



Multimedia Wireless Networks: Technologies, Standards, and QoS

鄭瑞光

Ray-Guang Cheng

台灣科技大學電子系

EE 705-3, Ext. 6371

crg@mail.ntust.edu.tw

Office Hours: 13:30~15:30 Mon.



Objective

- Understand the terms and basic concepts of quality of service
- Use the knowledge that you learned to
 - Read papers/standards
 - Use QoS Tools
 - Teamwork





Outline

- Multimedia applications and quality of service (QoS)
 - Multimedia Applications
 - QoS Fundamentals
 - QoS Mechanisms
 - Classification
 - Channel Access Mechanism
 - Packet Scheduling Mechanisms
 - Traffic Policing Mechanism
 - Resource Reservation Signaling Mechanisms
 - Admission Control
 - QoS Architecture





Outline

- Chapter 1
 - the nature of multimedia applications
 - users' expectations for multimedia applications
- Chapters 2 and 3
 - QoS fundamental concepts
 - QoS mechanisms





Outline

- Selected Standards
 - Wireless Local Area Networks (WLAN)
 - 802.11 (WiFi)
 - 802.11e
 - 802.11s
 - Wireless Metropolitan Area Networks (WMAN)
 - 802.16-2004 (WiMAX)
 - 802.16e (WiMAX with mobility supporting)



A decorative graphic on the left side of the slide, consisting of overlapping yellow, red, and blue squares with a black crosshair.

To Do

- Raise questions during class
- Meet/Discuss with your team members

- Self-introduction
 - Who you are?
 - What you do?
 - Why you are here?

A decorative graphic consisting of overlapping yellow, red, and blue squares with a black crosshair is positioned to the left of the title.

Reference

Reference:	Multimedia Wireless Networks: Technologies, Standards, and QoS By Aura Ganz, Zvi Ganz, Kitti Wongthavarawat
Materials:	<u>http://elearning.ntust.edu.tw/</u>
Agency:	新月書局 · 2331-7856





Networking Options

WIRED

- Not flexible
- Expensive labor
- Unfriendly to interiors
- Cheap price
- **Low profit = no motivation**



WIRELESS

- Flexible
- Easy installation
- Friendly to interiors
- Higher price
- **Good profit = motivation**





Channel Capacity

- Channel capacity: the maximum data rate can be supported
- Important parameters:
 - Data rate (C): bps
 - Bandwidth (B): Herz (Hz)
 - Noise (N)
 - Bit error rate (BER)
- Target: Maximize C for a given B subject to a target BER requirement
 - The Shannon capacity gives us the upper limit!
 - The Nyquist formula tells us how many levels we need!



Shannon–Hartley Theorem

- Shannon's channel capacity:

$$C = B \log_2(1 + SNR)$$

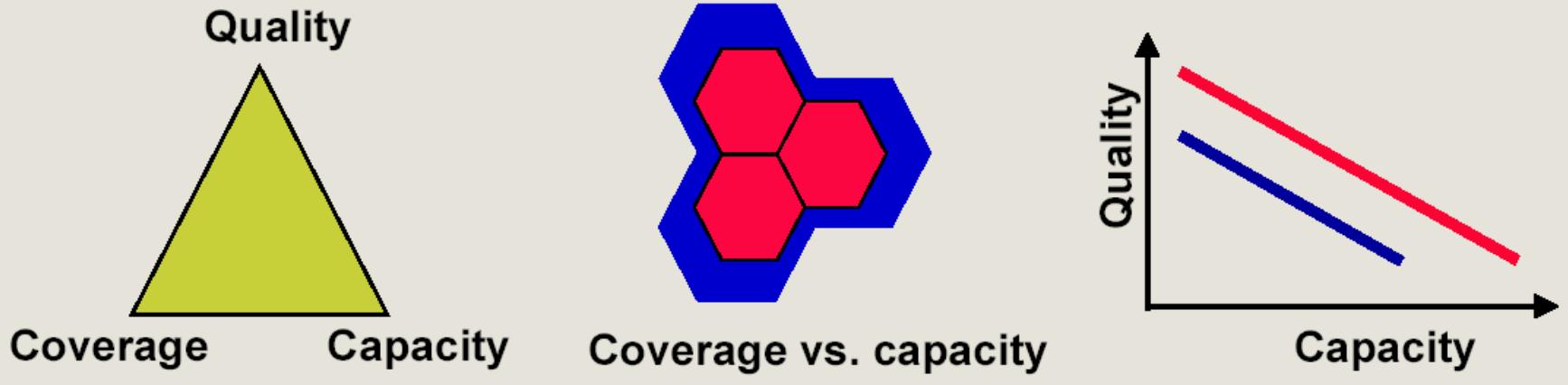
- with Gaussian distributed noise;
- SNR: signal-to-noise ratio:
 $E_b/N_0 = ST_b/N_0 = S/(kTR)$
- C can be increased by
 - Increasing B: it increases noise and decreases SNR
 - Increasing S: it introduces non-linearity and results inter-modulation noise



