Implications of Supporting Multimedia Applications on Wireless LAN Design

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Outline

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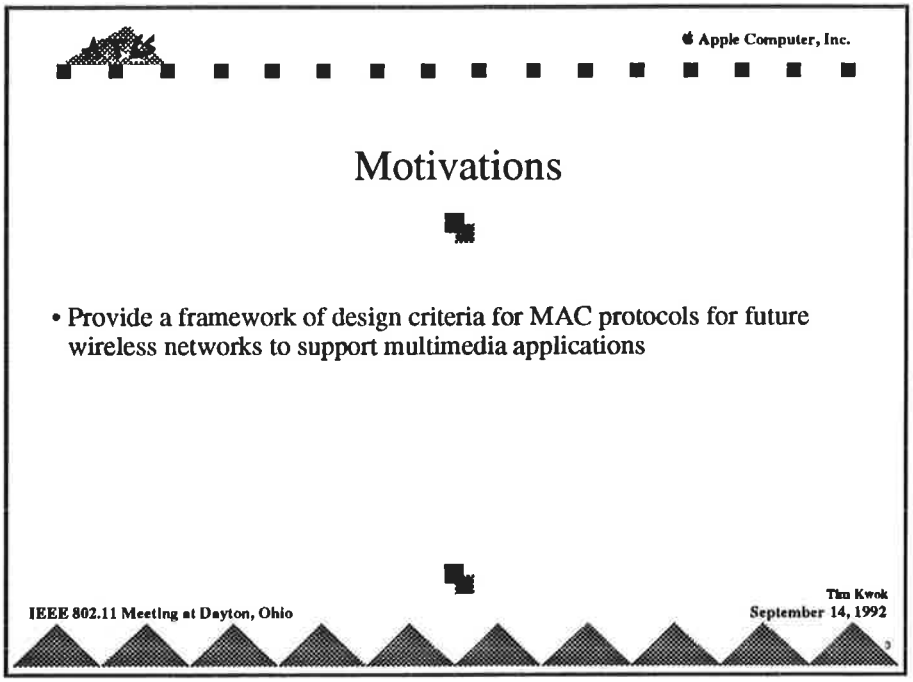
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Motivations
• Provide a framework of design criteria for MAC protocols for future wireless networks to support multimedia applications
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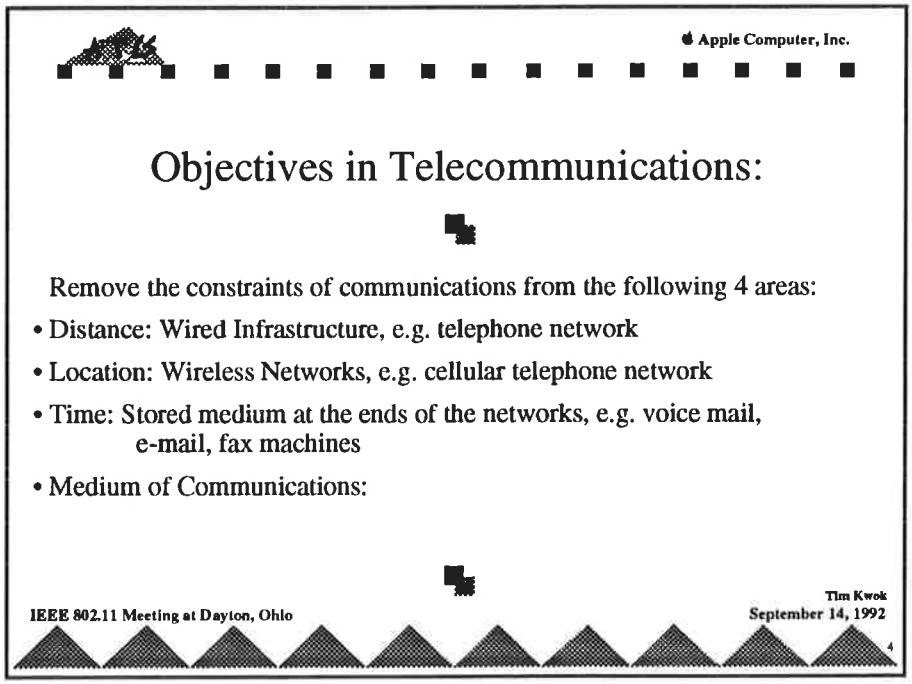
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Objectives in Telecommunications:
Remove the constraints of communications from the following 4 areas:
• Distance: Wired Infrastructure, e.g. telephone network
• Location: Wireless Networks, e.g. cellular telephone network
• Time: Stored medium at the ends of the networks, e.g. voice mail, e-mail, fax machines
• Medium of Communications:
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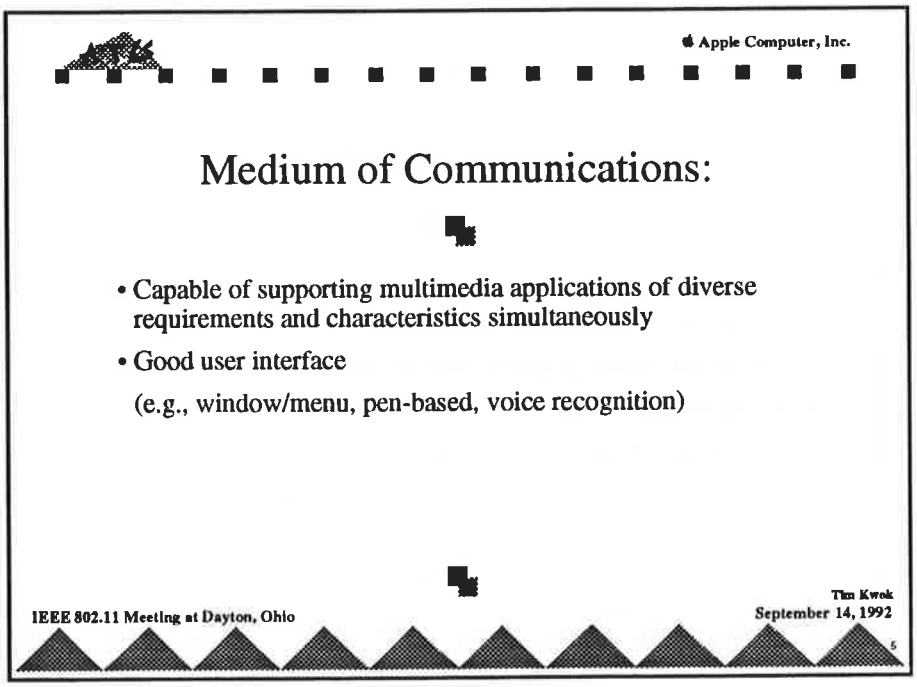
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Medium of Communications:
• Capable of supporting multimedia applications of diverse requirements and characteristics simultaneously
