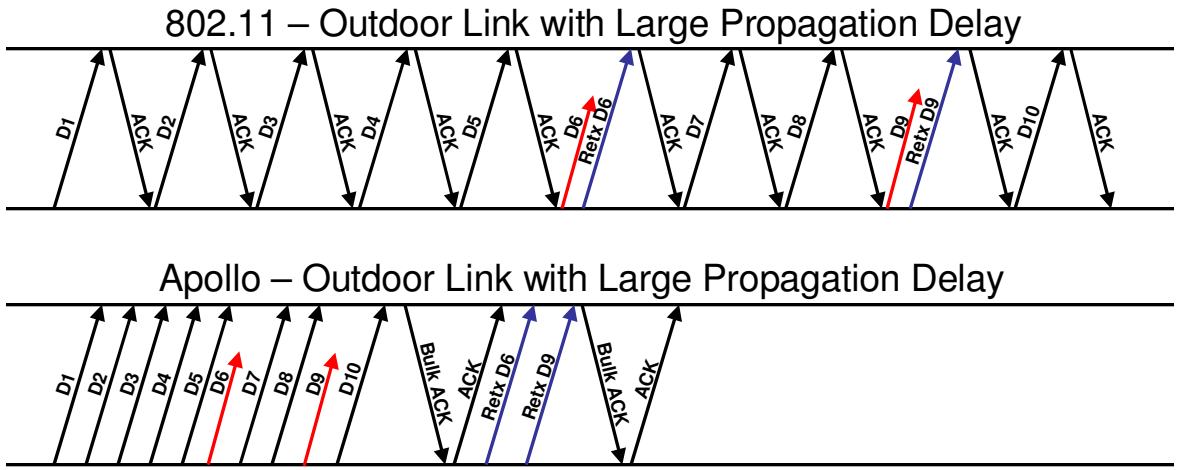
- 802.16-like QoS Architecture
  - Apollo Layer Connections with different scheduling service suitable for Best Effort or Real Time traffic
- Scheduler allocates uplink/downlink resources to Apollo Connections.
  - Sophisticated air link resources allocation via a self-adaptive and auto-configurable traffic scheduling engine, which can provide strict performance guarantees.
  - Goal: Maximize throughput of BE connections while satisfying the delay/jitter constraints of RT connections
  - Guaranteed fairness
  - Optimized for Double Play (Voice/Data) deployments

Apollo Overview (3/5)

- Apollo utilizes 802.11 MAC/PHY for packet Reception and Transmission

- Minimal 802.11 MAC/PHY
  - Only 802.11 encapsulation/decapsulation is active
  - Modified PHY operation eliminates 802.11 overhead
    - Backoff disabled – not necessary for the polling protocol
    - 802.11 acknowledgments disabled – Retransmissions are handled at Apollo layer via the ARQ module.

Apollo Overview (4/5)

