Wireless LAN Services for Hot-Spot

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Overview

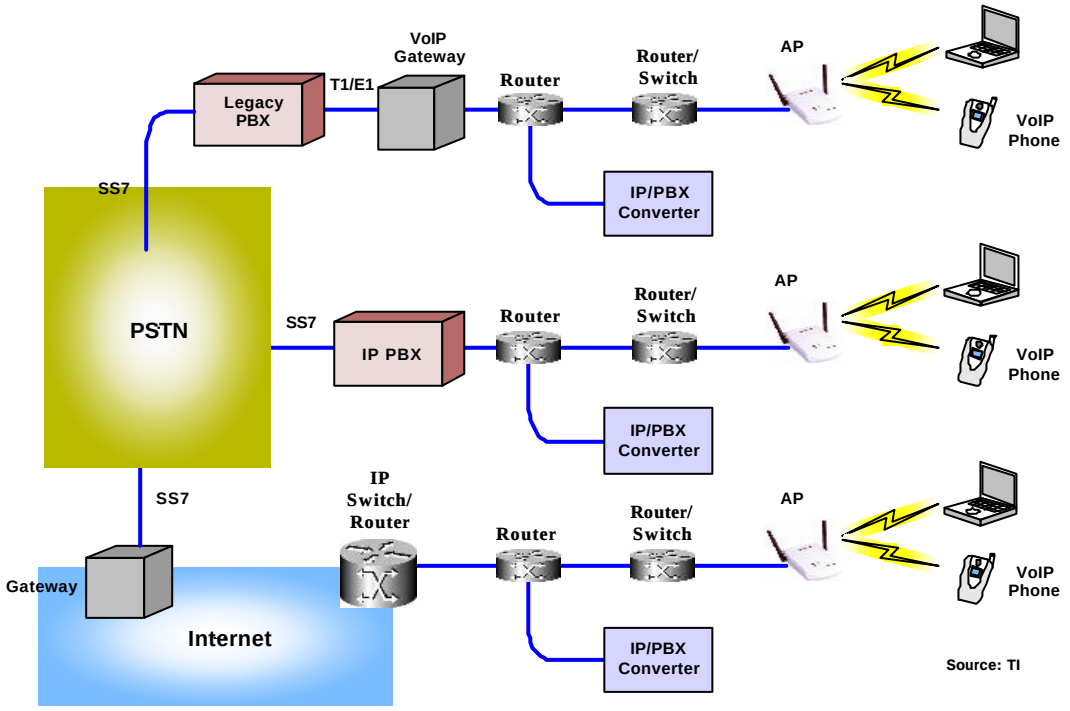
Overview

- IEEE 802.11 WLAN is currently dominant technology
- Next generation WLAN technology will be developed based on the current IEEE 802.11 WLAN
- Most recent next generation WLAN will be IEEE 802.11e WLAN
- At the end of next year, IEEE 802.11n standard will emerge to support 100Mbps at MAC SAP
- Current and future MAC technologies will be addressed in this presentation

Wireless LAN Services

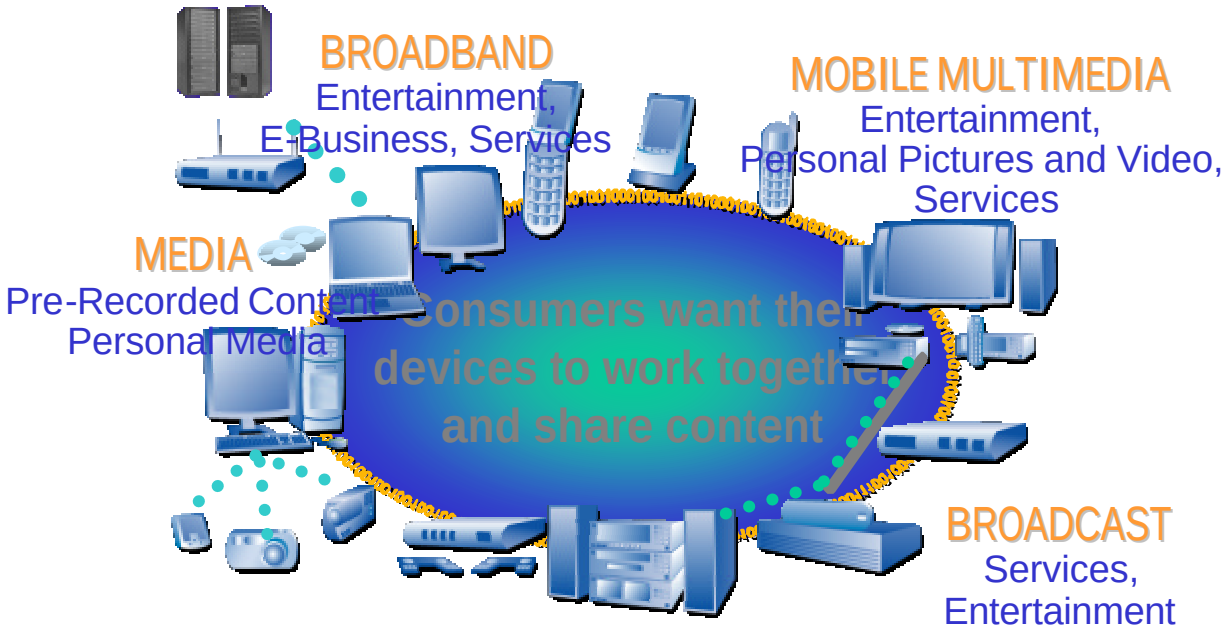
VoIP + Wireless LAN

- Wireless extension of current VoIP service
- Initial stage of home or office networking that is possible in a near future