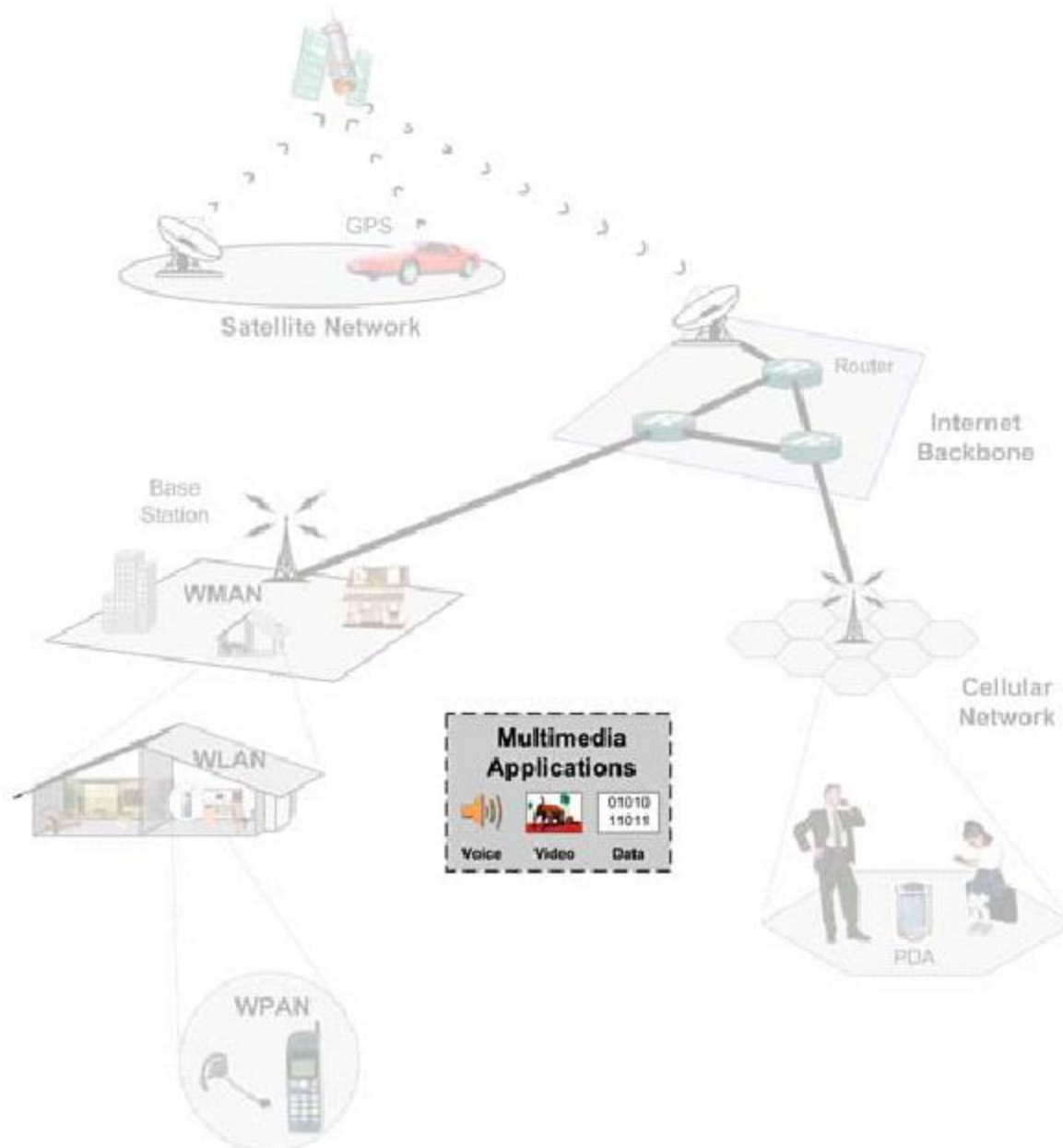


Wireless Technology Limitations

- What is “Performance” of a radio network
 - CCQ



- Coverage
 - Cell radius
- Capacity
 - Speech
 - Erlang/cell/MHz
 - Data
 - Kbps/cell/MHz
- Quality
 - Speech
 - Block error rate
 - Latency
 - Data
 - Packet loss rate
- Mobility
 - Speed





From Wiki

- Quality of service (QoS)
 - the overall performance of a telephony or computer network, particularly the performance seen by the users of the network.
- QoS Indexes:
 - error rates, bandwidth, throughput, transmission delay, availability, jitter, etc.