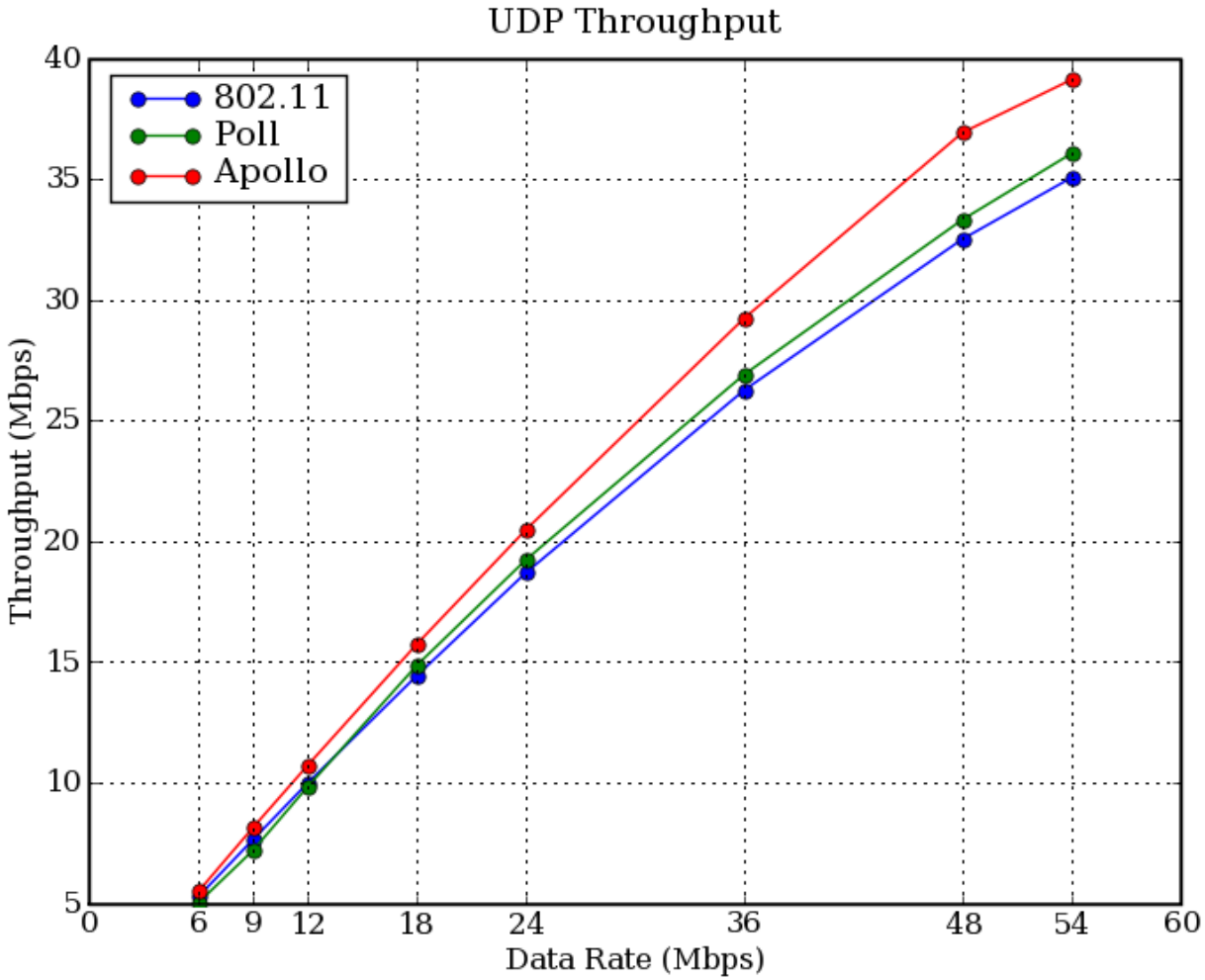


- Automatic Repeat Request (ARQ)
  - A proprietary bulk-ACK method replaces the insufficient 802.11 ACK mechanism.
    - Acknowledge a burst of packets instead of just one packet
    - Selectively Retransmit lost packets

Apollo Overview (5/5)

- Packet Aggregation
  - Several packets are packed in a single PDU before transmission
  - Minimized protocol overhead for Multimedia Traffic (i.e. VoIP)
  - Throughput improvement
  - System load reduction
- TCP Optimization Module
  - Improved TCP throughput
- Hardware-independent
- Platform-independent

