

# Triple Play Services over Mobile WiMAX

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These slides are available on-line at:

<http://www.cse.wustl.edu/~jain/wimax/3play.htm>

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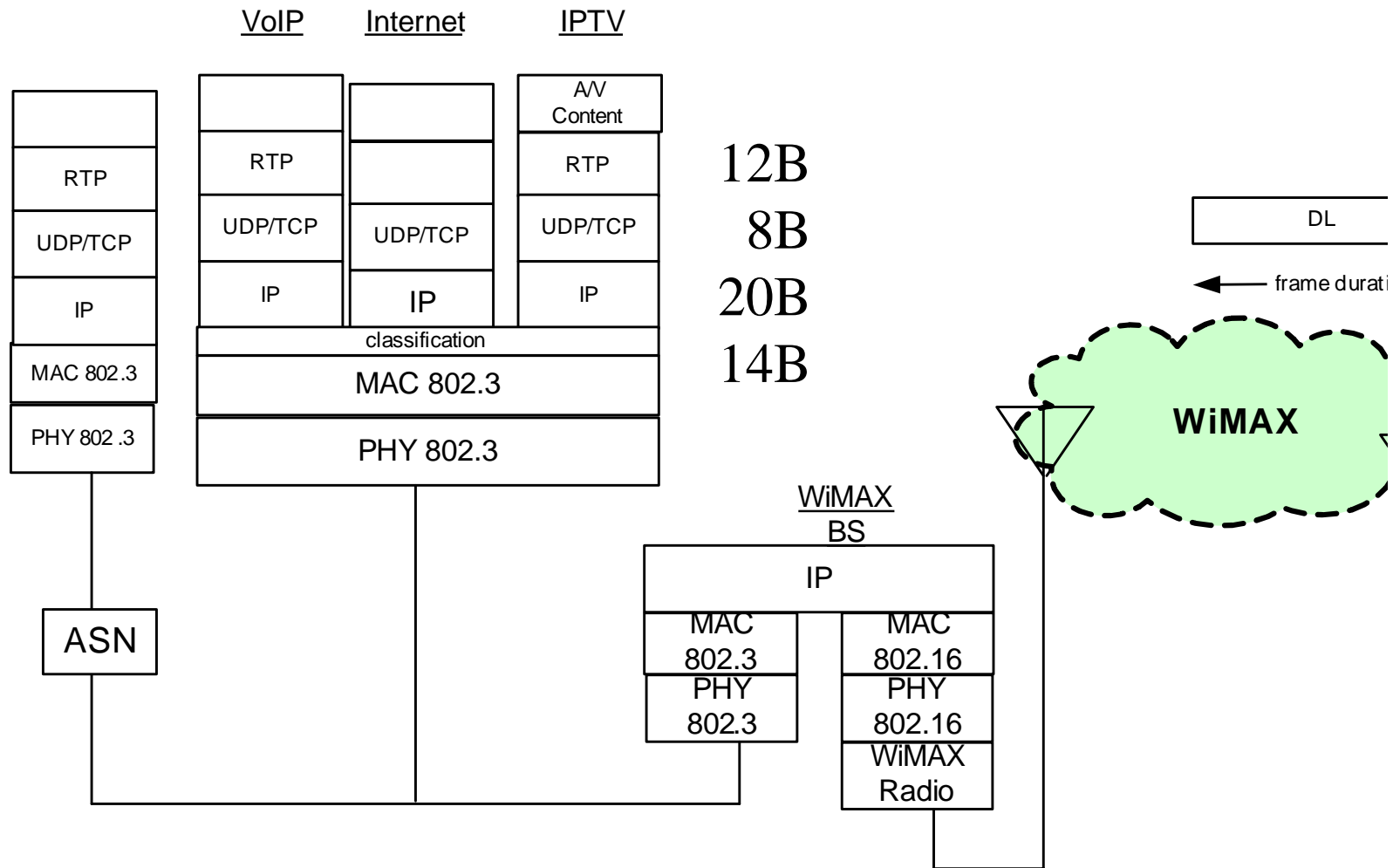