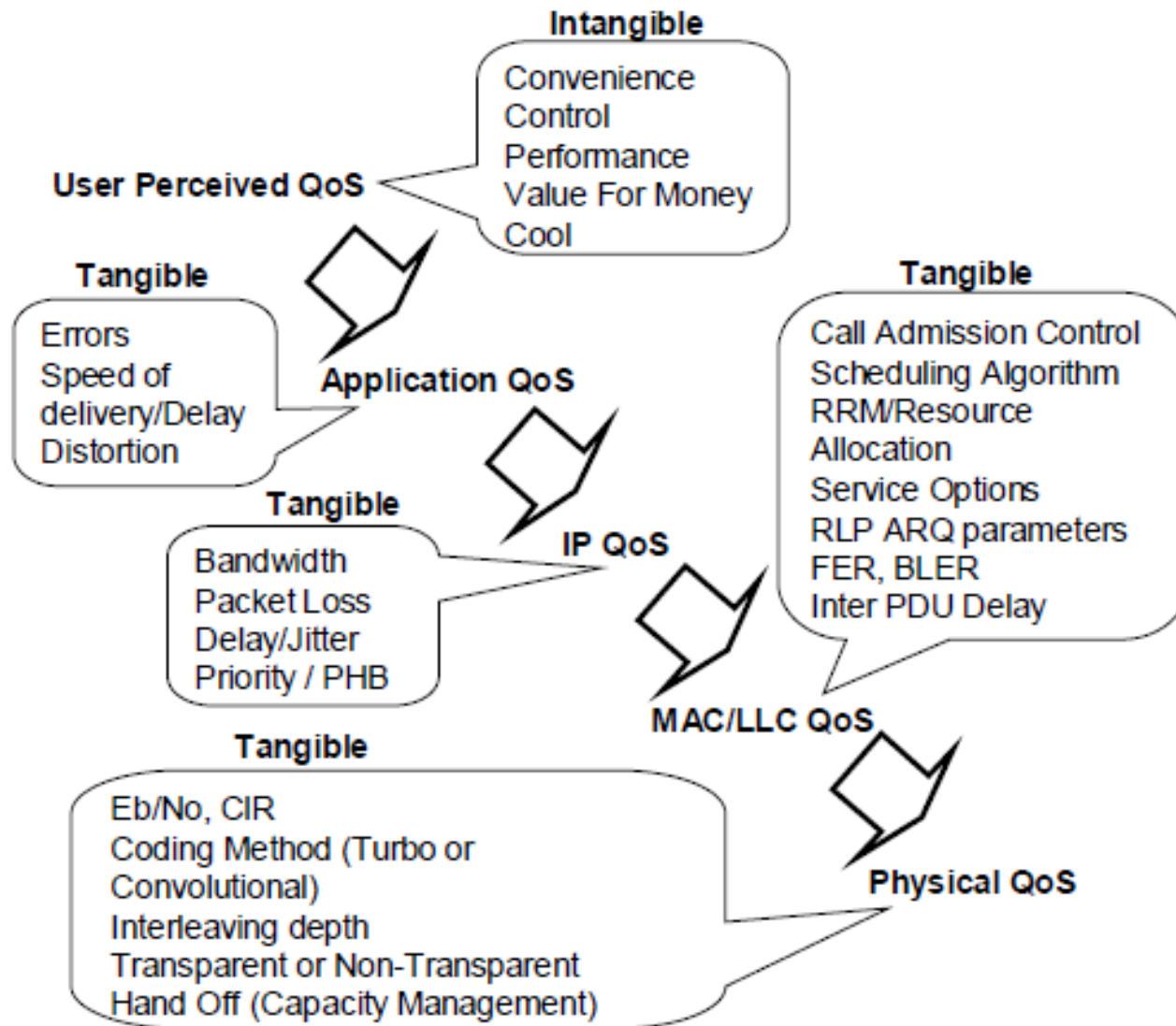


Figure 2 : A hierarchical framework for wireless QoS



*Broadband Mobile Wireless
Research Laboratory*



A decorative graphic on the left side of the slide, consisting of overlapping yellow, red, and blue squares with a black crosshair.

Solutions

- Two main approaches:
 - *Bandwidth over-provisioning*
 - *Bandwidth management*

Evaluation Criteria

5	Excellent	<ul style="list-style-type: none"> • Clearly describe the problem, importance, and challenge with strong evidence • Strong evidence to support the conclusion; correct content • Good presentation skill; Well-prepared with passion • Always keep eye contact to the audiences; PPT with many figures • Precise and correct answers to all questions
4	Best	<ul style="list-style-type: none"> • Properly describe the problem, importance, and challenge with some evidence • Some evidence to support the conclusion • Content is almost correct; Well-prepared with passion • Eye contact to the audiences for 2/3 of the talk; PPT with some figures • Can answer all questions