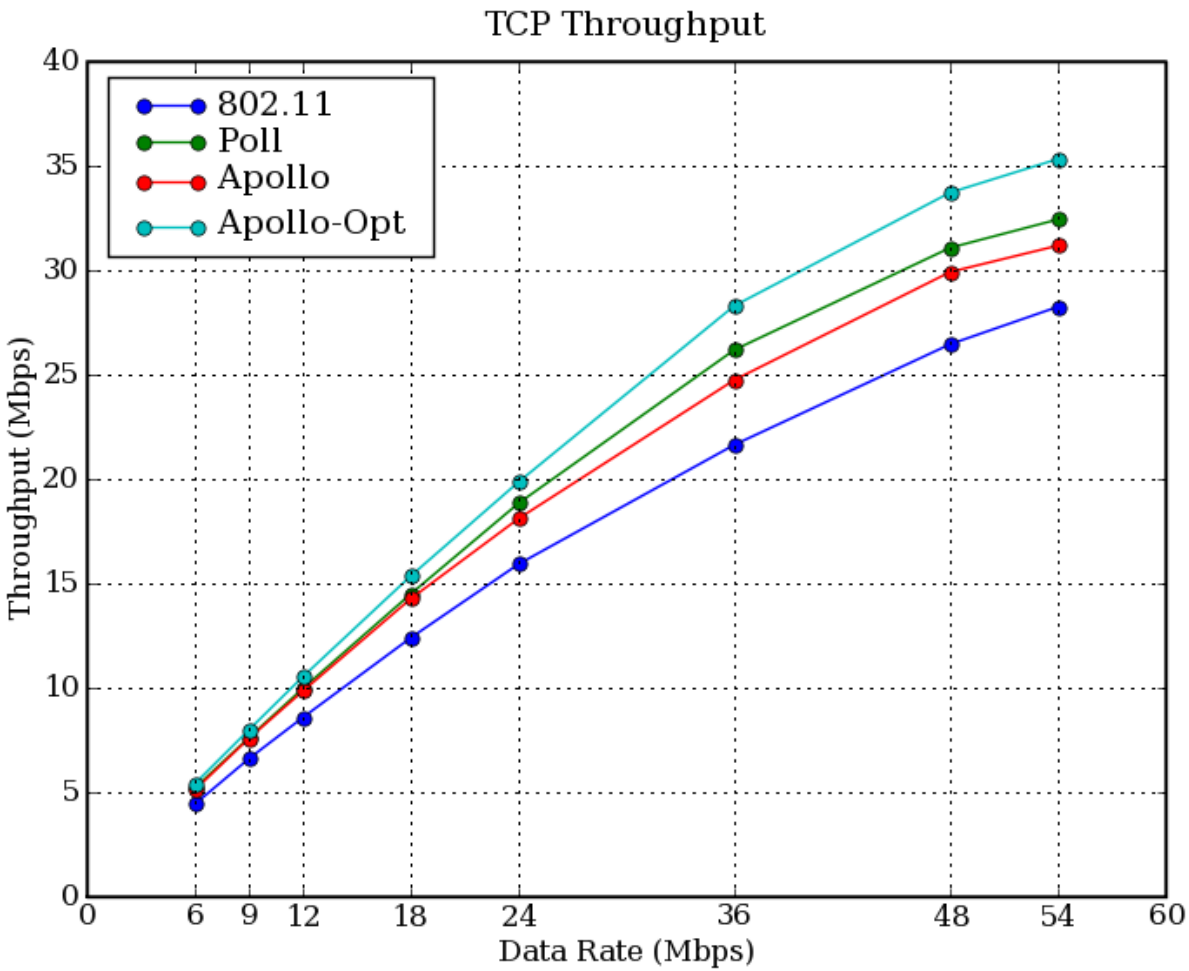
Benchmarks - UDP



Increased Throughput

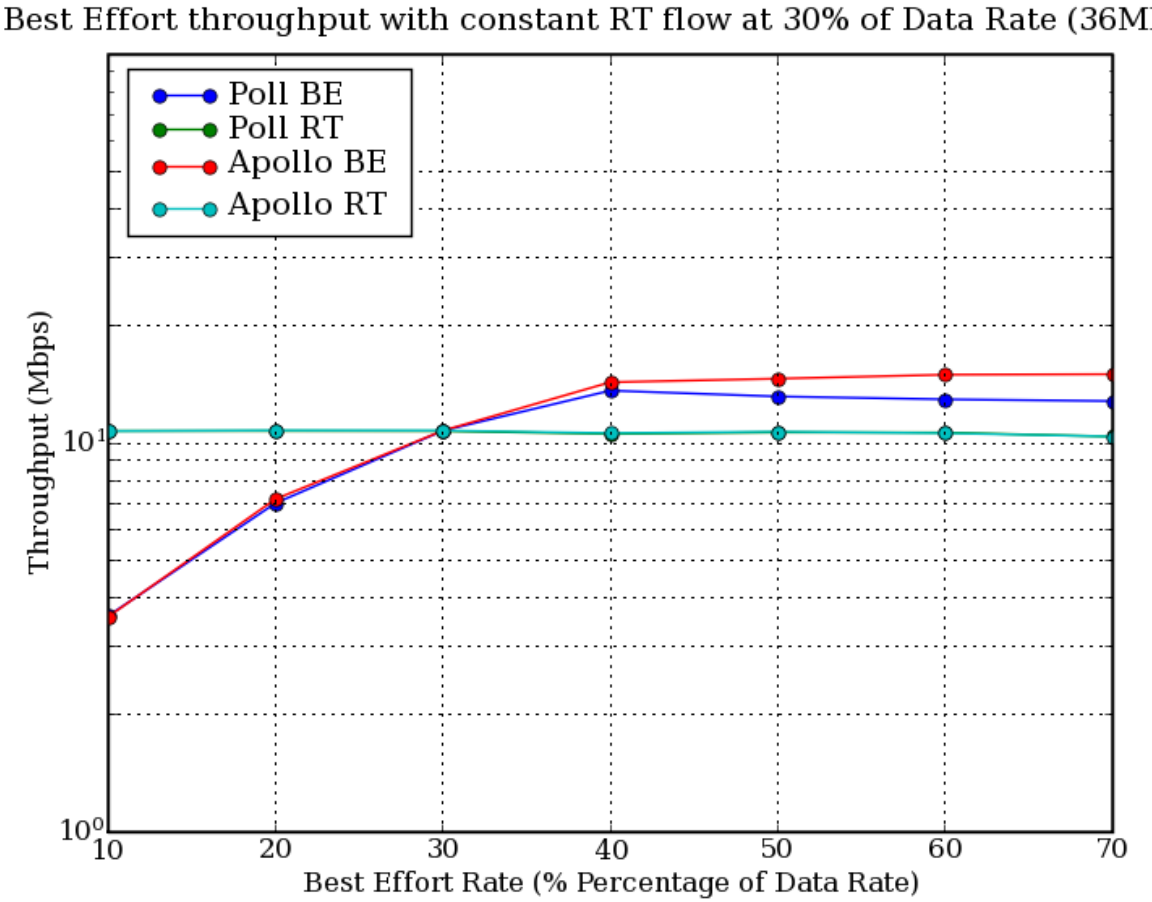
- Reduced 802.11 protocol overhead
- Efficient Polling Protocol

