# Modem/Audio Integration

# Concurrent Audio And Modem Acceleration

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# Outline

- **Introduction and Scope**
- **Impact of Audio/Modem Acceleration**
- **Features and Cost Considerations**
- **Scalable Signal Processing**
- **Conclusions**

# Introduction

**Acceleration means…**

- **Hardware optimized for function**
- **Quality of service**
- **Reduced impact on other system resources = better user experience**
- **Cost for the accelerator silicon**

# Product Requirements

**Concurrency is essential today...**

- u **Modem functions (V.90, fax, voice)**
- u **Audio functions**

**...and tomorrow:**

- u **DSL**
- u **Streaming video**
- u **Speech recognition/synthesis**
- u **Advanced audio codecs**

**A programmable accelerator
makes this possible**

# User Expectations

u **Excellent value (quality/price)**

u **Easy installation and widespread compatibility (fewer support calls!)**

u **Demonstrably better performance and reliability**

u **Upgrade potential**

# Features And Cost Considerations

- Simultaneous acceleration of DirectX® audio APIs with hi-fi hardware sample rate conversion and mixing

- V.90 data/fax/voice modem

- Scalable signal processing to utilize host MIPS, but only when necessary

- Cost delta vs. fully soft audio/modem and AMR: $5 - $15 depending on range of features

# Performance Impact
## (Ref: PC 98 section 17)

- **Game audio**
    - **24 voice Synthesizer at 22 kHz: 12 MHz**
    - **8 channel HRTF 3D at 22 kHz: 28 MHz**
    - **Total: 40 MHz**
- **Soft modem**
    - **Typical designs cost 60 MHz in training, and drop to 40 MHz in transmission**
- **Total for concurrent operation: 90 Mhz, 30% of a minimum PC 99 PC**

# Accelerator Economics (1 of 3)

- **Assuming:**
  - **The previous slide is a representative load**
  - **A minimum PC 99 CPU (300 MHz) costs $63**
  - **An accelerator costs about $10**
- **Spending 30% of the CPU on concurrent 3D audio and modem costs about $19, while in use**
- **This analysis changes constantly, because CPU prices follow Moore's Law**
- **The conclusions don't change, because Moore's law applies to DSPs, too**

# Accelerator Economics (2 of 3)

u **Hardware-software migration is possible for other system components and applications**

u **Save the CPU MIPS for:**

  u **Soft DVD**

  u **Graphics intensive games**

  u **Videophone codecs**

  u **IP network security processing**

    u **Encryption for secure commerce**

    u **VPNs for secure connection from home networks to corporate networks**

# Accelerator Economics (3 of 3)

- PC OEMs report average support call rates of 28%
- Soft audio and modems work, but they are still vulnerable to long latency events
- These rare events may cause support calls:
  - If they break a modem connection
  - If they introduce irritating audible noise
- Soft devices present a new challenge:
  - Will the net additional support calls cost more in dollars and customer goodwill than the saved material cost? The customers will tell us.

# Scalable Signal Processing

u **Provide maximum performance and broad range of features**

u **Assign priority to using accelerator resources first, then use host only as necessary**

u **Algorithms can utilize all available resources to minimize "captive" costs**

u **Active load monitoring allows optimal resource allocation**

# Fully Scalable Algorithms

- Algorithms run on accelerator or host
- Algorithms can scale their resource usage
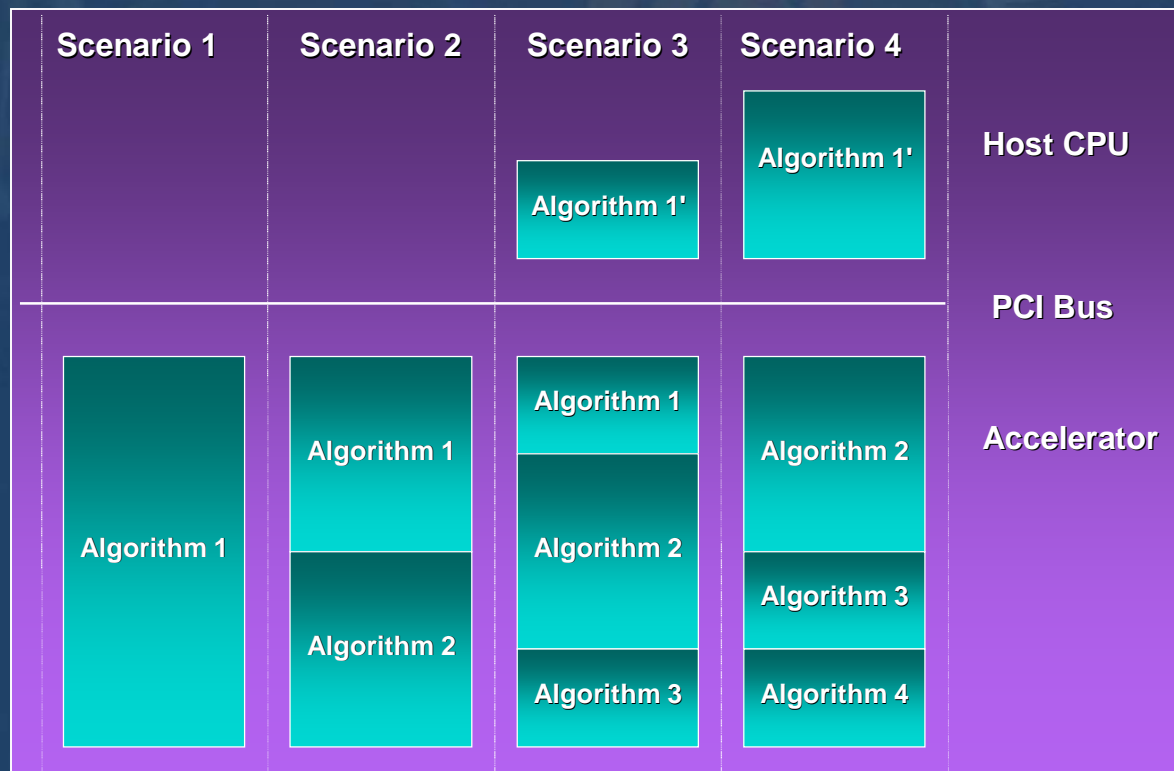
# Conclusions

- **Acceleration offers demonstrably increased performance and reliability**
- **A modest CPU plus audio/modem accelerator can provide lower overall system cost with performance equivalent to a more expensive CPU**
- **Scalable signal processing provides the best of both worlds**

# Call To Action

- **Understand the economic analysis of audio/modem acceleration**
- **Consider the total cost of ownership (BOM, support calls, etc.) when choosing between soft and accelerated architectures**
- **WDM is designed to support accelerators:  Use it!**