

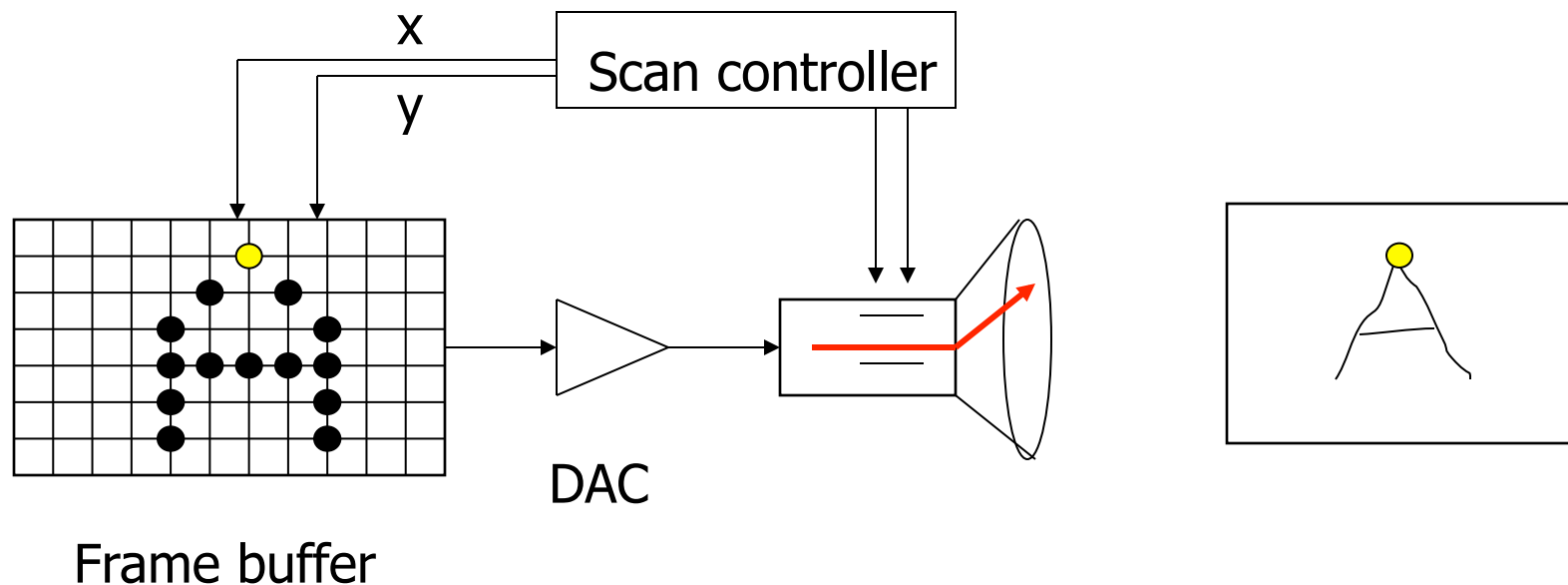


Graphics Hardware

- Input devices
- Output devices
- Graphics accelerator
 - Video Memory (frame buffer)
 - Display/Graphics Processor
 - Video controller
- CPU/Memory/Disk ...

Raster Graphics System

- Raster: An array of picture element (pixel)





Frame Buffer

- Frame buffer: the memory to hold the pixel intensity values
- Properties of a frame buffer that affect the graphics performance:
 - Size: screen resolution
 - Depth: color level
 - 1 bit/pixel: black and white**
 - 8 bits/pixel: 256 levels of gray**
 - 24 bits/pixel: 16 million colors (true color)**
 - Speed: refresh speed



Size of Frame Buffer

- Depends on the 'depth' for each pixel
- The more color you want, the more bits you will need for each pixel
- Exercise: 1024 x 1280 screen with 24 bits per pixel, how large is the frame buffer?