• Good user interface
(e.g., window/menu, pen-based, voice recognition)
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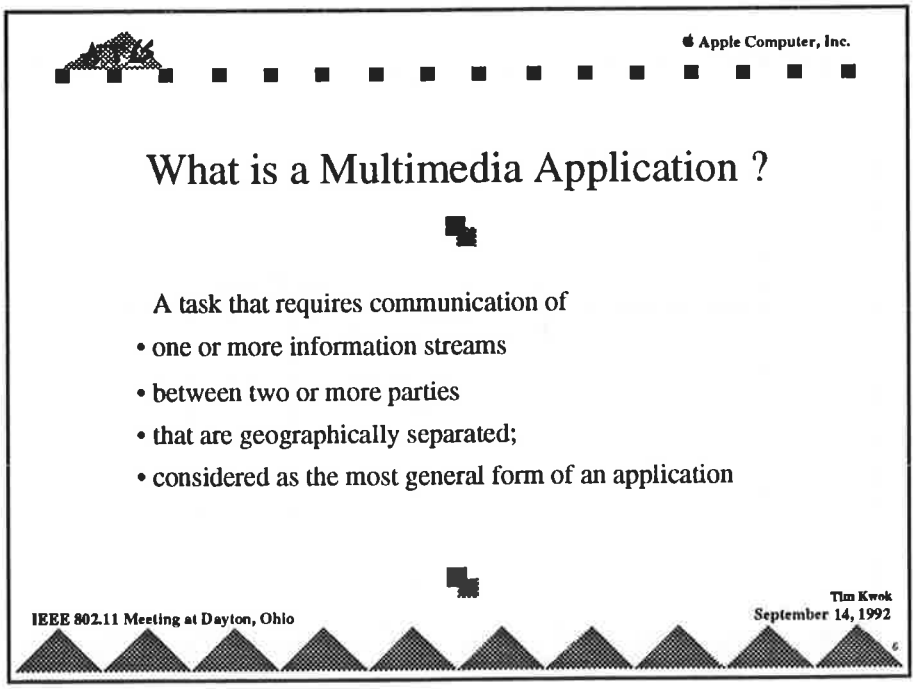
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What is a Multimedia Application ?
A task that requires communication of
• one or more information streams
• between two or more parties
• that are geographically separated;
• considered as the most general form of an application
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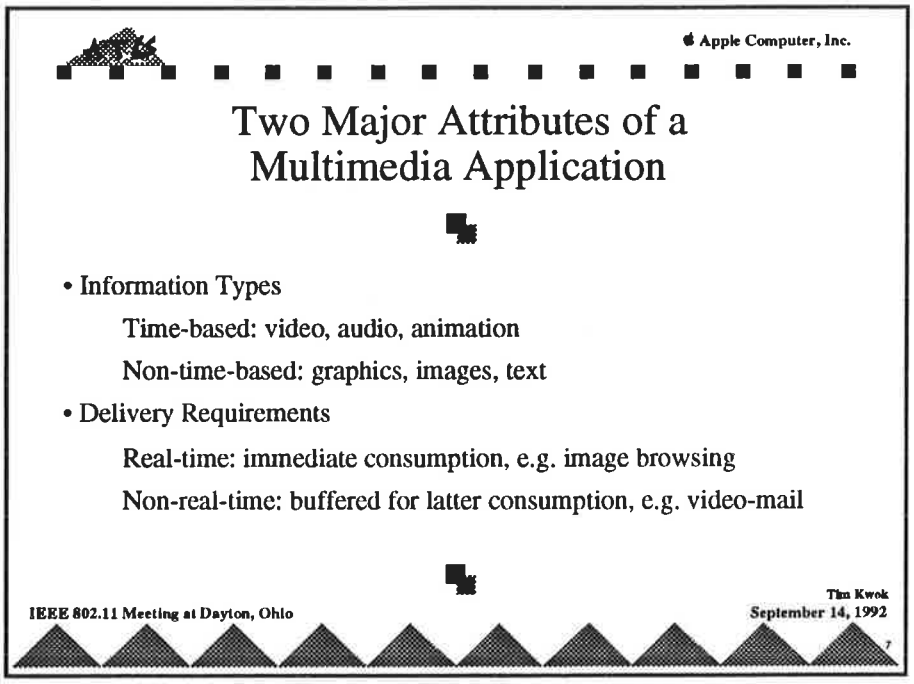
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Two Major Attributes of a Multimedia Application
• Information Types
Time-based: video, audio, animation
Non-time-based: graphics, images, text
• Delivery Requirements
Real-time: immediate consumption, e.g. image browsing
Non-real-time: buffered for latter consumption, e.g. video-mail
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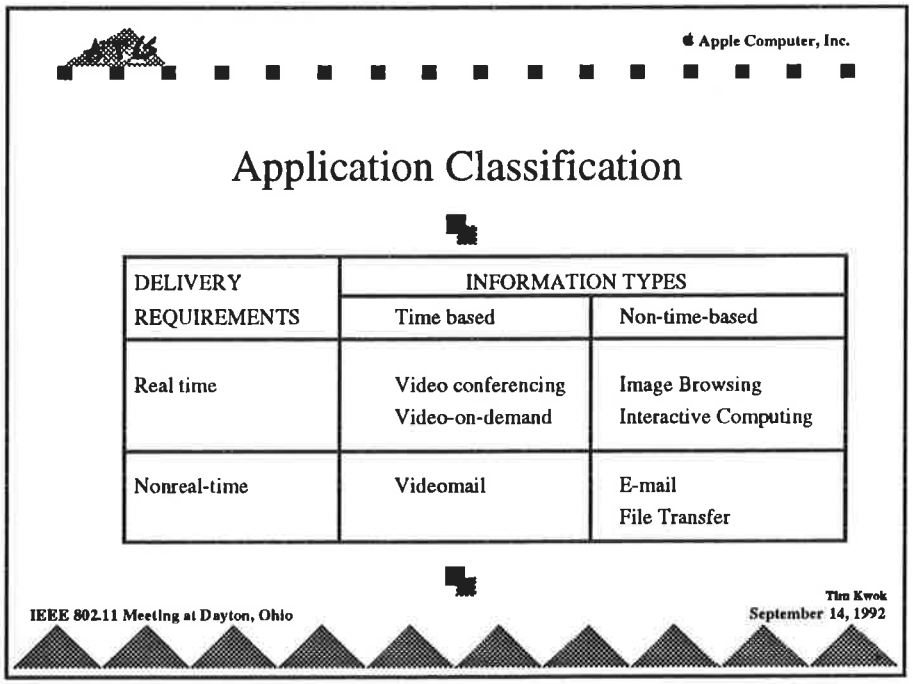
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Application Classification
DELIVERY REQUIREMENTS
INFORMATION TYPES
Time based
Non-time-based
Real time
Video conferencing
Video-on-demand
Image Browsing
Interactive Computing