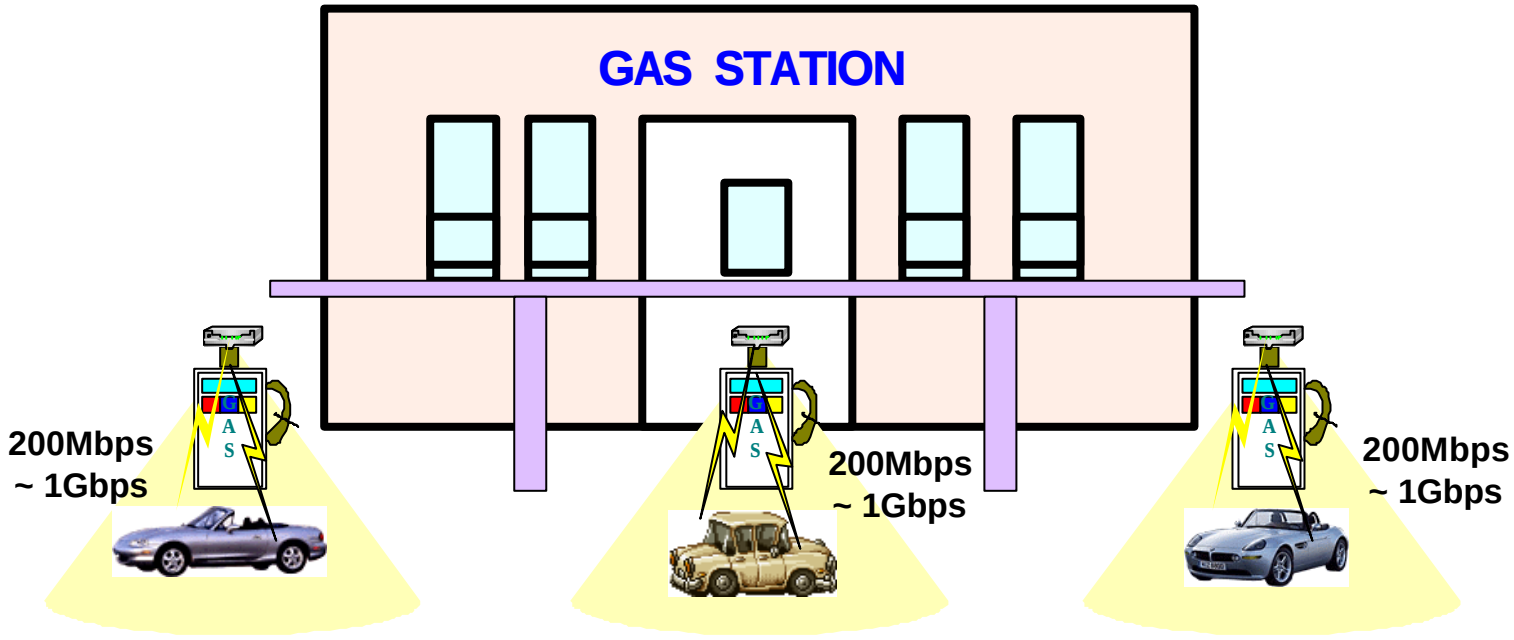
Home & Office Networks

- **Realization of networks of home or office equipments**
- **Wireless transmission service for game, HDTV, medical examination, etc.**



Info-Station

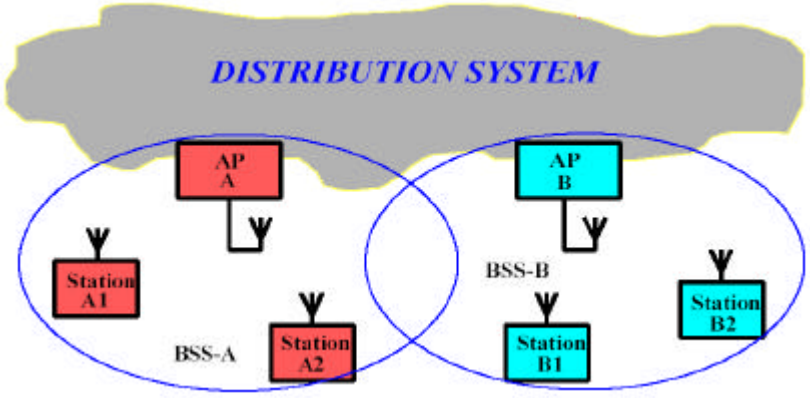
- Multimedia service in gas station, shopping mall, etc.
- Quick download of music and cinema

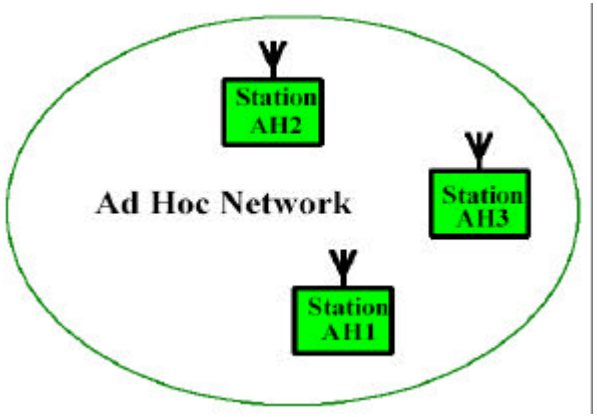


Current IEEE 802.11 MAC Protocol

IEEE 802.11 System

- **Infrastructure Mode**
  - Infrastructure Basic Service Set (BSS)
  - One Access Point (AP) and multiple stations (STAs)
- **Ad hoc Mode**
  - Independent Basic Service Set (IBSS)
  - No AP and multiple STAs