Benchmarks - TCP



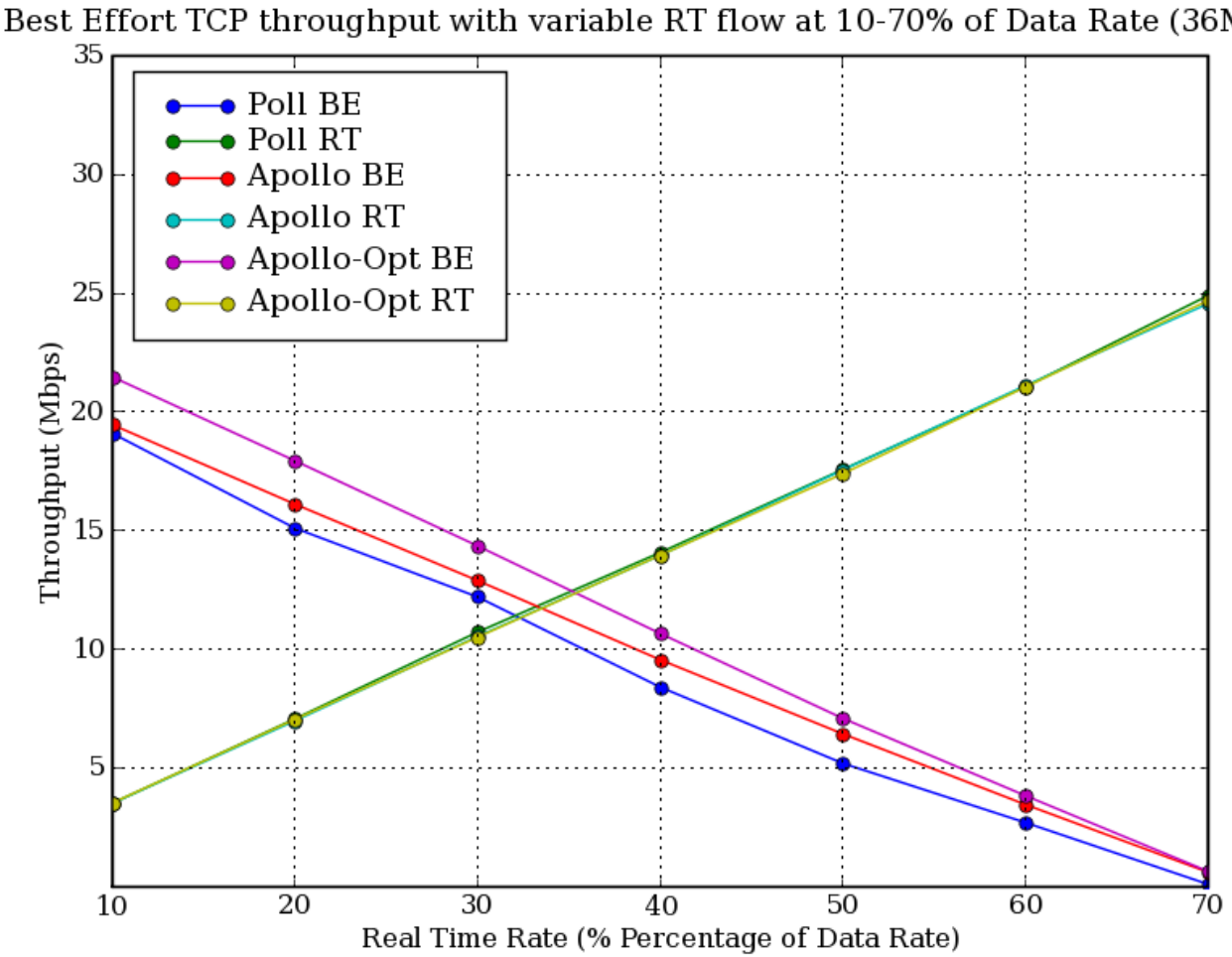
- Increased TCP Throughput
- Additional gains with TCP Optimizer