Nonreal-time
Videomail
E-mail
File Transfer
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Other Attributes of a Multimedia Application

- Symmetry of connection
- Point-to-point vs Multipoint
- Human vs computing device
- Access networks:
  - Wireless vs. Wired
  - Ad hoc vs. Based stations
- Mobility

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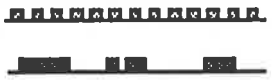
Application Characteristics

1. Traffic Characteristics:
   - Periodic: e.g., video, audio
   - Bursty: e.g., file transfer, printing



2. Communications Requirements
   - Bandwidth
   - Delay
   - Error

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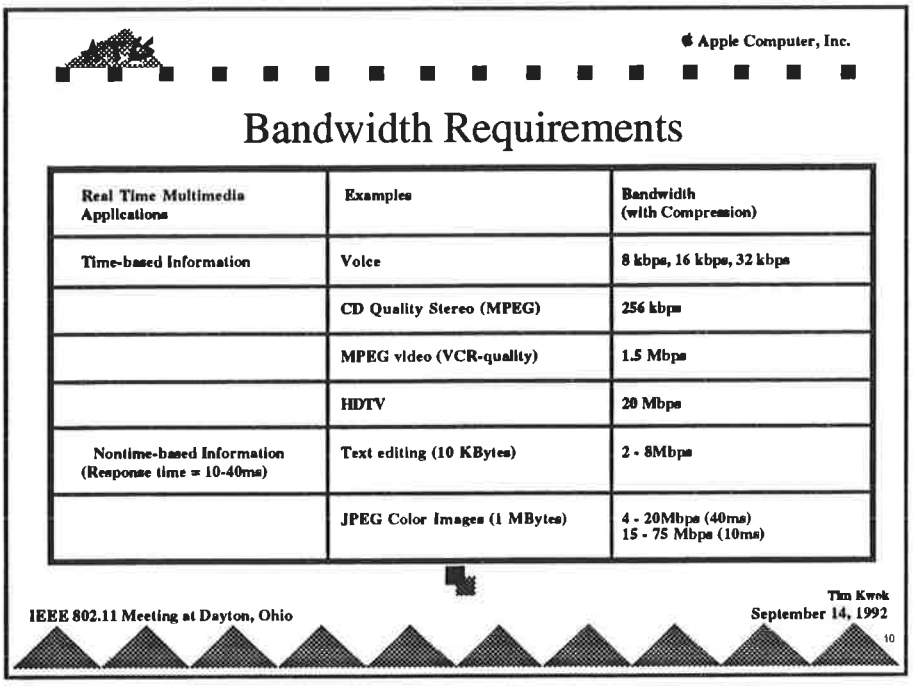
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Bandwidth Requirements
Real Time Multimedia Applications
Examples
Bandwidth (with Compression)
Time-based Information
Voice
8 kbps, 16 kbps, 32 kbps
CD Quality Stereo (MPEG)
256 kbps
MPEG video (VCR-quality)
1.5 Mbps
HDTV
20 Mbps
Nontime-based Information (Response time = 10-40ms)
Text editing (10 KBytes)
2 - 8Mbps
JPEG Color Images (1 MBytes)
4 - 20Mbps (40ms)
15 - 75 Mbps (10ms)
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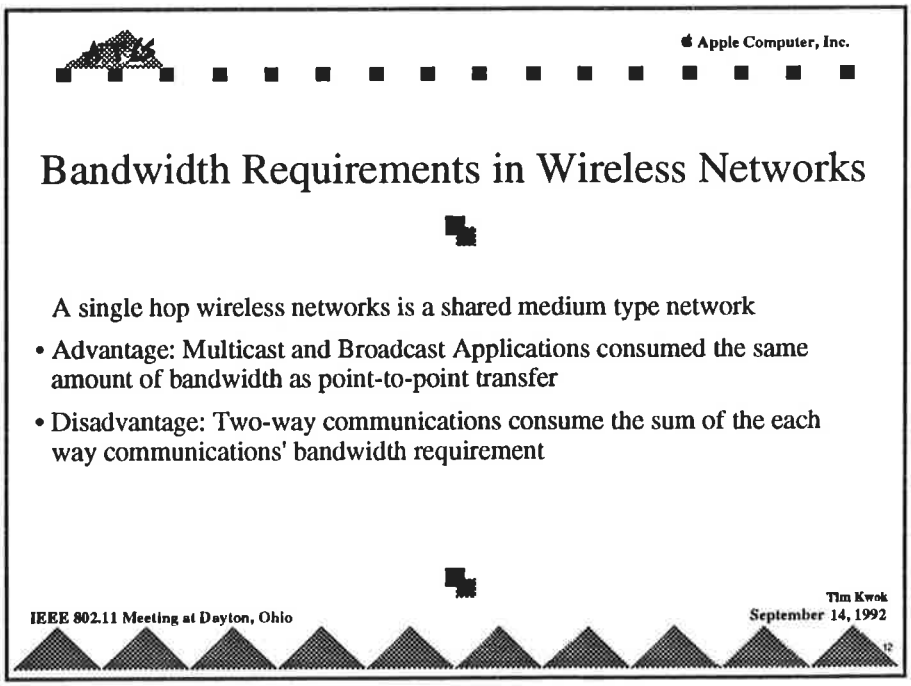