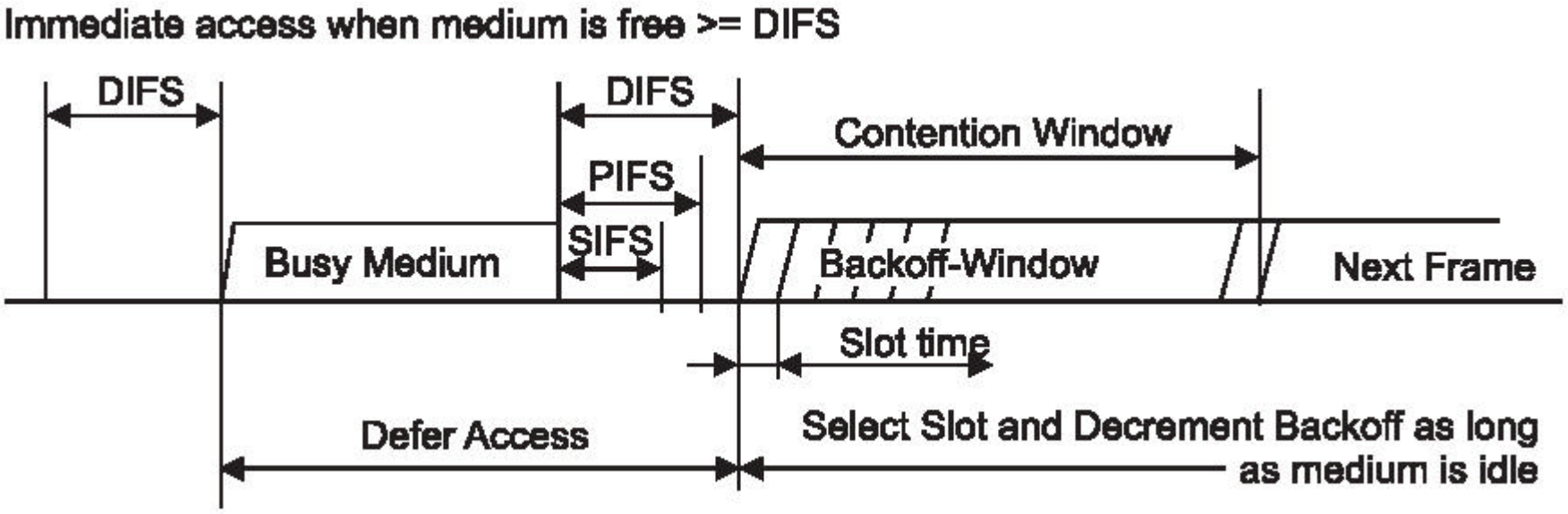


DCF

➢ Distributed Coordination Function (DCF)

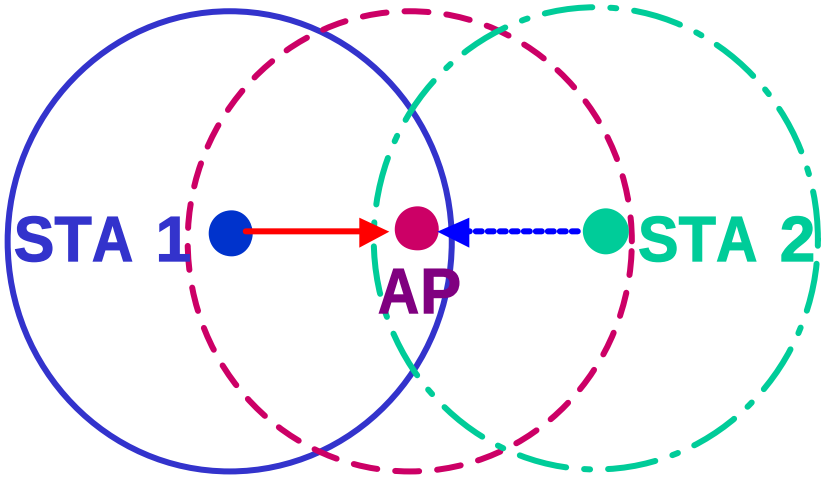
- **802.11 MAC protocol is based on CSMA-CA scheme**

  (Ethernet MAC protocol: CSMA-CD scheme)