- ❑ Triple Play: What and Why?
- ❑ Protocol Model and Parameters
- ❑ Factors Affecting Capacity
- ❑ Capacity Estimation

# Why Triple Play?

- ❑ Three Key Mobile Services:
  - Voice, Video, and Internet
- ❑ Video and entertainment are key to future growth of broadband – key revenue generators
- ❑ Legacy mobile technologies, designed for voice, have difficulty managing video workload
- ❑ WiMAX Operators need analytical data to plan their capacity and justify their investments

# Protocol Stack



# System Parameters

- ❑ Channel width: 10 MHz
- ❑ OFDMA Frame Size: 5 ms
- ❑ Duplexing: TDD
- ❑ DL:UL Ratio = 2:1
- ❑ Subchannelization: PUSC

# Factors Affecting Capacity

- ❑ Location: Terrain, foliage, buildings
  - ⇒ Signal to interference and noise ratio (SINR)
  - ⇒ Modulation and coding schemes
- ❑ Urban/Sub-urban/Rural Regions:
  - Urban ⇒ Higher capacity
  - Rural ⇒ Longer reach
  - Suburban
- ❑ Mobile Speed: High speed
  - ⇒ Doppler shift ⇒ Inter-carrier interference
  - ⇒ Lower MCSs



## Factors Affecting Capacity (Cont)

- ❑ Frequency Band:
  - Lower frequencies have longer reach
  - 700 MHz provides provides larger coverage area than 2.5 GHz  $\Rightarrow$  Good for rural deployments
  - Lower frequencies require larger antenna and antenna spacing  $\Rightarrow$  MIMO difficult
  - Lower frequencies  $\Rightarrow$  Smaller channel width
- ❑ Handoffs: 50 ms for real time applications, 3-10 seconds for non-real-time



# Factors Affecting Capacity (Cont)

## ❑ Scheduling

- Key to WiMAX performance and QoS
- Vendor specific
- Aggregating small payloads can increase the capacity by an order of magnitude