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Bandwidth Requirements in Wireless Networks
A single hop wireless networks is a shared medium type network
• Advantage: Multicast and Broadcast Applications consumed the same amount of bandwidth as point-to-point transfer
• Disadvantage: Two-way communications consume the sum of the each way communications' bandwidth requirement
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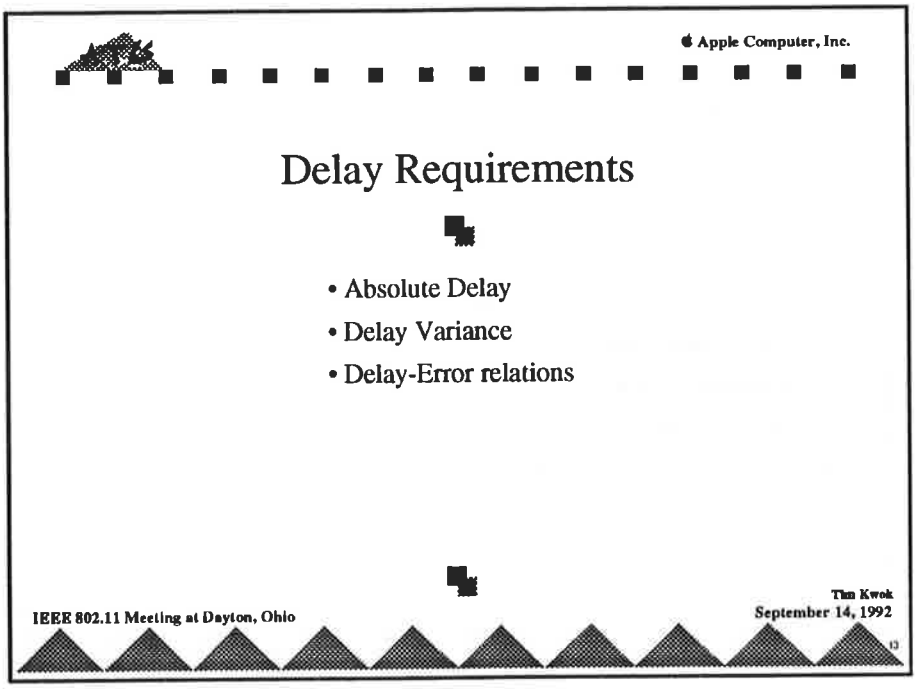
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Delay Requirements
• Absolute Delay
• Delay Variance
• Delay-Error relations
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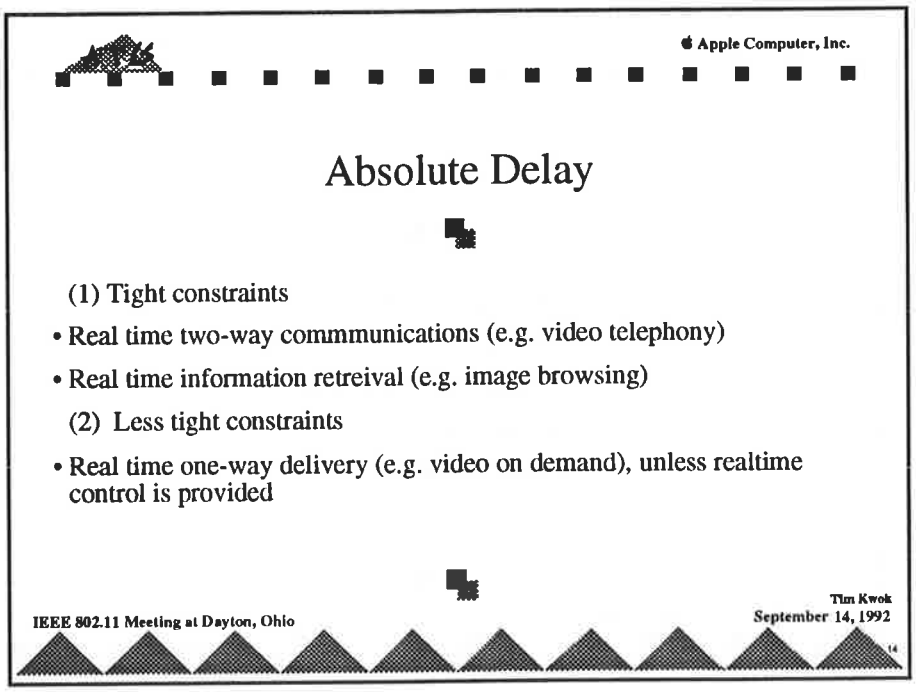
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Absolute Delay
(1) Tight constraints
• Real time two-way commmunications (e.g. video telephony)
• Real time information retreival (e.g. image browsing)
(2) Less tight constraints
• Real time one-way delivery (e.g. video on demand), unless realtime control is provided
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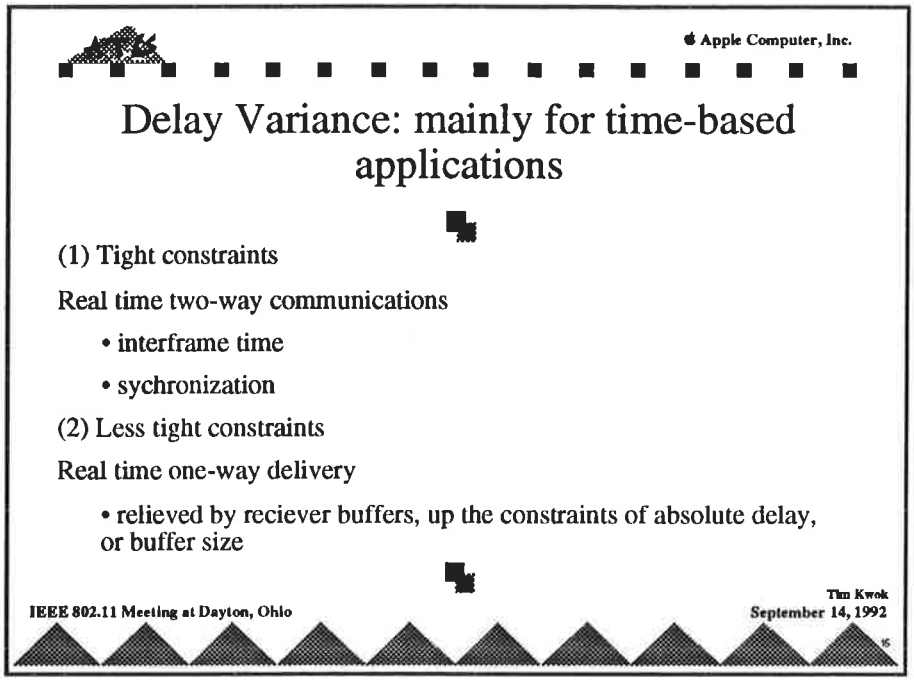