Benchmarks – Variable BE



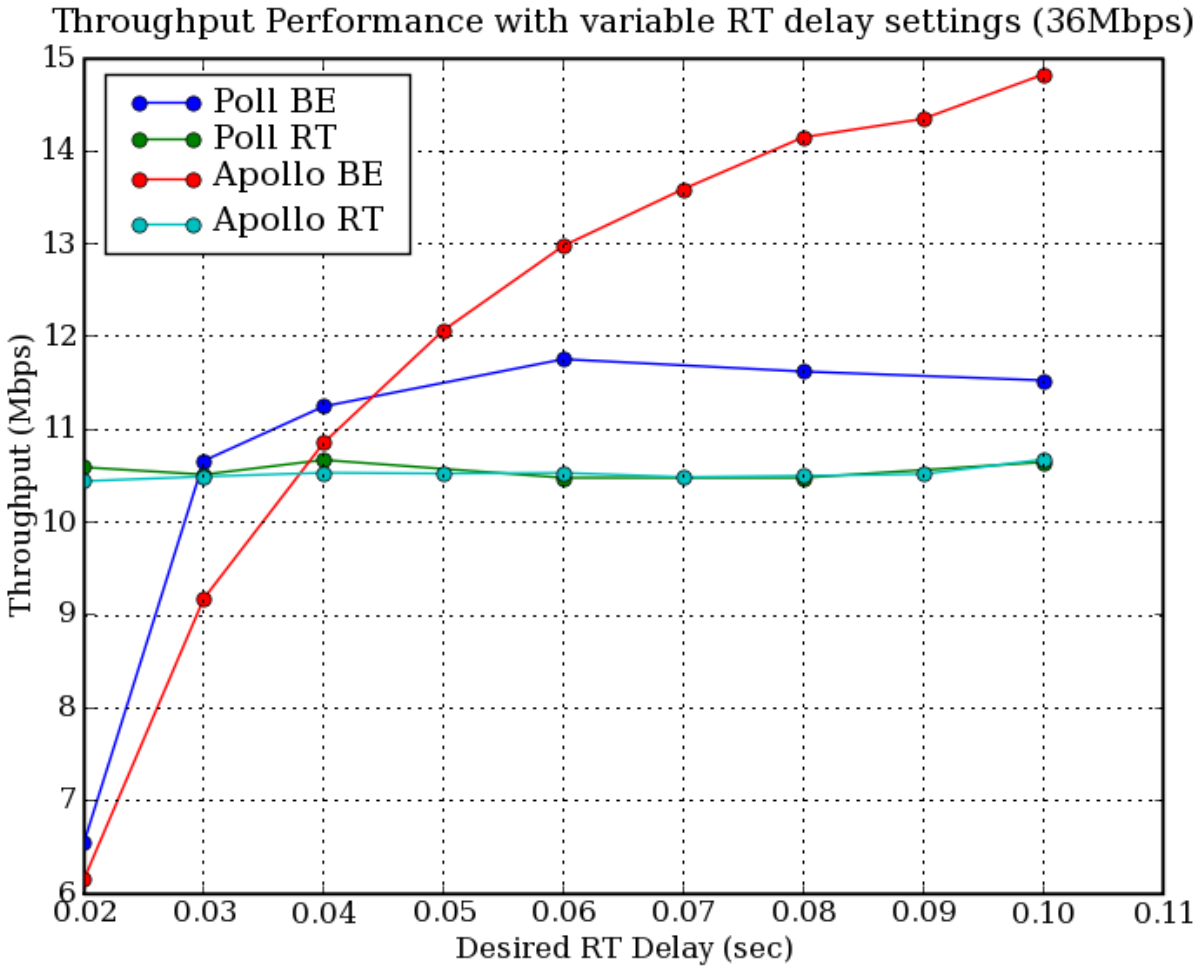
- Scheduler maintains desired RT delay even under BE saturation.
- System does not accept additional BE flow above 40% in order to maintain QoS for the RT flows.