DCF

➢ Hidden Node Problem

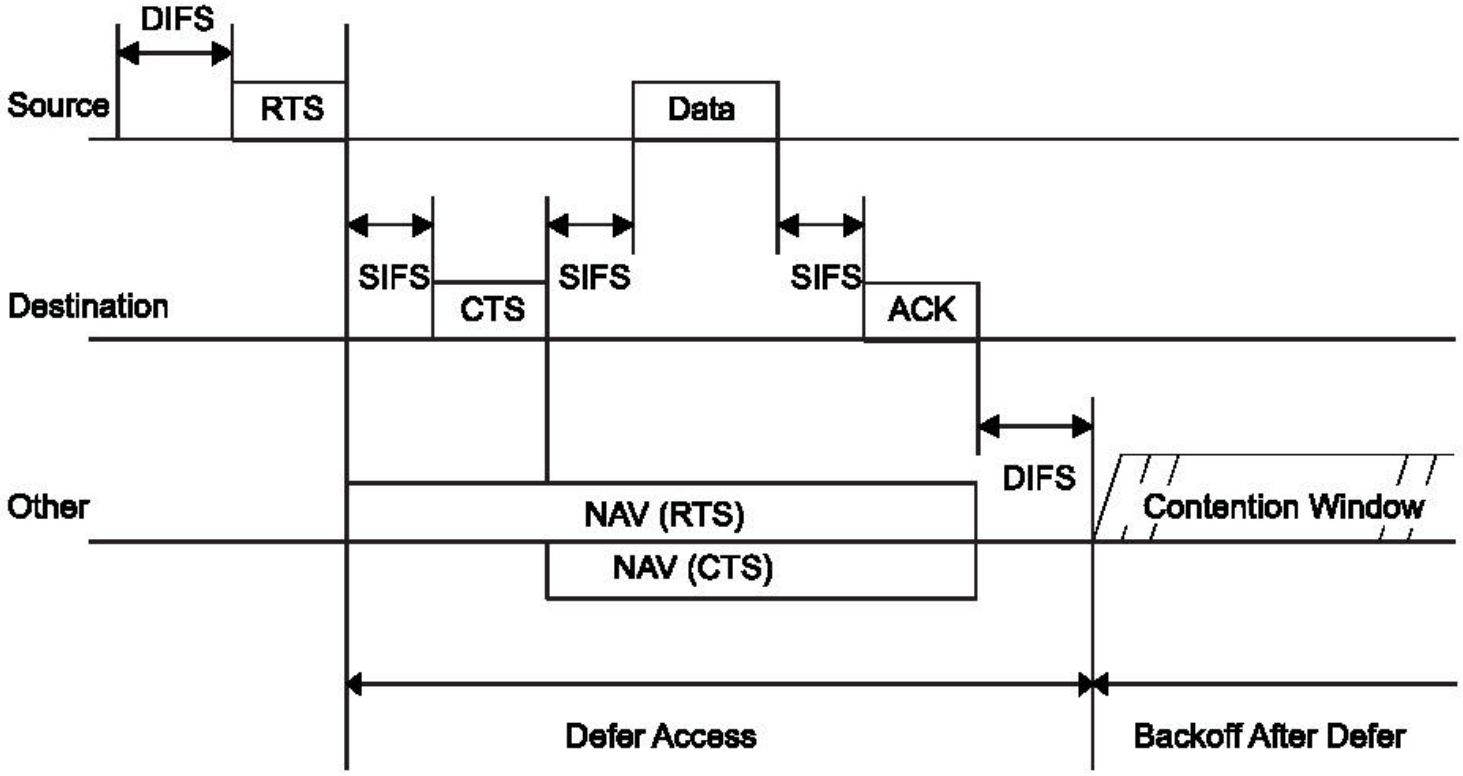


STA 1: currently transmitting
STA 2: attempting to transmit

DCF

➢ Collision Avoidance (CA)

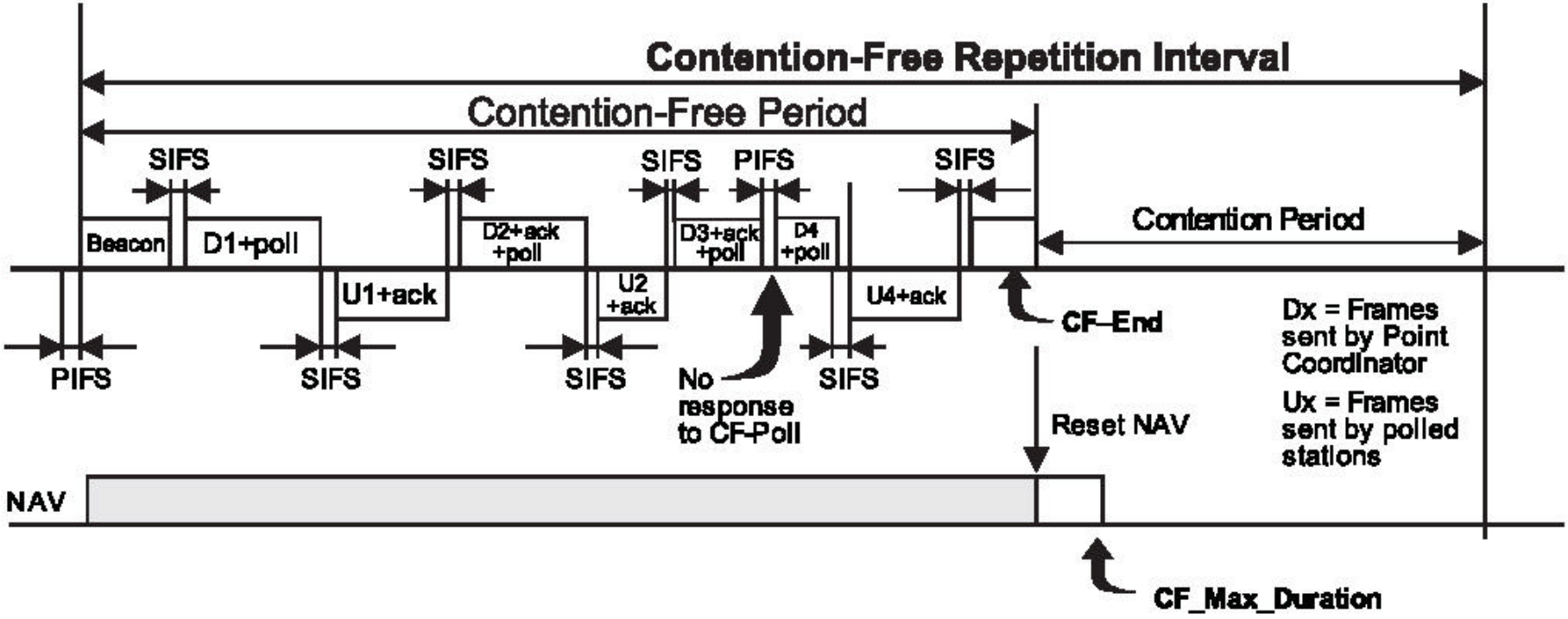
- Solves the hidden node problem



PCF

➢ Point Coordination Function (PCF)

- **Polling based transmission**



Limitations

- **Signaling Overhead**
  - RTS-CTS or polling is needed for every MSDU transmission
  - Ack is needed for every MPDU (a fragment of MSDU) transmission
  - This is inefficient especially for real time service
- **Not Sufficient Support for QoS Service**
  - No specification for the service with various service requirements
  - No policy for the general QoS service

MAC Enhancements

(Based on IEEE 802.11n Contributions, IEEE 802.11-03/0509r0 & 04/0312r0)

Two Factors for Efficiency of RTS-CTS Method

- **Data Frame Length**
  - RTS-CTS method is efficient in the case of transmissions of long data frames
  - But, inefficient with short data frames
- **Numbers of STAs and Transmission Attempts**
  - Related with the number of retransmissions
  - Efficient in the case of many STAs and transmission attempts
  - But, inefficient with small numbers of STAs and transmission attempts