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Delay Variance: mainly for time-based applications
(1) Tight constraints
Real time two-way communications
• interframe time
• sychronization
(2) Less tight constraints
Real time one-way delivery
• relieved by reciever buffers, up the constraints of absolute delay, or buffer size
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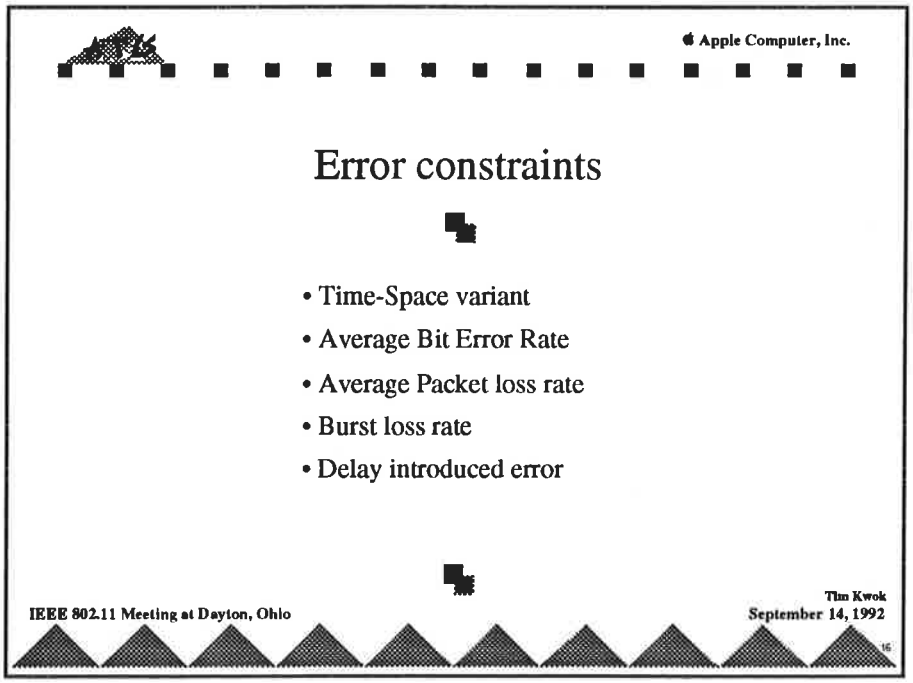
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Error constraints
• Time-Space variant
• Average Bit Error Rate
• Average Packet loss rate
• Burst loss rate
• Delay introduced error
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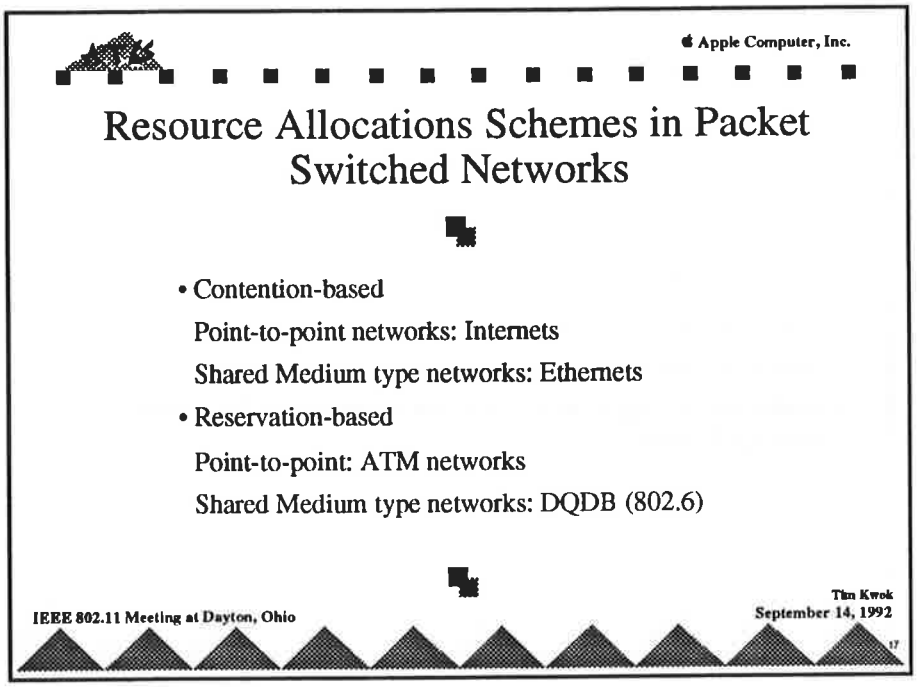
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Resource Allocations Schemes in Packet Switched Networks
• Contention-based
Point-to-point networks: Internets
Shared Medium type networks: Ethernets
• Reservation-based
Point-to-point: ATM networks
Shared Medium type networks: DQDB (802.6)
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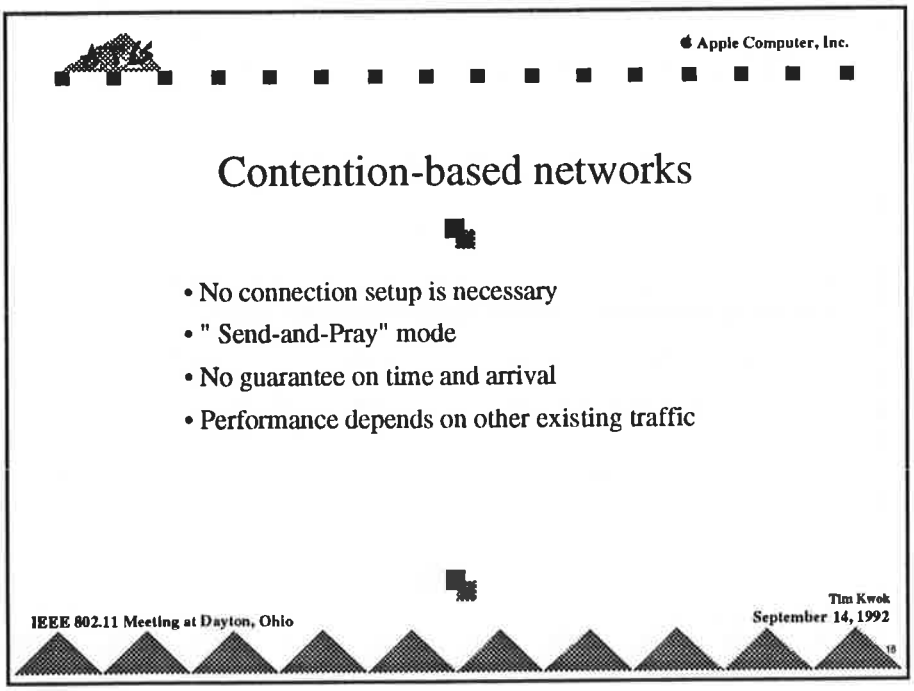
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Contention-based networks
• No connection setup is necessary
• " Send-and-Pray" mode
