Multimedia Transport Over Wireless LANs

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- Encourage the creation of a PAR
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Consumer Benefits of Multimedia Networks

- Lets Users Consume Content in Preferred Locations
  - Allows access from any room
  - Provides for both stationary and mobile appliances

- Reduces the Cost of Appliances
  - Leverages compute power & peripherals of “media server”
  - Central upgrade point mitigates obsolescence

- Enables “Sharing” Among Appliances
  - Content sharing
  - Peripheral sharing
  - Connection sharing

Content Use Is More Enjoyable, Convenient and Affordable
Home Multimedia Drivers/Trends

- **Broadband is a Key Driver for Multimedia Content**
  - 45 million homes with broadband (cable & dsl) access by 2002
  - Multimedia apps key driver of broadband demand
    ~ 63% cited downloads of audio, video & games files
    ~ 54% would increase consumption of streaming

- **Streaming Media Trends**
  - 65 million downloads of RealPlayer
  - 2000 radio and TV stations broadcasting on the internet
  - Many major service providers looking at remote applications

- **Stored Media Trends**
  - 14 million DVRs (e.g., TiVO, Replay) by 2004
  - Digital audio now a industry phenomena
    ~ 180 million MP3 files downloaded on a weekly basis
    ~ 30M portable MP3 players (e.g., Rio) by 2003
    ~ MP3 will be > $1 billion business by 2003
  - Digital cameras & v-conferencing > $1 billion by 2003
### Market Evolution of Multimedia Network Devices

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**1999**
- Desktop PCs
- Broadband Modems

**2000**
- Desktop PCs
- Residential Gateways

**2001+**
- Desktop PCs
- Residential Gateways
- Set-Top Boxes
Multimedia Network Adoption


Home Entertainment Networks
- Projections based on
  - Average Penetration of CE products
  - Entertainment networks Penetration rate
  - Nodes per household

Home Entertainment Networks (non-PC)

PC Networking

Millions of Dollars

1998 1999 2000 2001 2002 2003 2004
Consumer Interest in Multimedia Networking

Interest in Home Multimedia LAN

Data only LAN | MM LAN
---|---
89% | 9%
90% | 8%
88% | 10%

Desired Attributes

- Performance: 88% Important, 10% Not Important, 2% Don't Know
- Media Quality: 90% Important, 8% Not Important, 2% Don't Know
- Ease of Use: 89% Important, 9% Not Important, 2% Don't Know

* 279 US Households Survey
Tutorial: Transporting Multimedia Over 802.11b Wireless LANs

Dr. Rajugopal Gubbi

Sept 13, 1999
Asynchronous data v/s multimedia (MM) Streams

Asynchronous Data
• Little or no latency restrictions
• Real-time delivery not an issue
• All data frames are treated equally

Multimedia streams
• Need security due to copyright restrictions
• Sensitive to latency in delivery
• Network throughput is an issue as it controls how many MM streams can be efficiently supported at a given time
• All MM frames can NOT be treated equally
• Hence need stream support at the MAC level
• Further needs dynamic management of the network resources
What is a stream?

- A stream is a set of frames requiring specific services and a specific range of parameter values for the required services. Some of the examples of the services are:
  - Latency: How often the stream frames are transmitted independent of the network traffic conditions.
  - Bandwidth: How many stream frames are transmitted per second independent of the network traffic conditions.
  - Priority: How important is this stream compared to other traffic on the network
  - Channel protection: How much error correction or retransmission is carried out on the frames of the stream.
- Streams are virtual connections over the basic MAC/PHY services of transmission and reception of frames.
What is needed for Multimedia data transport (1)?

The requirements of transporting multimedia streams over LANs are grouped into three broad categories. They are; Latency, Bandwidth Management, and Channel Throughput.

- **Latency**
  - Streams from interactive applications demand tighter latency in delivery. While voice streams require the latency to be less than 10ms, a video stream can tolerate latencies up to 100ms (or about 3 frames).
  - For streams from non-interactive real-time applications, latency jitter increases the buffer size required at the receivers.
  - Hence the LAN should support a stream to be transmitted at pre-negotiated intervals of time.
What is needed for Multimedia data transport (2)?

- Bandwidth Management
  - MM stream support needs a mechanism for an STA to negotiate and obtain the required bandwidth
  - Since the start and end of a stream or the content of the stream is unpredictable at the MAC level, there is a need for a simple mechanism to negotiate/re-negotiate the bandwidth required by each STA.
  - Since different MM streams could have different priorities, priority management is needed to transport the most important streams with appropriate quality (guaranteed service)
  - Due to the limited number of PHY channels, efficient bandwidth management across coordinators is essential.
What is needed for Multimedia data transport (3)?

- **Channel Throughput**
  - Collision free operation increases the channel throughput and reduces latency of delivery
  - Without error detection/correction, one bit error could mean
    - for voice stream, loss of up to 10ms worth of data
    - for video stream, in the worst case scenario, corrupted data frame could mean the entire video frame or even all the remaining picture frames in the current group of frames being dumped
  - Channel errors reduce the channel throughput with no error correction
    - 25% PER is typical in the home environment
  - With error correction, the channel throughput required for the multimedia streams can be sustained
  - Extreme interference in the channel means finding a better channel to support the throughput required by the multimedia streams
What else is needed or not needed?

- Isochronous support over lossy medium is a difficult task. However, simple-but-clever multimedia coordination can achieve the same goals.
- MM stream support does not necessarily need different mechanisms for authentication/ de-authentication / association/ re-association/ disassociation.
- Improved ease-of-use desirable for installation, authentication, security and channel selection.
- Encryption is required in order to preserve the copyright restrictions on multimedia data along with the privacy of the user.
- Backward compatibility should not be ignored.
Is a solution possible?

A solution should be possible that…
  – Meets the market’s needs
  – Requires no changes to current STA
  – Enhances 802.11 to encompass applications beyond data
  – Is technically feasible and low cost