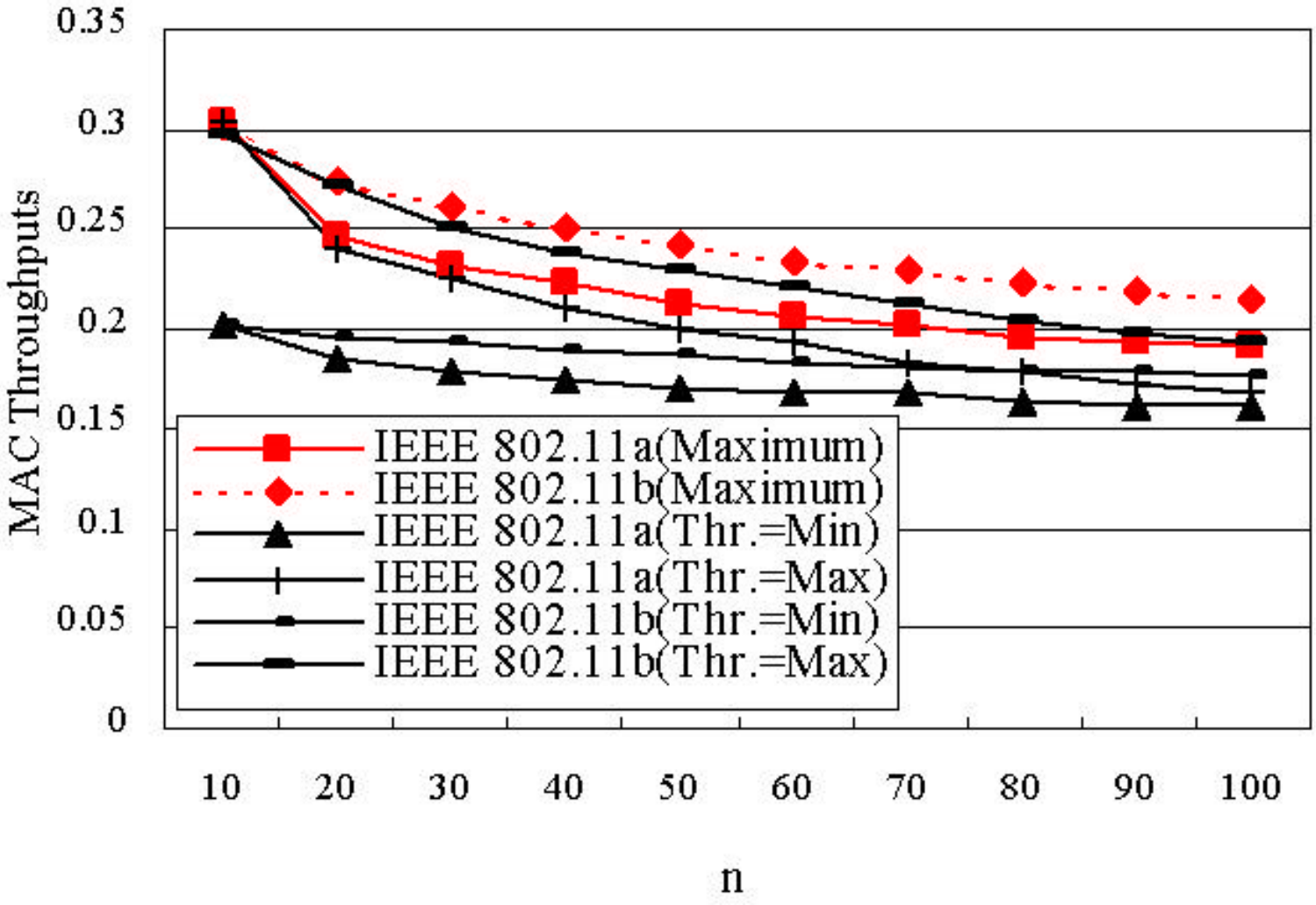
Dynamic RTS-CTS Threshold Control

- **Infrastructure BSS**
  - AP periodically monitors the number of STAs connected to itself, the number of transmission attempts and the data frame size distribution
  - AP calculates the optimal dot11RTSThreshold
  - AP broadcasts the updated threshold value to be used by STAs
  - Detailed algorithm is for further research
- **Independent BSS**
  - For further research