Benchmarks – Variable RT



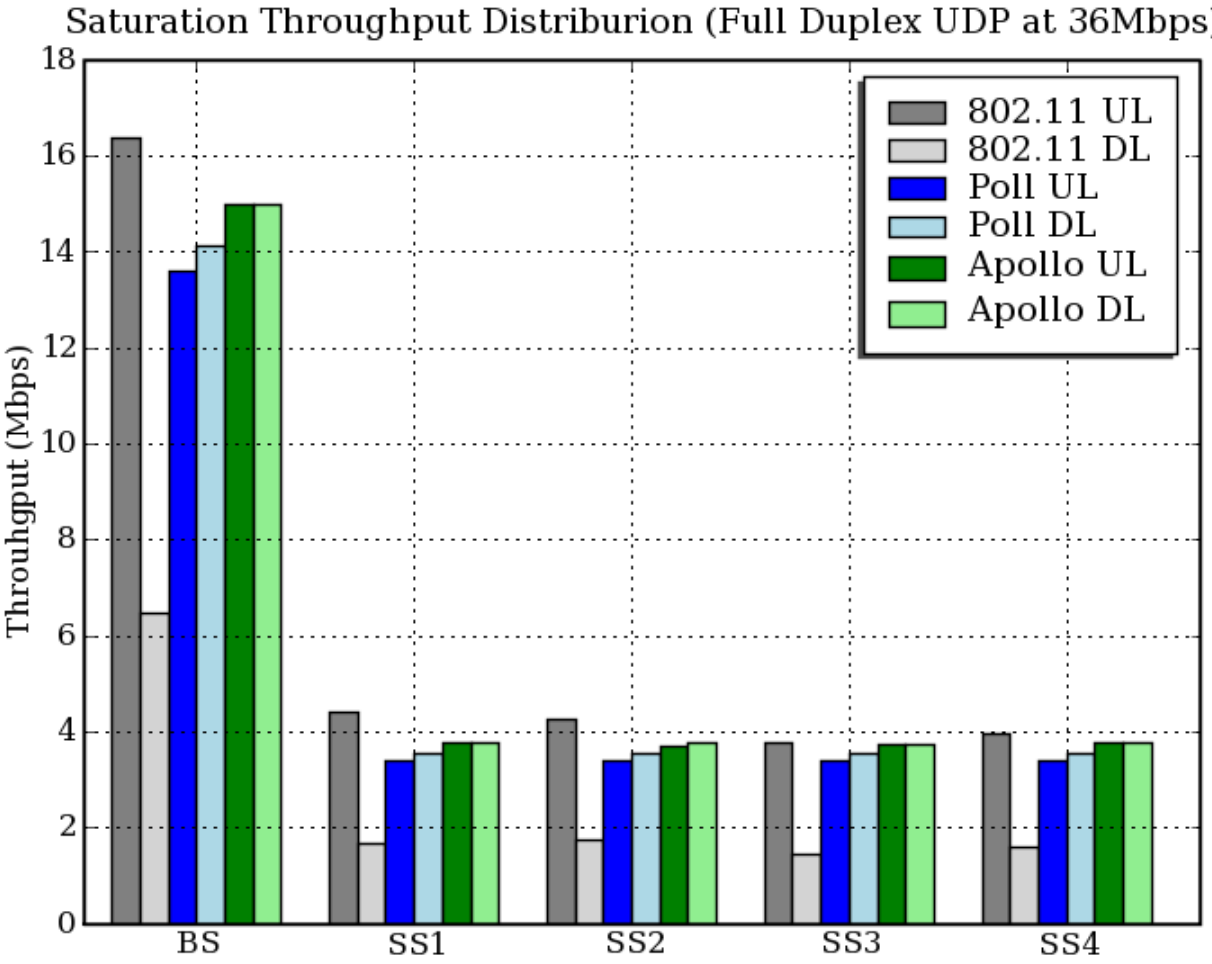
- Scheduler maintains high TCP throughput when RT flow is small.
- TCP is regulated appropriately when RT flow is increased in order to avoid QoS violations.

Benchmarks – Variable RT delay

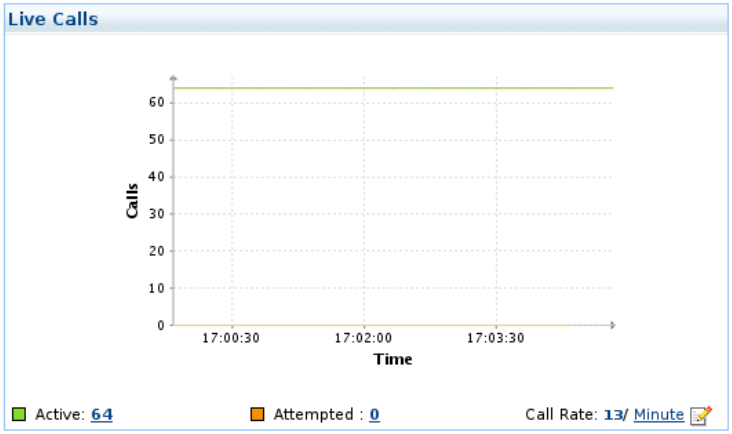


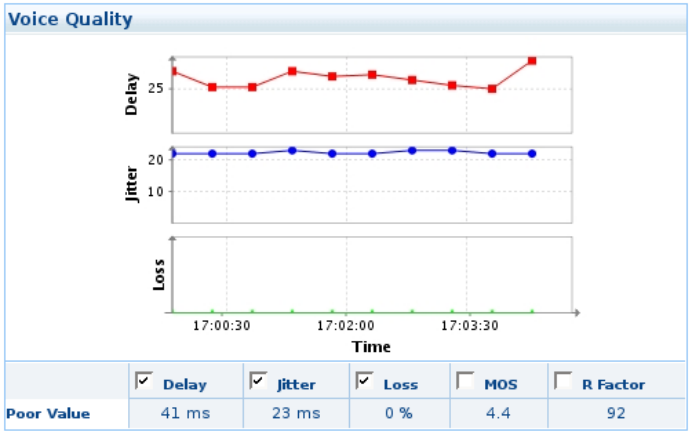
- Delay-Throughput trade-off
- Configurable according to deployment requirements