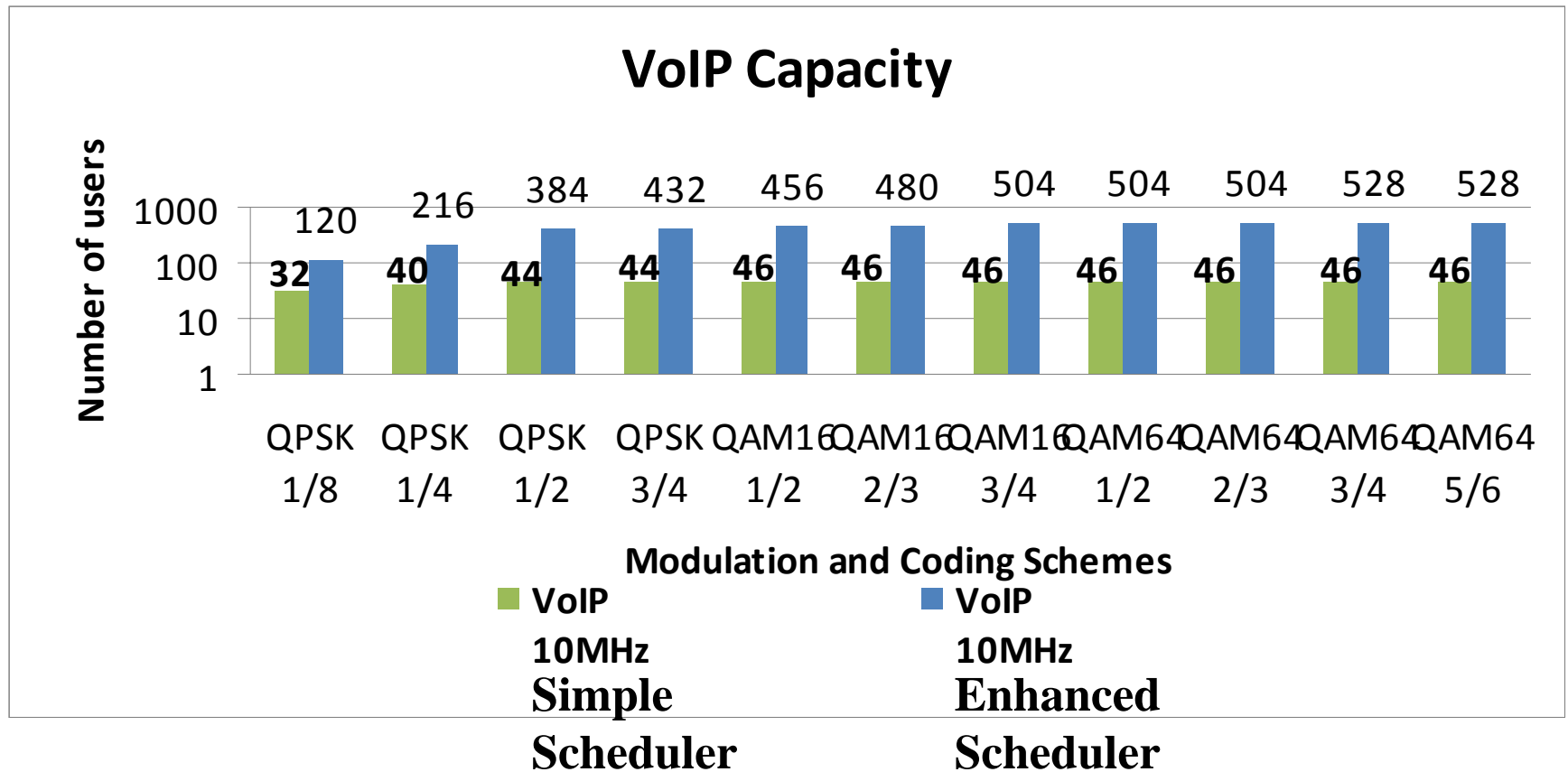
## ❑ Header compression:

- Robust Header Compression (RoHC)
- Header suppression

## ❑ Silence suppression

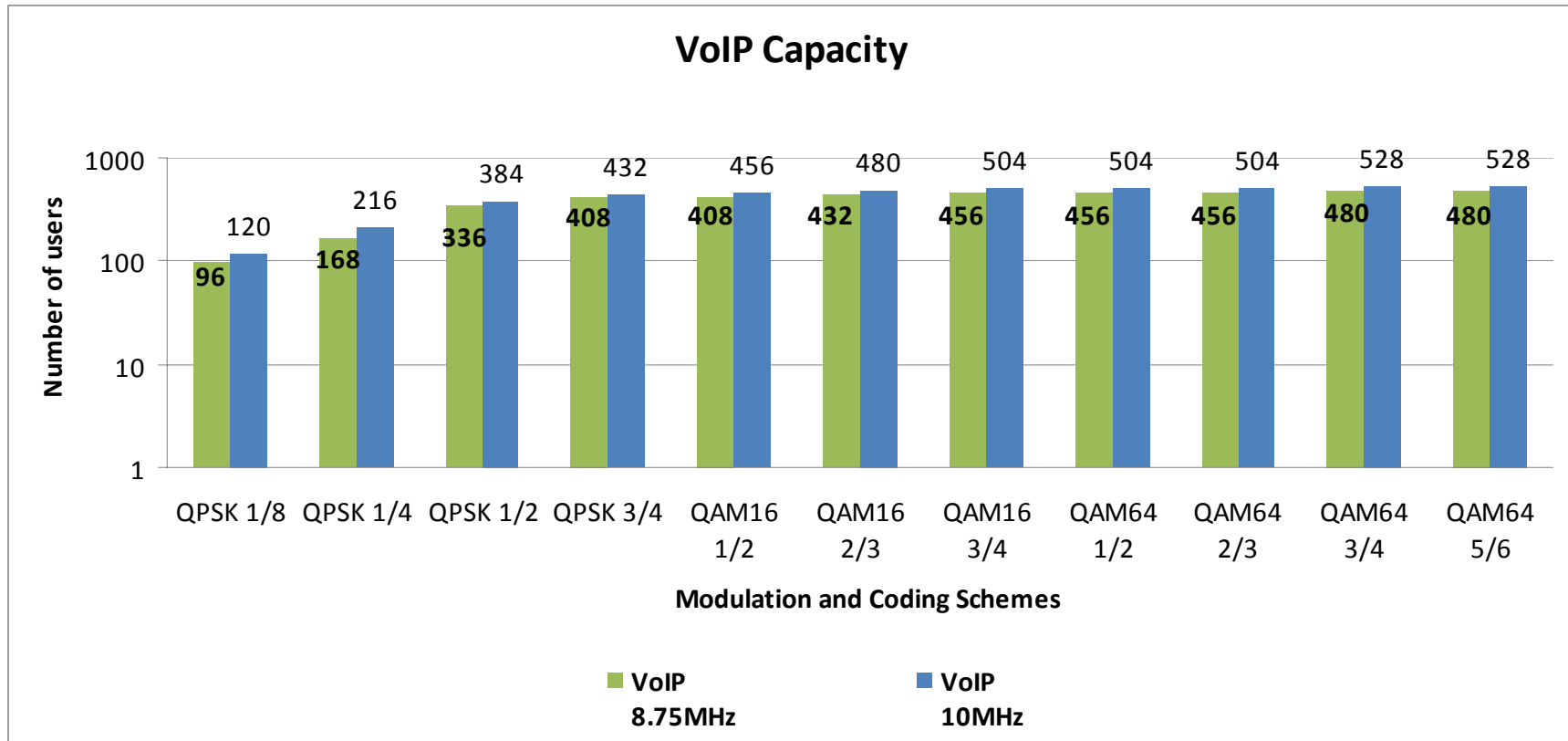
## ❑ ARQ/HARQ

# Effect of Scheduler



- Proper aggregation and scheduling can increase the performance by an order of magnitude

# VOIP Capacity



□ Limited by UL capacity

# Video Displays



42" 16x9 SDTV (1 Mbps)



26" 4x3 SDTV (850 kbps)