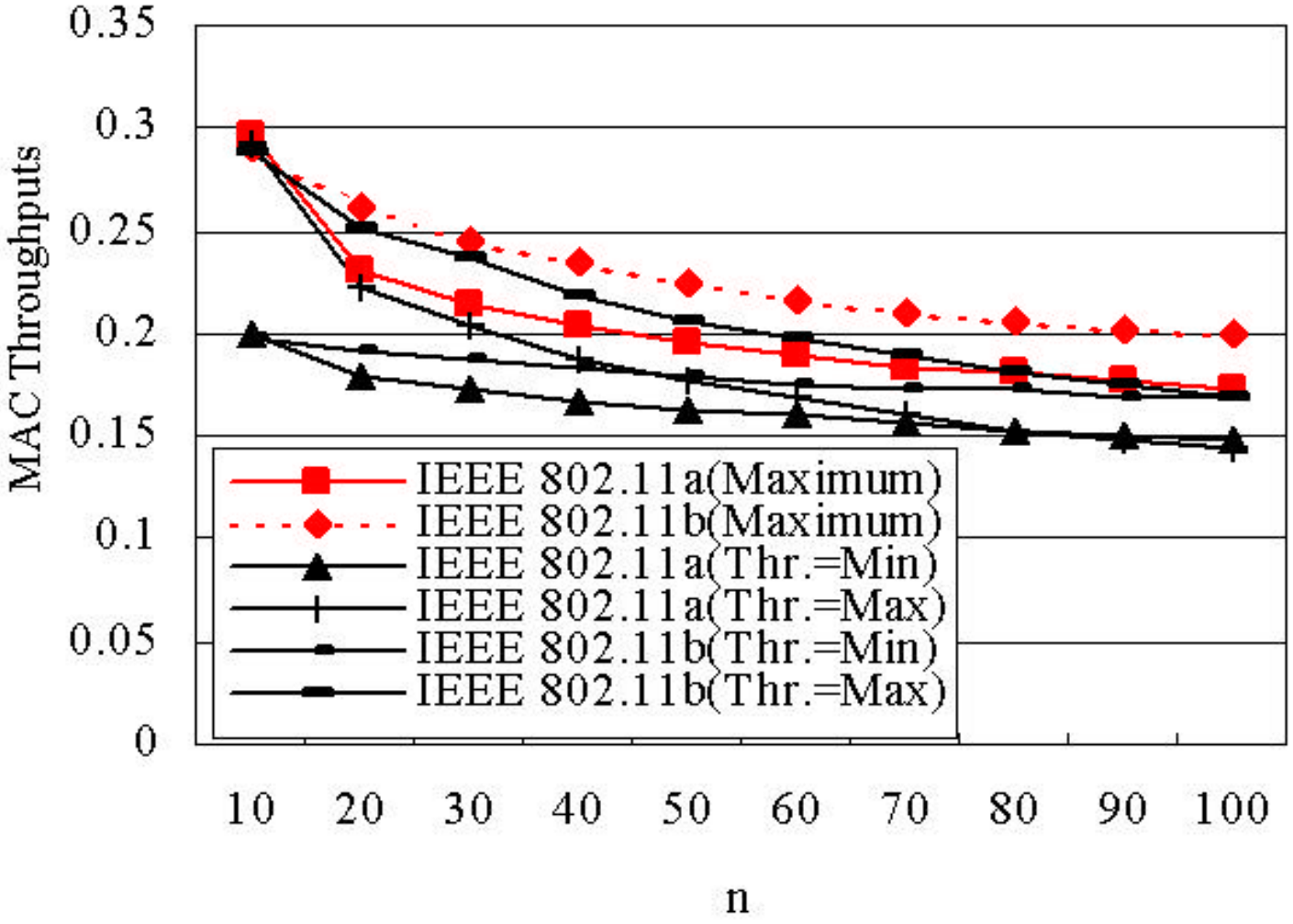
Simulation Condition

- n greedy STAs attempt to transmit data frames continuously using DCF protocol
- The length of data frames is variable based on the experimental statistics from NLANR (National Lab. for Applied Network Research) (www.nlanr.net/NA/Learn/paketsizes.html)
- p: the probability that a transmission attempt fails due to the hidden node problem (p = 0, 0.25, 0.5)
- Optimal RTS-CTS threshold was obtained using computer simulations for maximizing MAC throughput

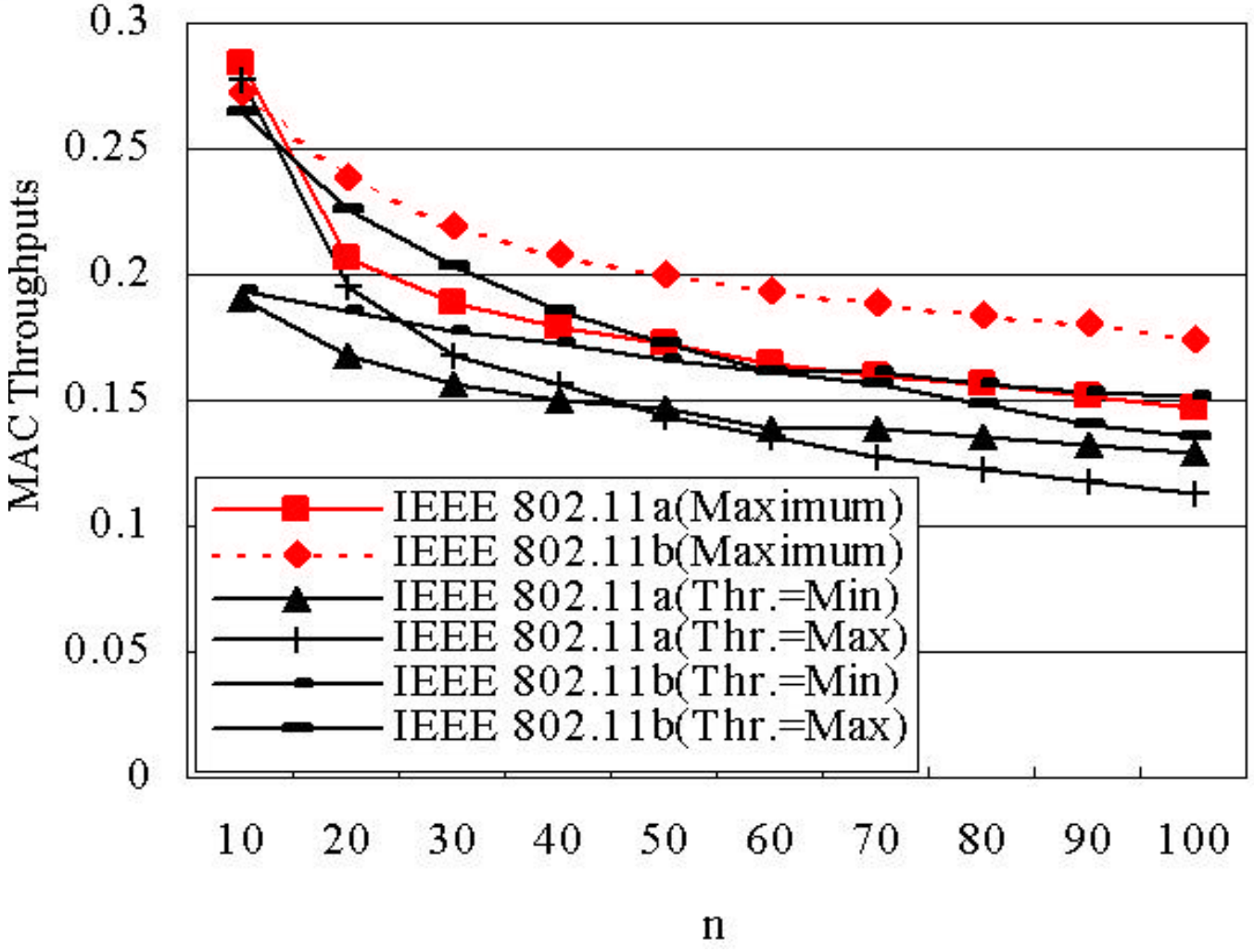
Throughput Analysis (p=0)