Benchmarks - Fairness

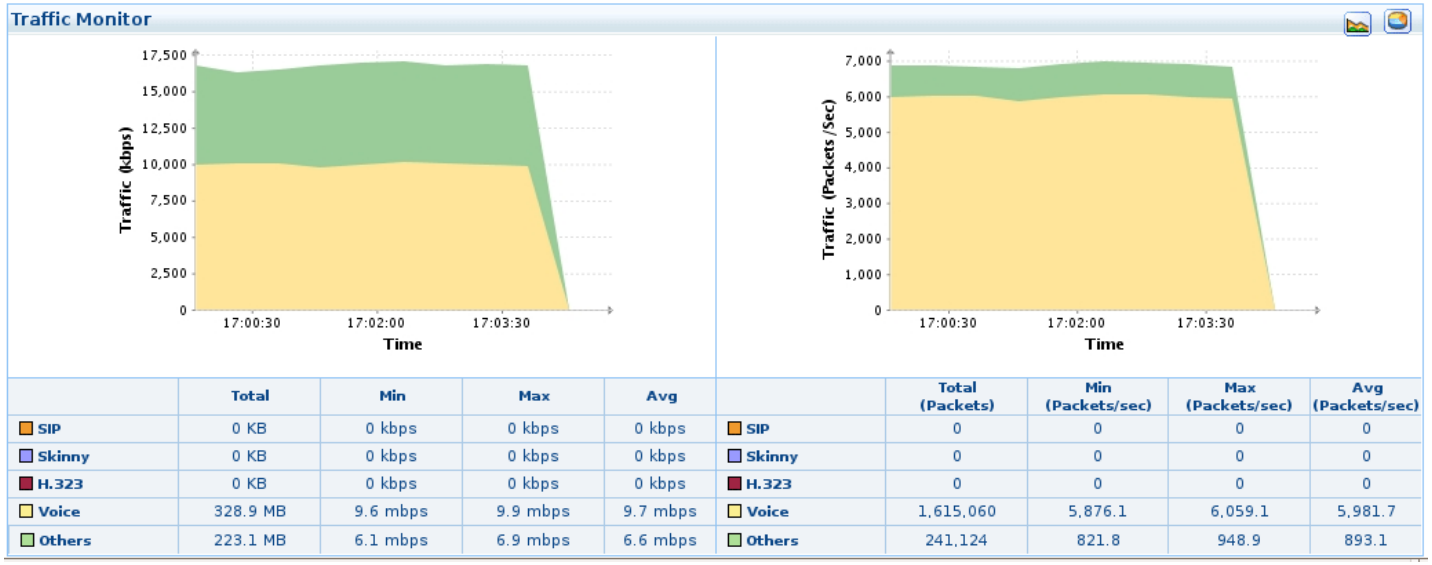


Benchmarks – VoIP (1/2)