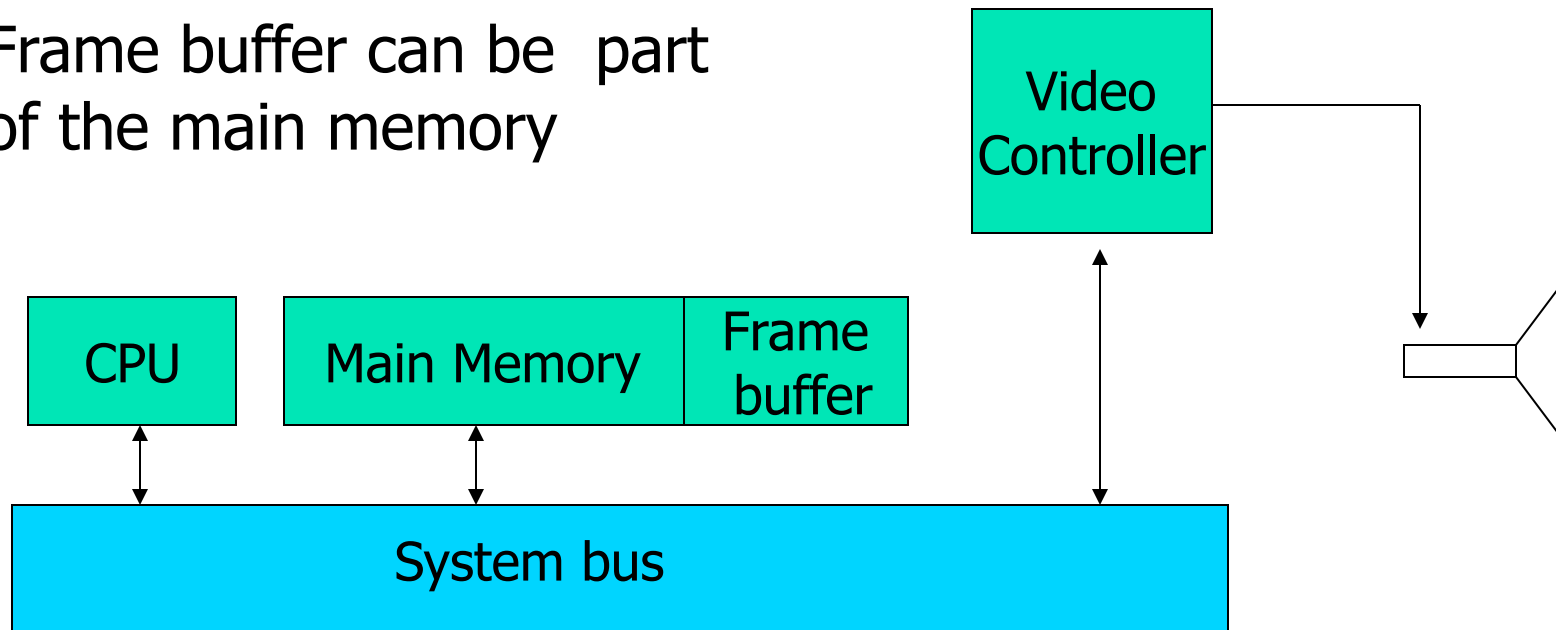
$$1024 \times 1280 \times 24 / 8 = 4\text{M Byte}$$