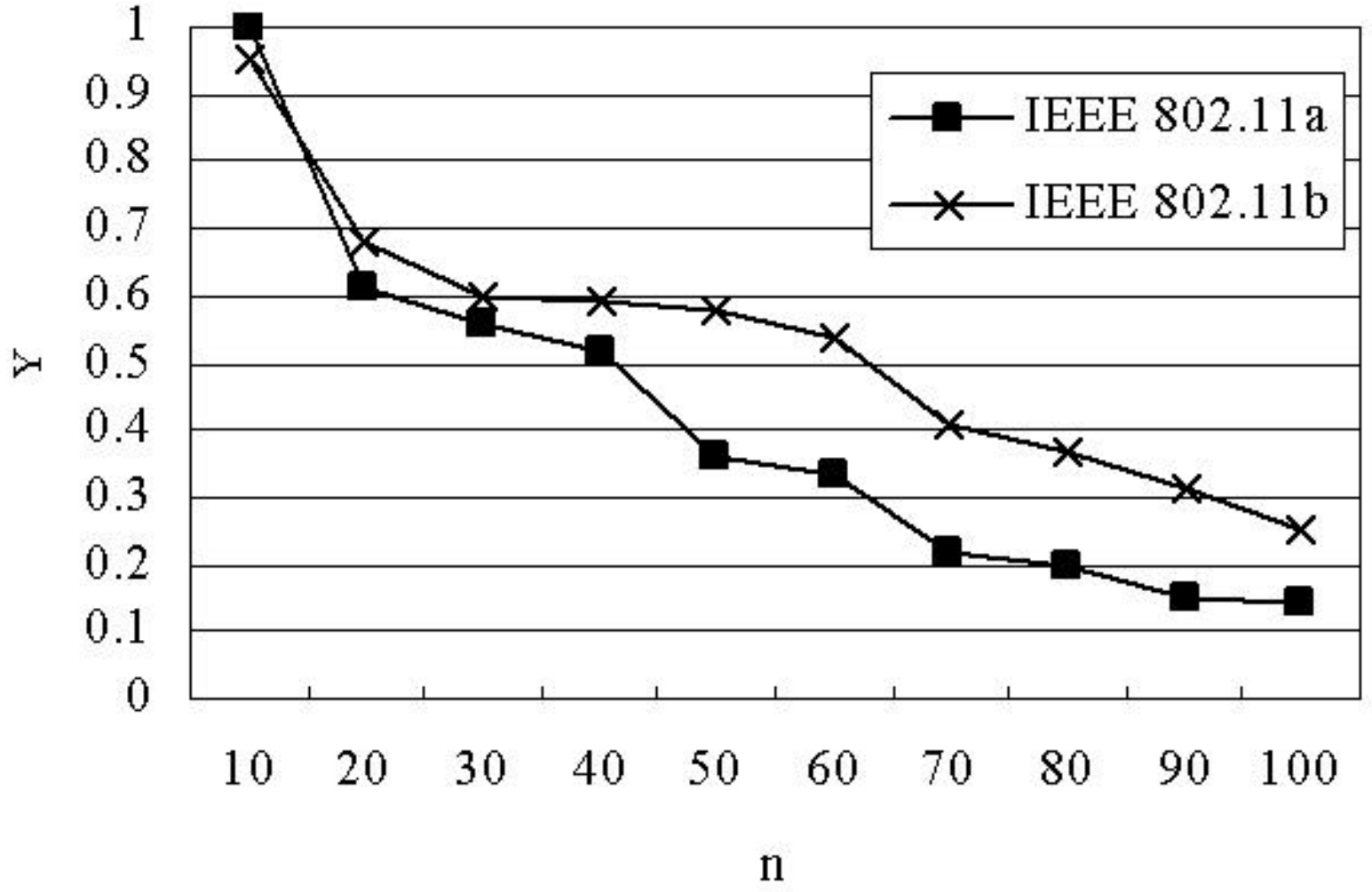
Throughput Analysis (p=0.25)



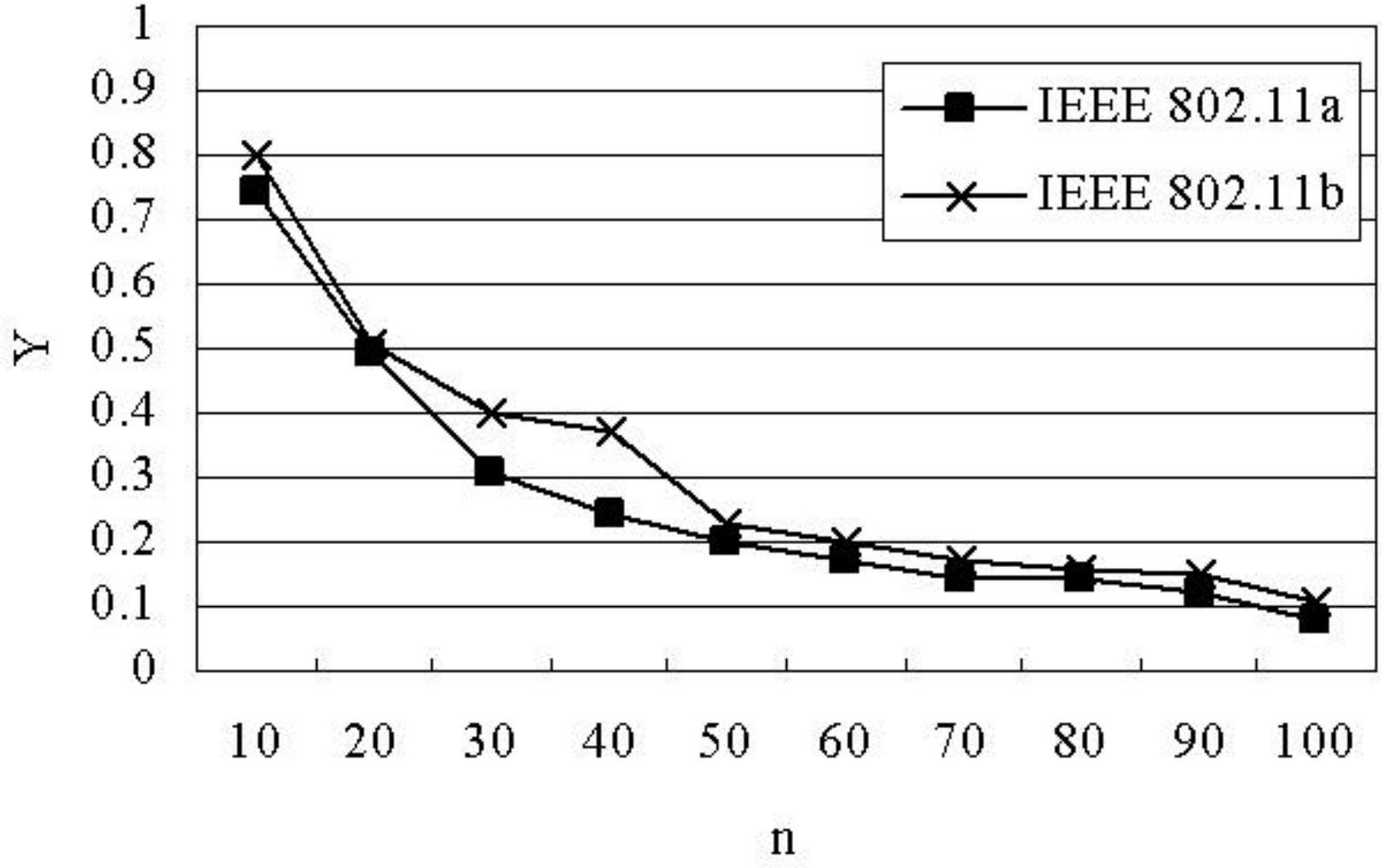
Throughput Analysis (p=0.5)