• No guarantee on time and arrival
• Performance depends on other existing traffic
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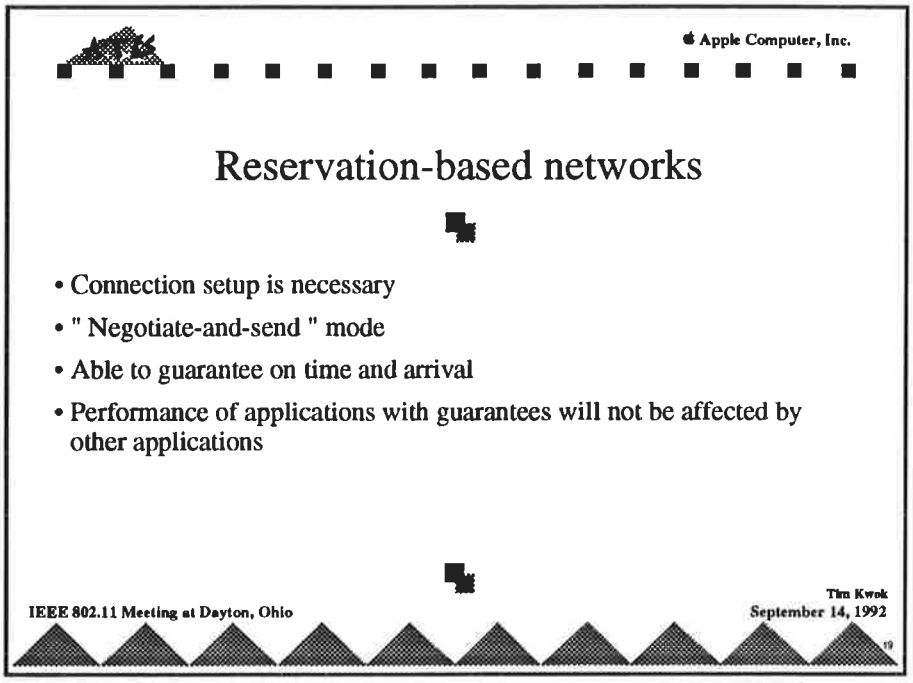
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Reservation-based networks
• Connection setup is necessary
• " Negotiate-and-send " mode
• Able to guarantee on time and arrival
• Performance of applications with guarantees will not be affected by other applications
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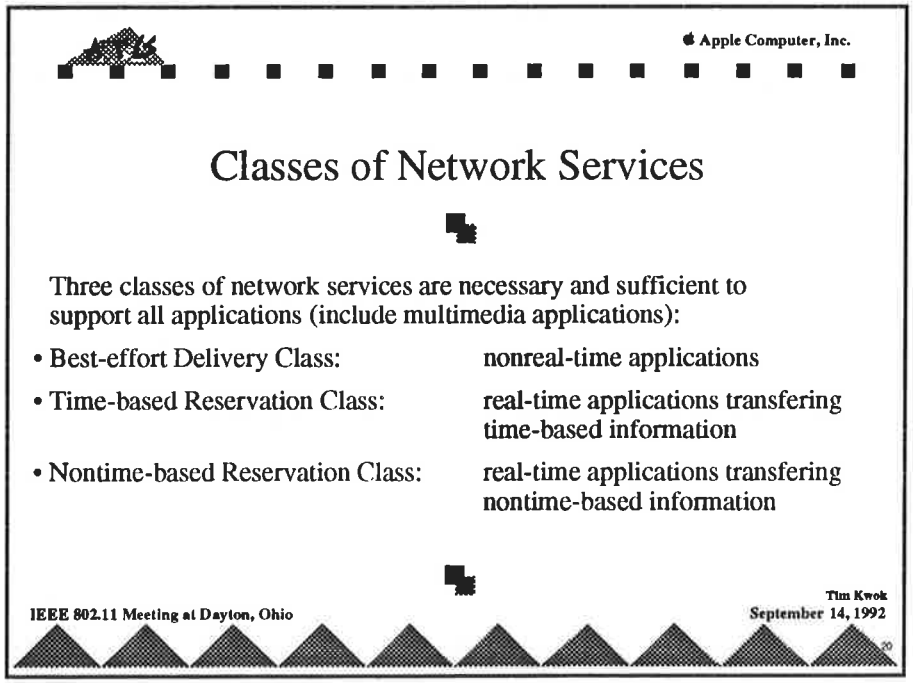
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Classes of Network Services
Three classes of network services are necessary and sufficient to support all applications (include multimedia applications):
• Best-effort Delivery Class: nonreal-time applications
• Time-based Reservation Class: real-time applications transfering time-based information
• Nontime-based Reservation Class: real-time applications transfering nontime-based information
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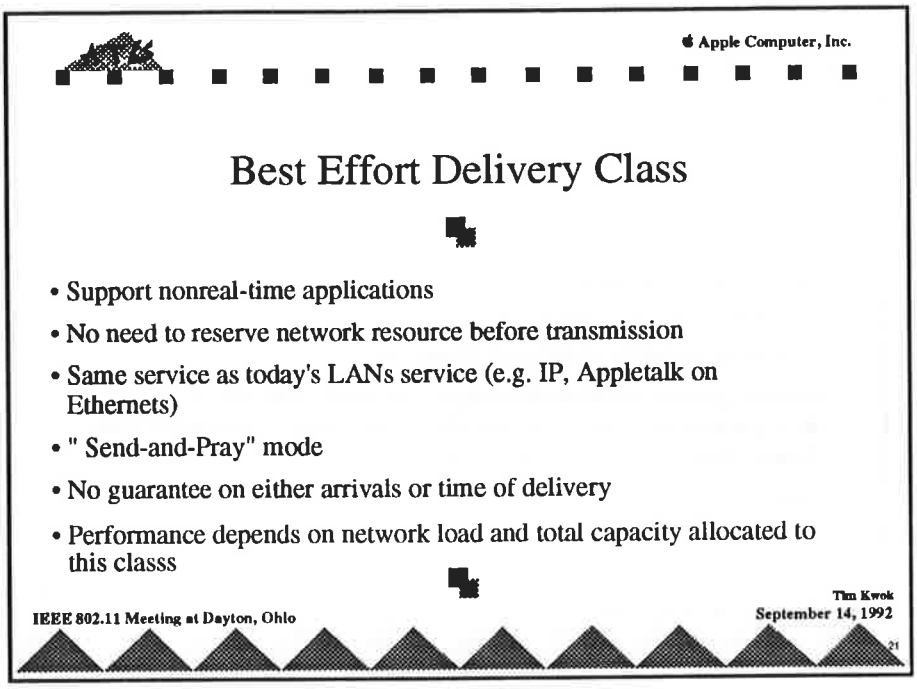
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Best Effort Delivery Class
• Support nonreal-time applications