- Frame buffer also stores other information such as the depth values



A simple graphics system

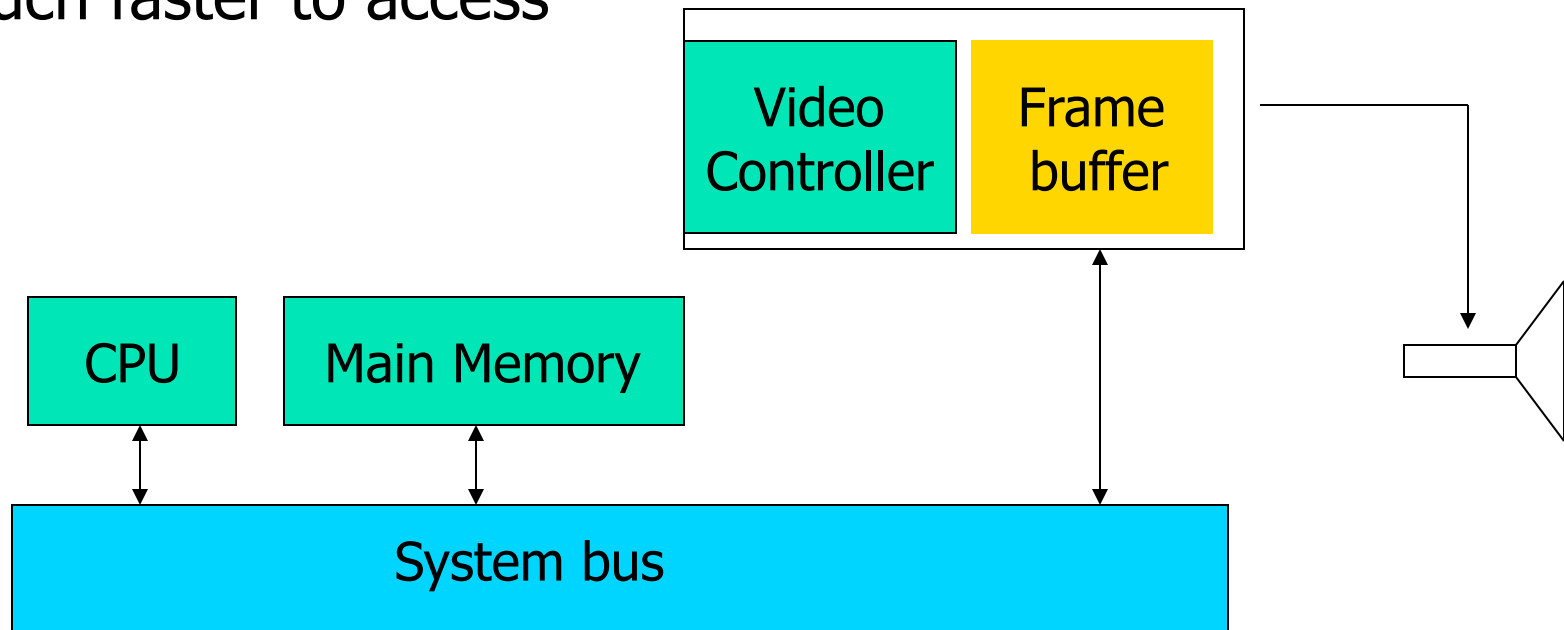
Frame buffer can be part of the main memory



Problem?