3	Good	<ul style="list-style-type: none"> • Describe the problem and conclusion • Lack of evidence to support the importance and conclusion • Content is almost correct; prepared with passion • Eye contact to the audiences for 1/3 of the talk; PPT with few figures • Can answer most of the questions
2	Normal	<ul style="list-style-type: none"> • Describe the problem without mentioning importance, and challenge • No clear conclusion • Content is understandable but has some errors; not well-prepared • Eye contact to the audiences less than 1/3 of the talk; PPT without figures • Only basic questions are answered
1	Bad	<ul style="list-style-type: none"> • Cannot clearly describe the problem and address its importance/challenge • Subject is not clear, lack of proper conclusion • Content is hard to understand; not well-prepared, less organized • Only basic questions are answered or even not answered



Evaluations

- 2023@HackMD
- 2024@HackMD
- 2024@GitHub
- 2025@HackMD



A decorative graphic in the top left corner consisting of overlapping yellow, red, and blue squares with a black crosshair.

Invited Talk

- AI and Its Age
 - Given by CEO and CTO of Taiwan Mobile
 - RB-105
 - 7:00~9:00 PM
- 1 pt for attending
- 4 pt for raising a question



Assignments

- Study Prof. Tommaso Melody's Paper
- QoS for LEO Satellite Communication