• No need to reserve network resource before transmission
• Same service as today's LANs service (e.g. IP, Appletalk on Ethernets)
• " Send-and-Pray" mode
• No guarantee on either arrivals or time of delivery
• Performance depends on network load and total capacity allocated to this classs
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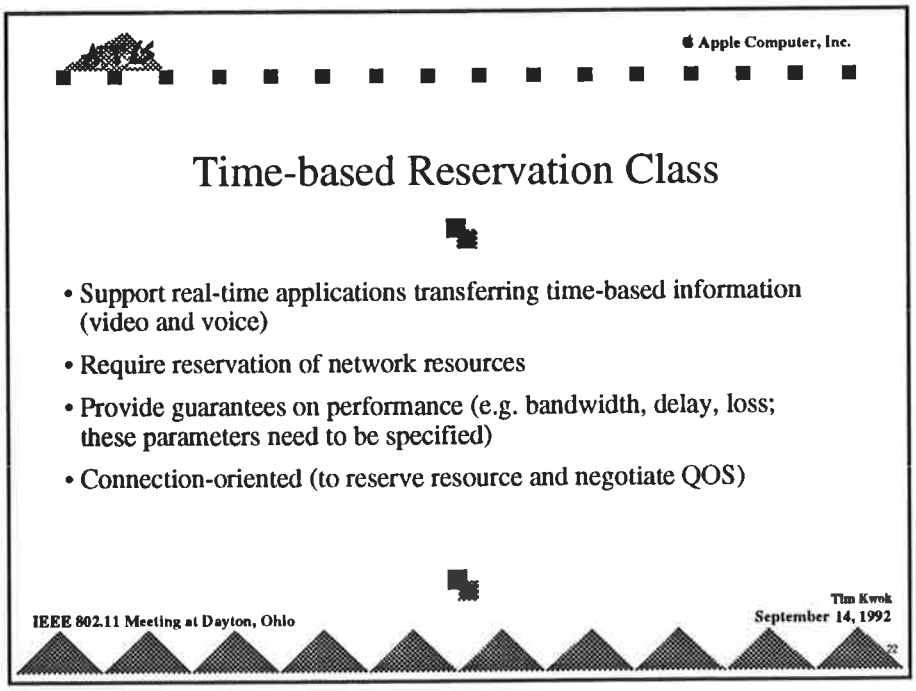
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Time-based Reservation Class
• Support real-time applications transferring time-based information (video and voice)
• Require reservation of network resources
• Provide guarantees on performance (e.g. bandwidth, delay, loss; these parameters need to be specified)
• Connection-oriented (to reserve resource and negotiate QOS)
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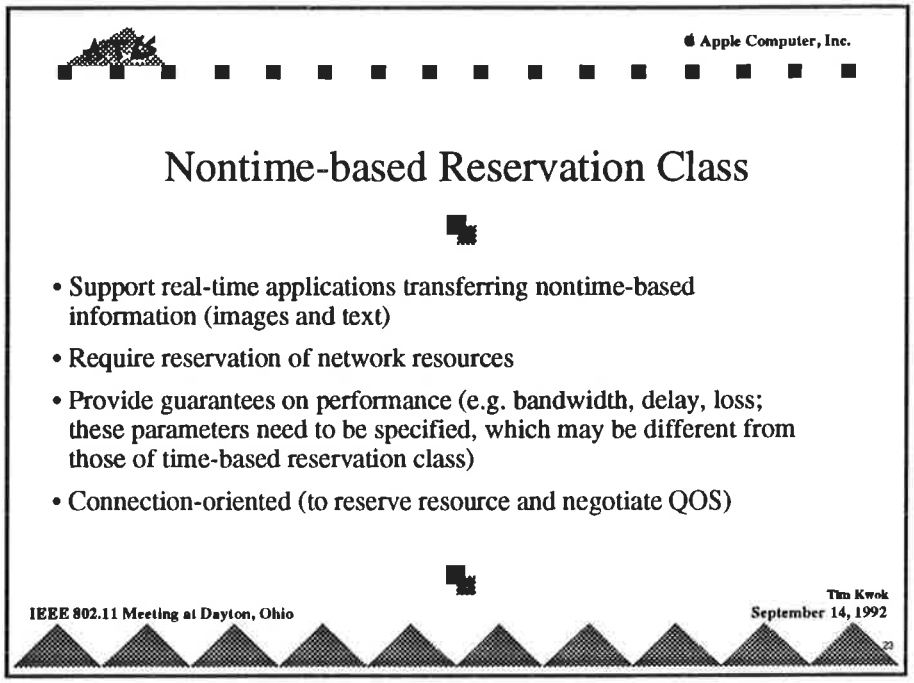
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Nontime-based Reservation Class
• Support real-time applications transferring nontime-based information (images and text)
• Require reservation of network resources
• Provide guarantees on performance (e.g. bandwidth, delay, loss; these parameters need to be specified, which may be different from those of time-based reservation class)