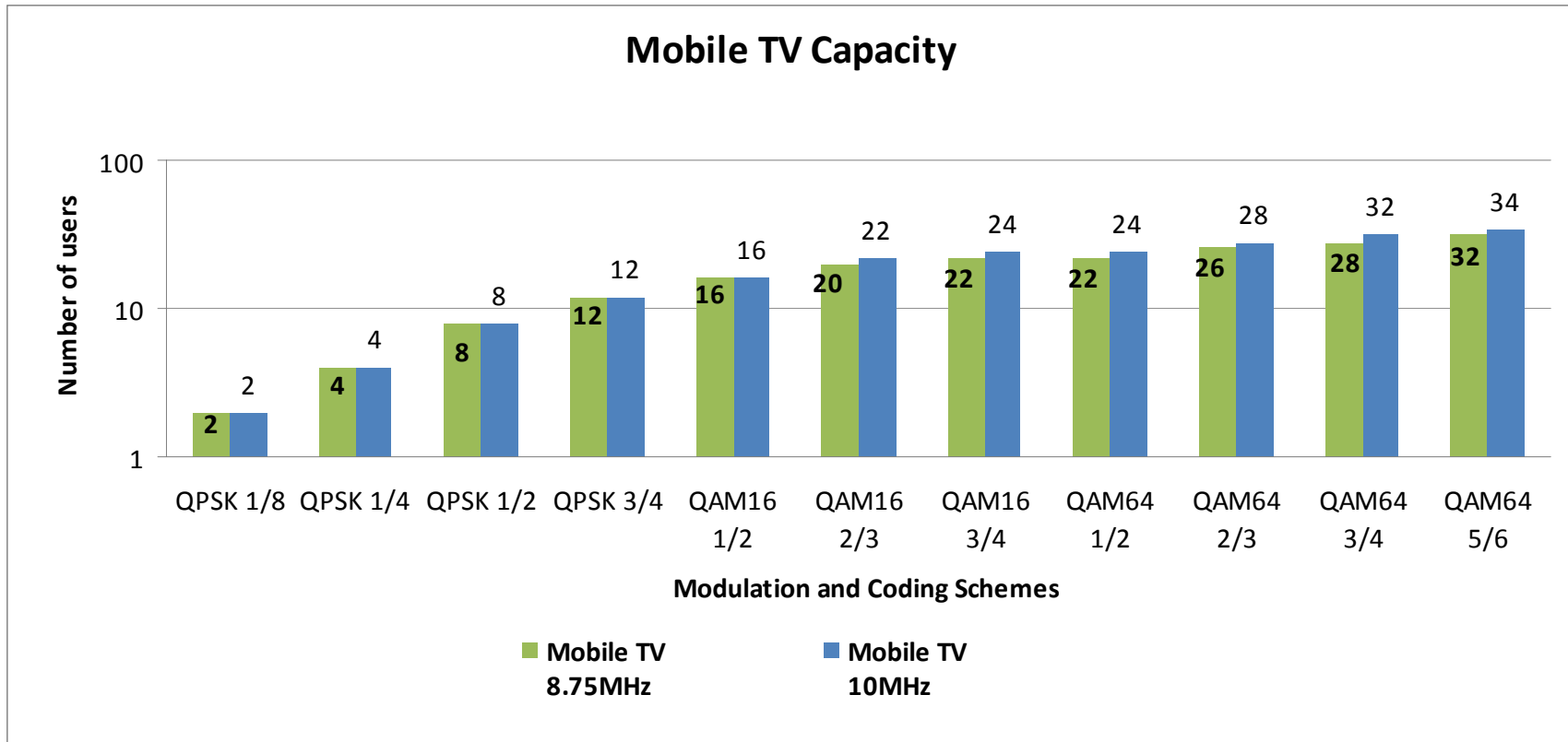


Laptop (700-800 kbps)