	Delay	Jitter	Loss	MOS	R Factor
Poor Value	41 ms	23 ms	0 %	4.4	92

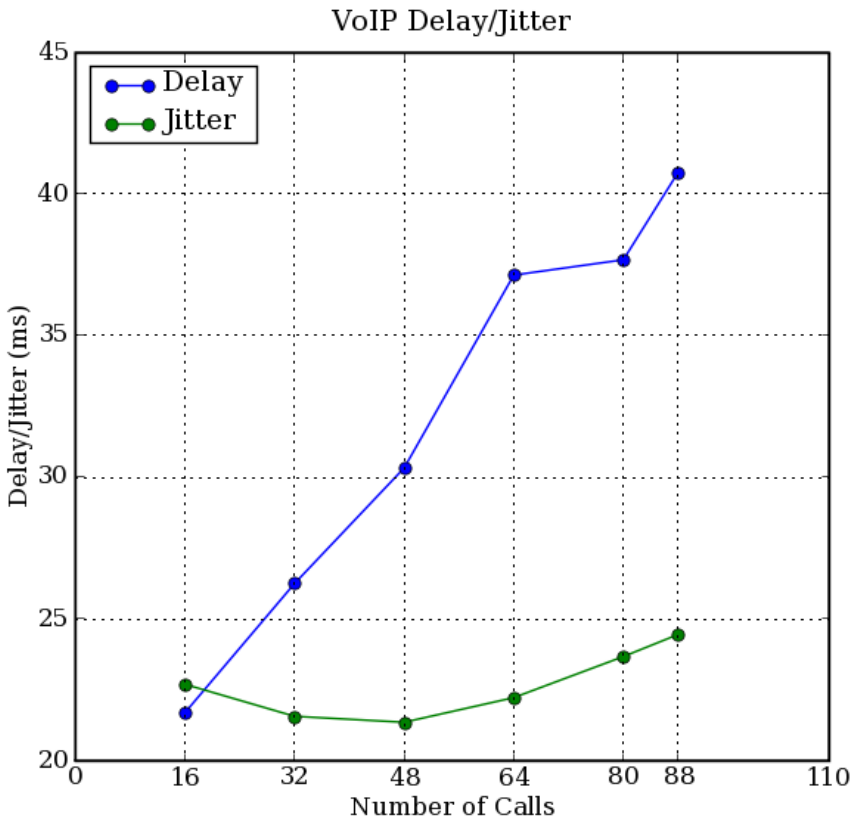


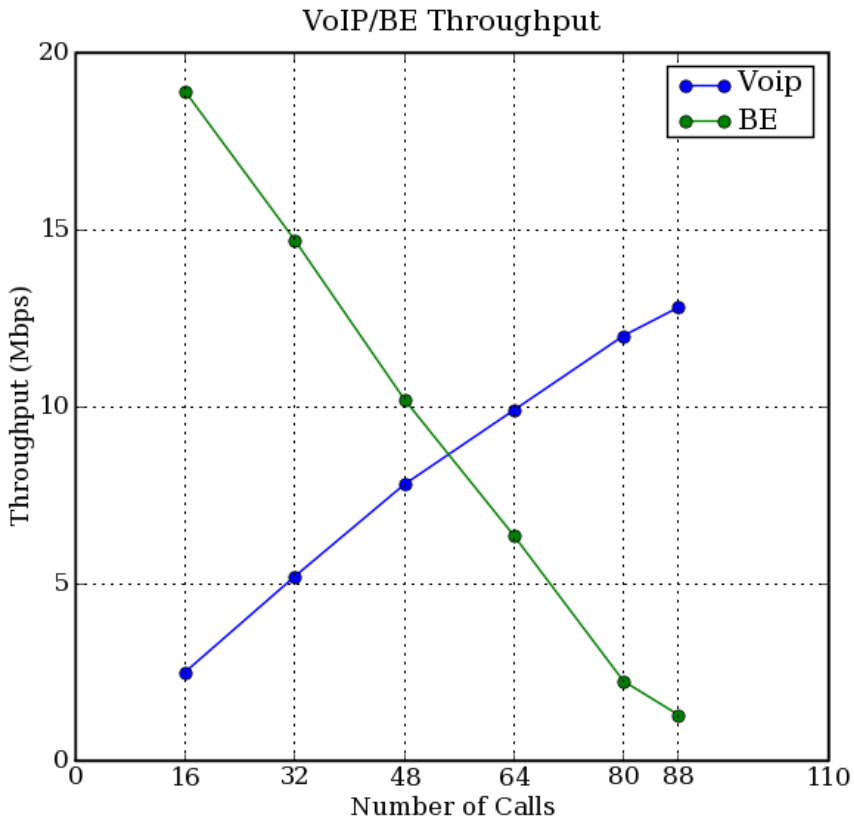
	Total	Min	Max	Avg
SIP	0 KB	0 kbps	0 kbps	0 kbps
Skinny	0 KB	0 kbps	0 kbps	0 kbps
H.323	0 KB	0 kbps	0 kbps	0 kbps
Voice	328.9 MB	9.6 mbps	9.9 mbps	9.7 mbps
Others	223.1 MB	6.1 mbps	6.9 mbps	6.6 mbps

	Total (Packets)	Min (Packets/sec)	Max (Packets/sec)	Avg (Packets/sec)
SIP	0	0	0	0
Skinny	0	0	0	0
H.323	0	0	0	0
Voice	1,615,060	5,876.1	6,059.1	5,981.7
Others	241,124	821.8	948.9	893.1

- G.711 codec
- Full Duplex Calls
- 36 Mbps Data Rate
- RT delay set at 60ms

Benchmarks – VoIP (2/2)





Future Work

- Admission Control
  - Prohibit a possible quality degradation for guaranteed services due to over subscription.
- QoS Enhancements
  - QoS Scheduler Engine extensions for triple-play infrastructures
- Adaptive Transmission Rate selection and Packet Aggregation configuration according to air link quality.
  - Rate selection using the custom bulk-ACK mechanism.
  - Packet Aggregation may cause throughput degradation in lossy environments. Its parameters (e.g. maximum packets to aggregate) must take into consideration the channel quality.