• Connection-oriented (to reserve resource and negotiate QOS)
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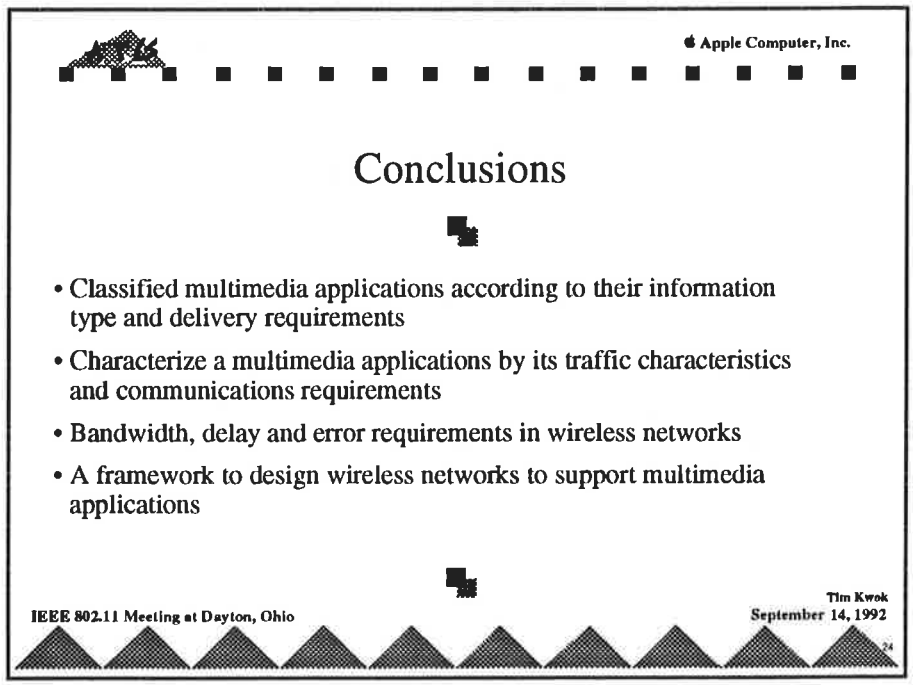
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Conclusions
• Classified multimedia applications according to their information type and delivery requirements
• Characterize a multimedia applications by its traffic characteristics and communications requirements
• Bandwidth, delay and error requirements in wireless networks
• A framework to design wireless networks to support multimedia applications
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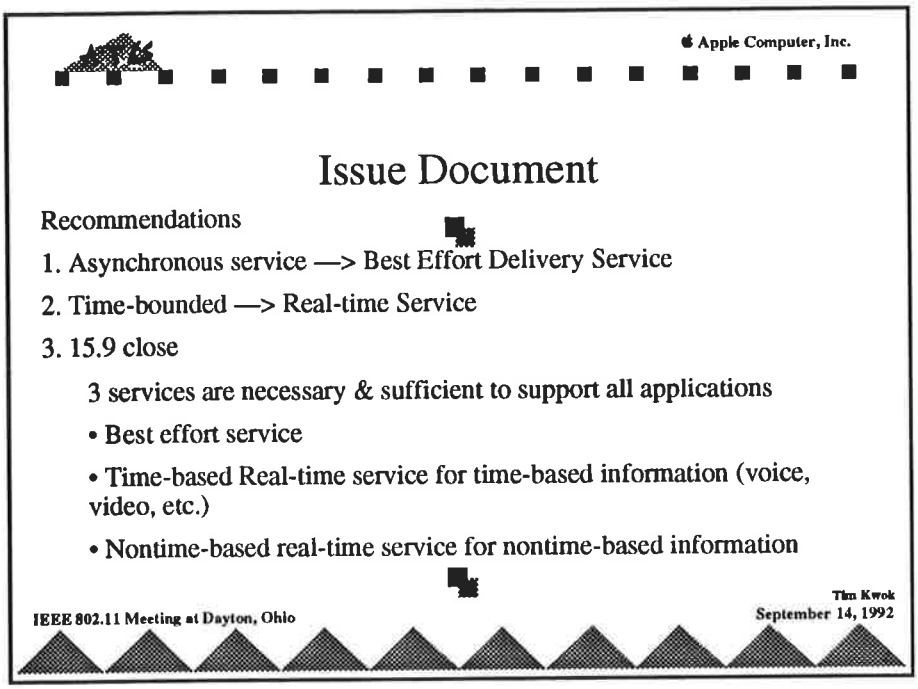
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Issue Document
Recommendations
1. Asynchronous service —> Best Effort Delivery Service
2. Time-bounded —> Real-time Service
3. 15.9 close
3 services are necessary & sufficient to support all applications
• Best effort service
• Time-based Real-time service for time-based information (voice, video, etc.)
• Nontime-based real-time service for nontime-based information
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