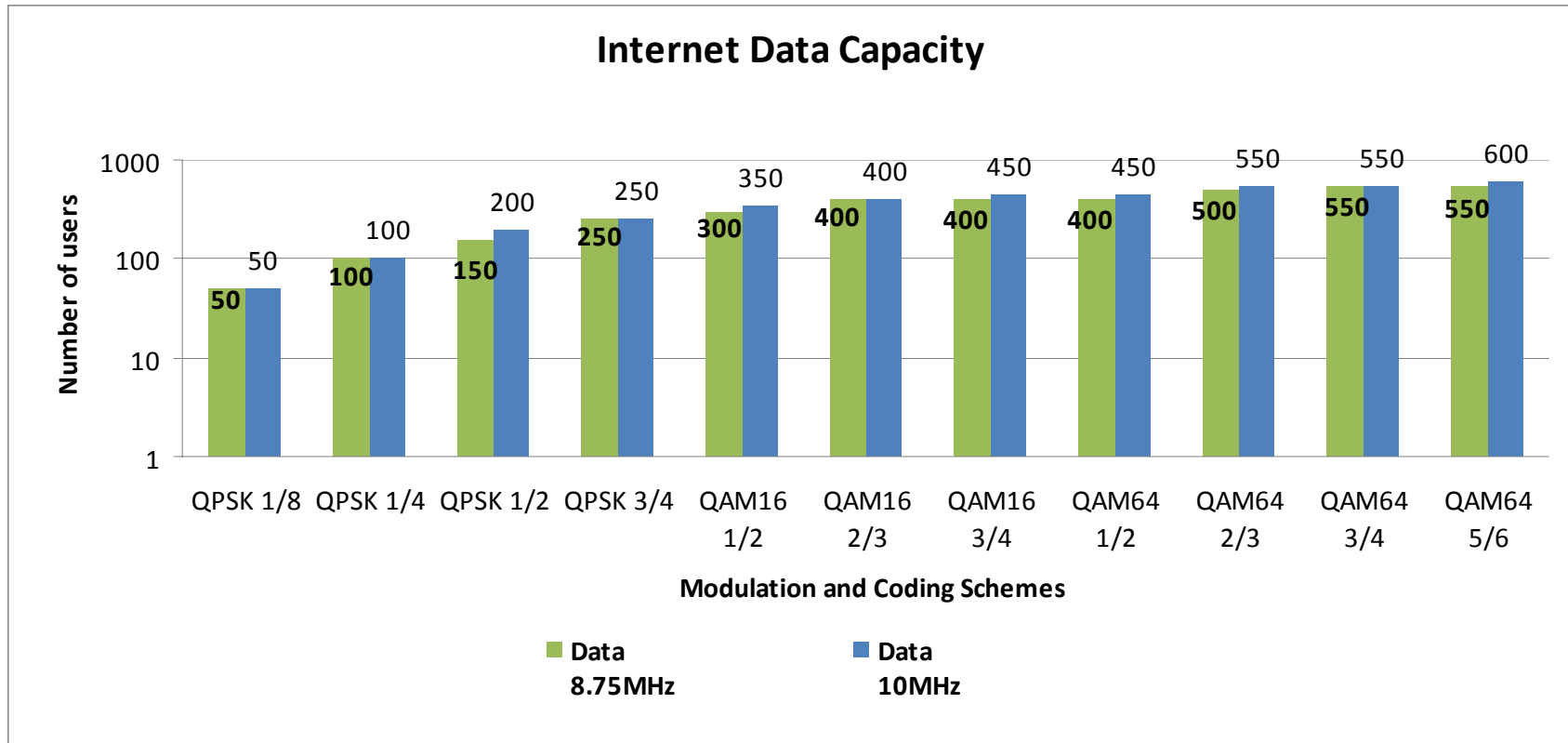
Palmtop (324 kbps)

# Mobile TV



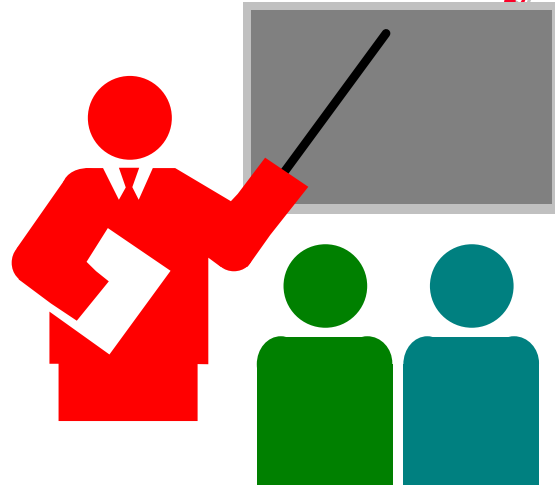
## □ H.264 MPEG-4

# Internet Data Access



□ 3GPP HTTP workload

# Summary



- ❑ WiMAX systems provide a good performance on Voice, Video, and Data
- ❑ Voice traffic generates small packets.  
10X performance with Aggregation and scheduling
- ❑ Video throughput distinguishes WiMAX from other legacy mobile networking technologies

## References

- ❑ WiMAX Forum White paper, “Triple Play Services including Mobile TV, VoIP, and Internet over Mobile WiMAX Networks,” April 2008.
- ❑ C. So-In, R. Jain, A. Tamimi, “Capacity Estimation of IEEE 802.16e Mobile WiMAX Networks,” Submitted to IEEE Communications Magazine, April 2008.
- ❑ C. So-In, R. Jain, A. Tamimi, “Seasonal ARIMA Models of Video Traffic for Mobile WiMAX and Other Wireless Broadband Access Technologies,” Submitted to ACM Multimedia 2008 conference, April 2008.