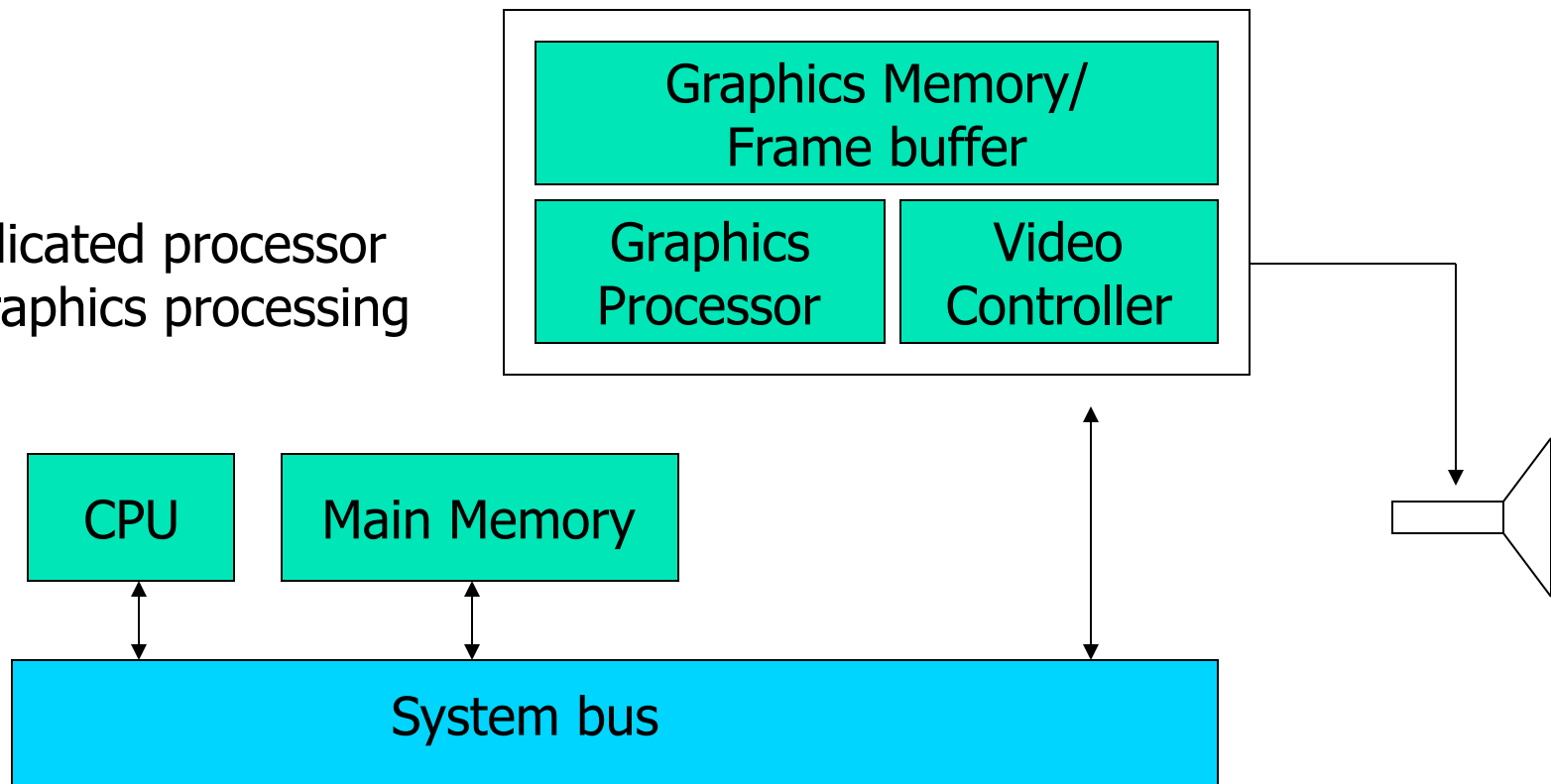
Dedicated memory

Video memory: On-board frame buffer:
much faster to access



Graphics Accelerator

A dedicated processor
for graphics processing



Graphics Accelerator



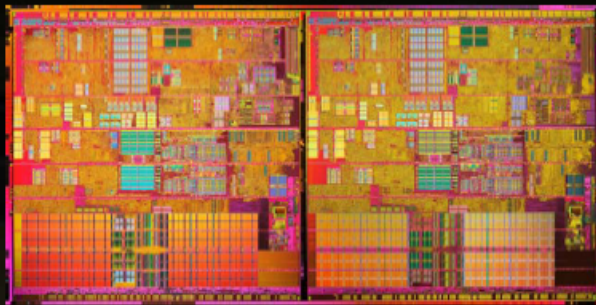
do you rely on your
graphics board
for productivity?



click here to find the
Oxygen and Permedia
accelerator that's right for you

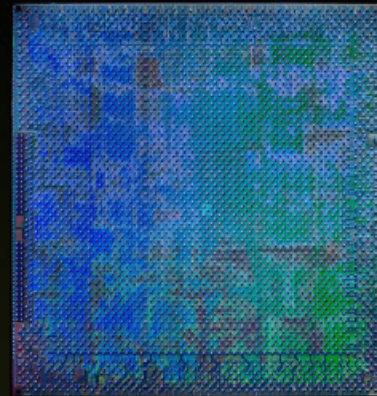


CPU vs. GPU



Pentium Extreme Edition 840

- 3.2 GHz Dual Core
- 230M Transistors
- 90nm process
- 206 mm²
- 2 x 1MB Cache
- 25.6 GFlops