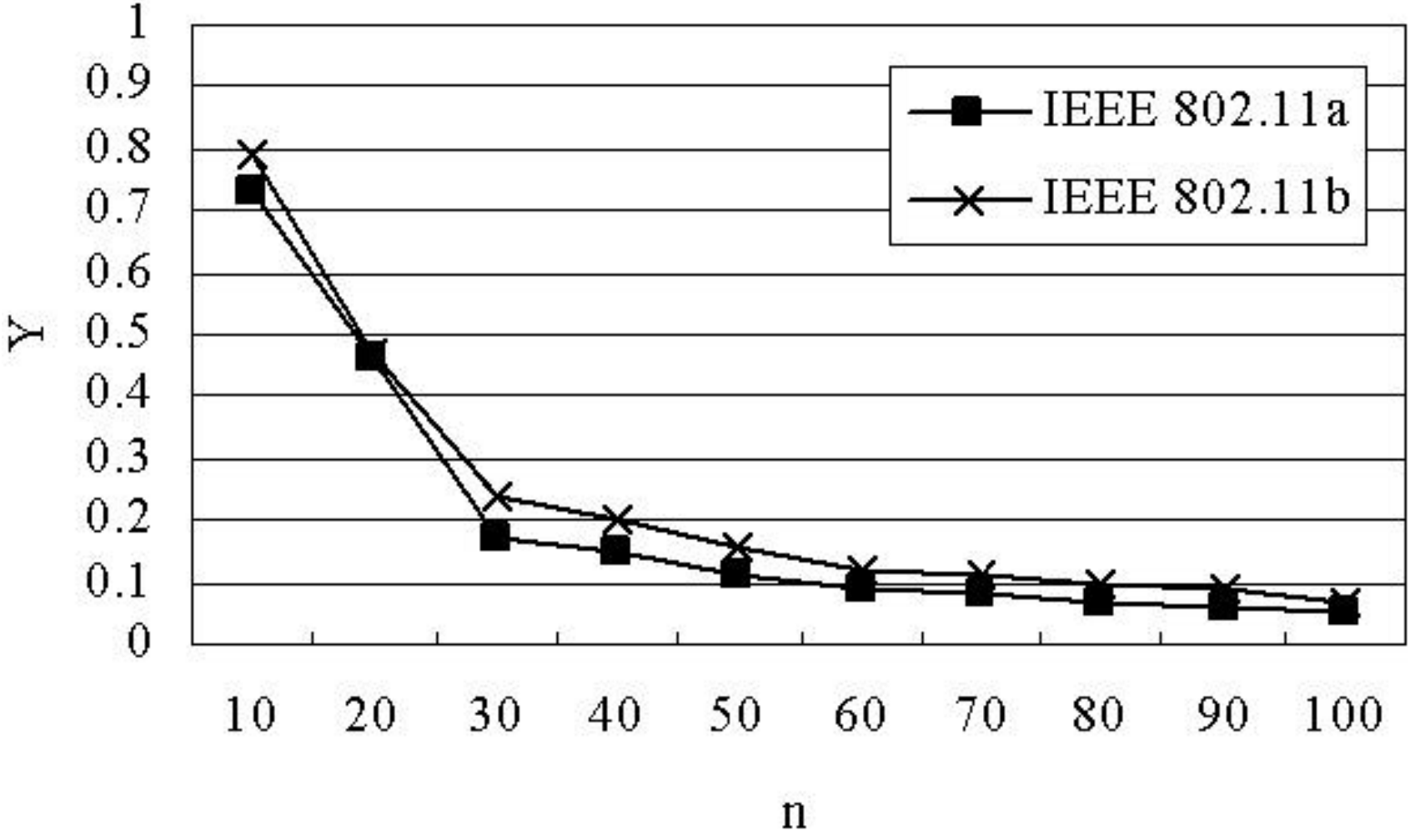
Optimal RTS-CTS Threshold (p=0)



Optimal RTS-CTS Threshold (p=0.25)



Optimal RTS-CTS Threshold (p=0.5)



Performance Improvements

- Average 25 % throughput improvement in IEEE 802.11a
- Average 28 % throughput improvement in IEEE 802.11b