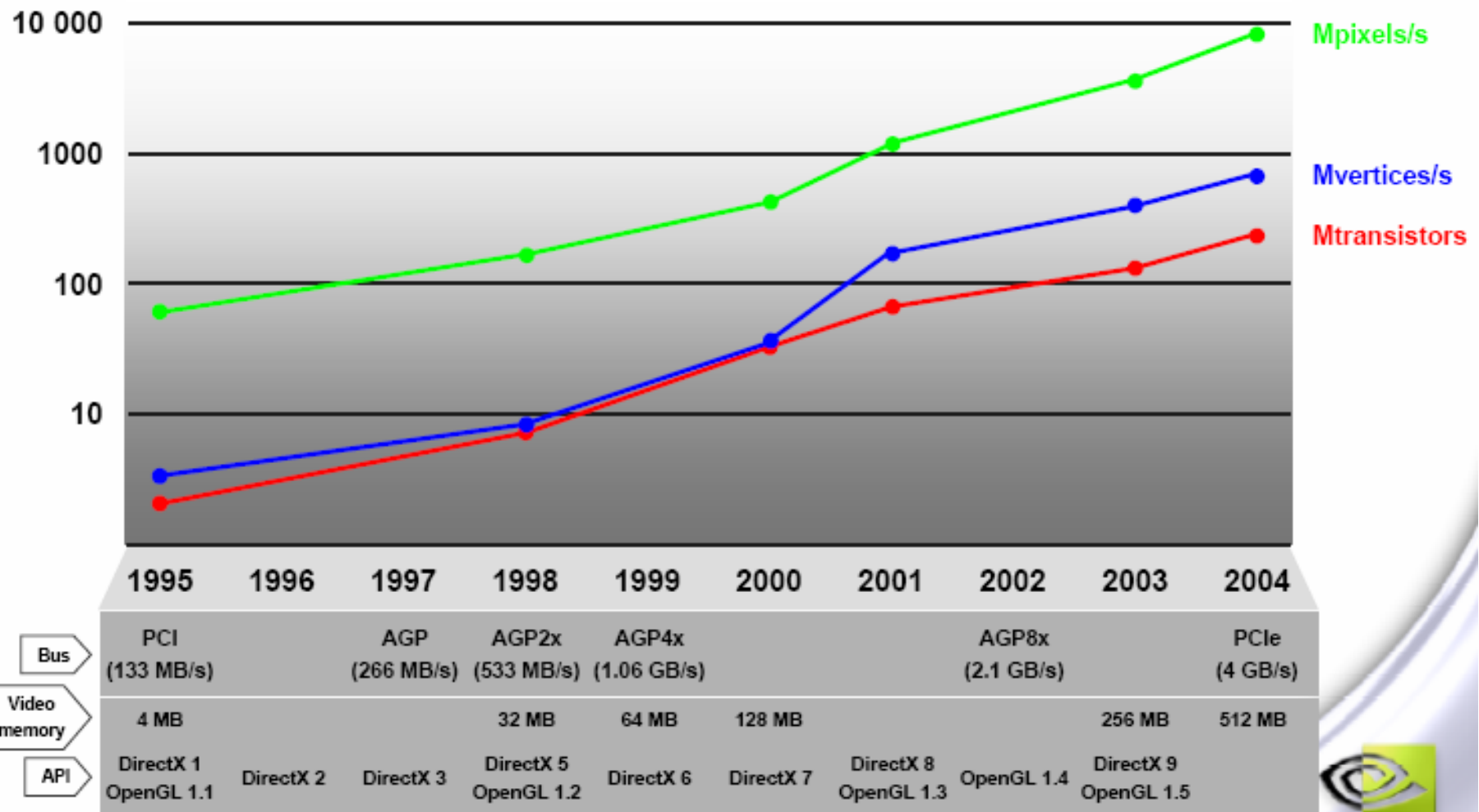


GeForce 7800 GTX

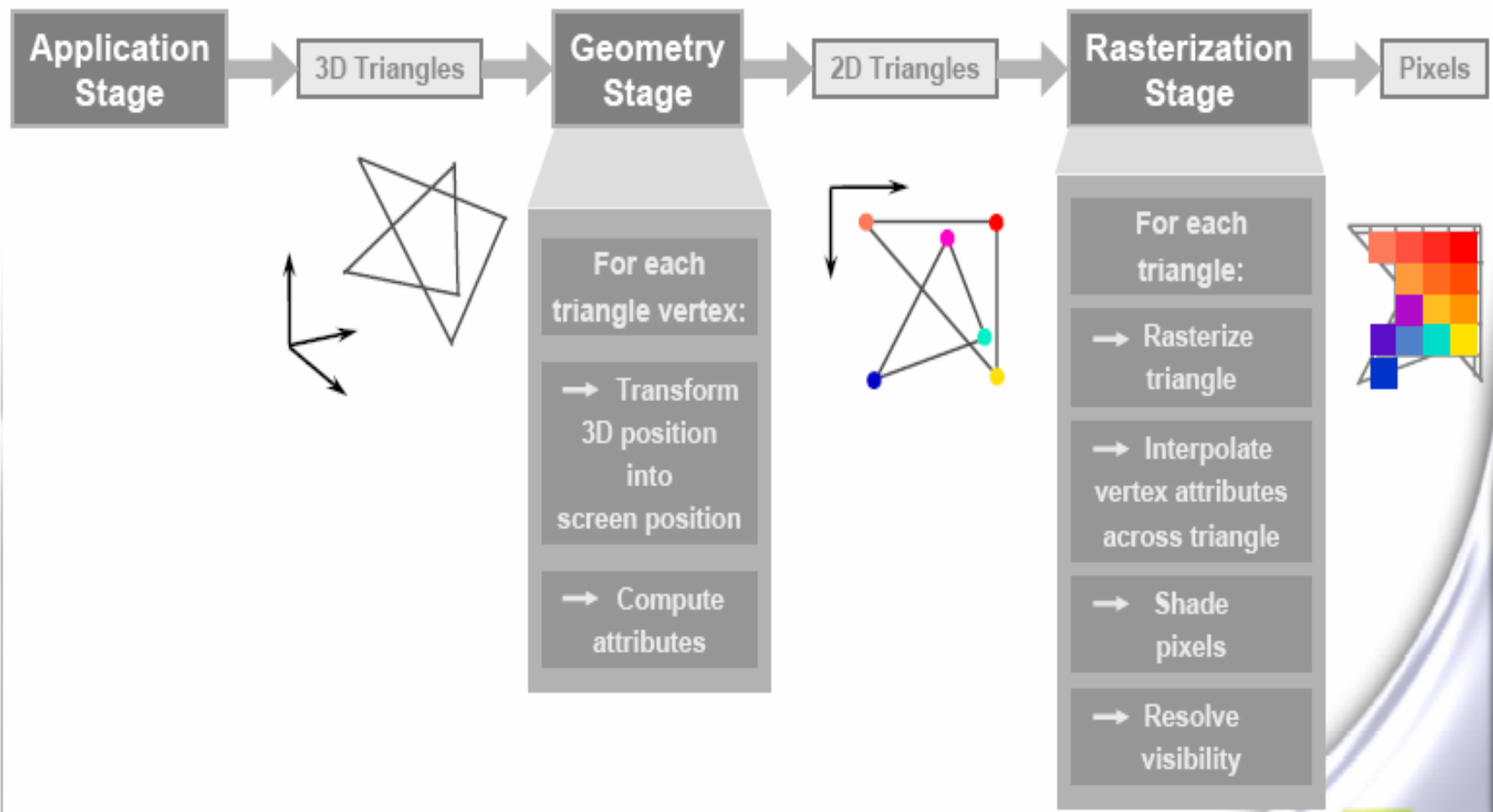
- 430 MHz
- 302M Transistors
- 110nm process
- 326 mm²
- 313 GFlops (shader)
- 1.3 TFlops (total)



Evolution of Performance

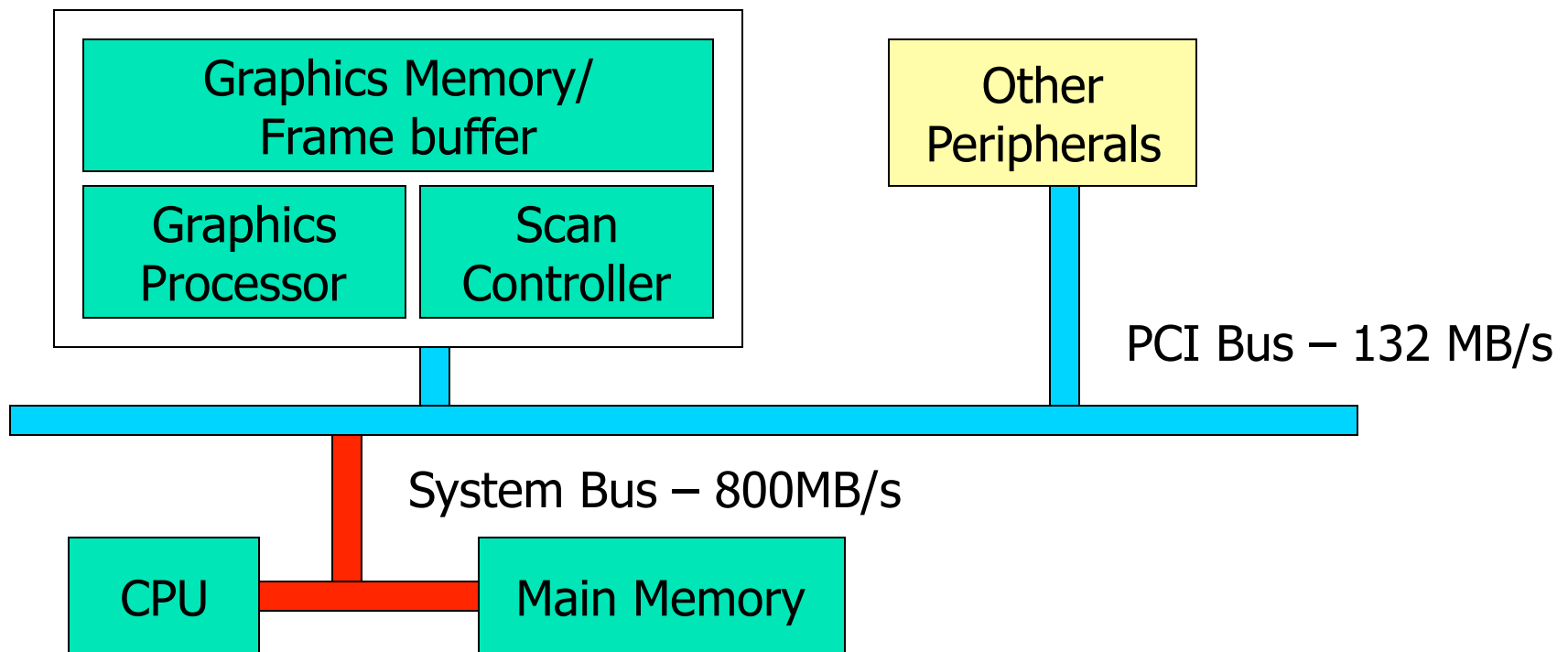


The Graphics Pipeline



Graphics Bus Interface

PCI based technology



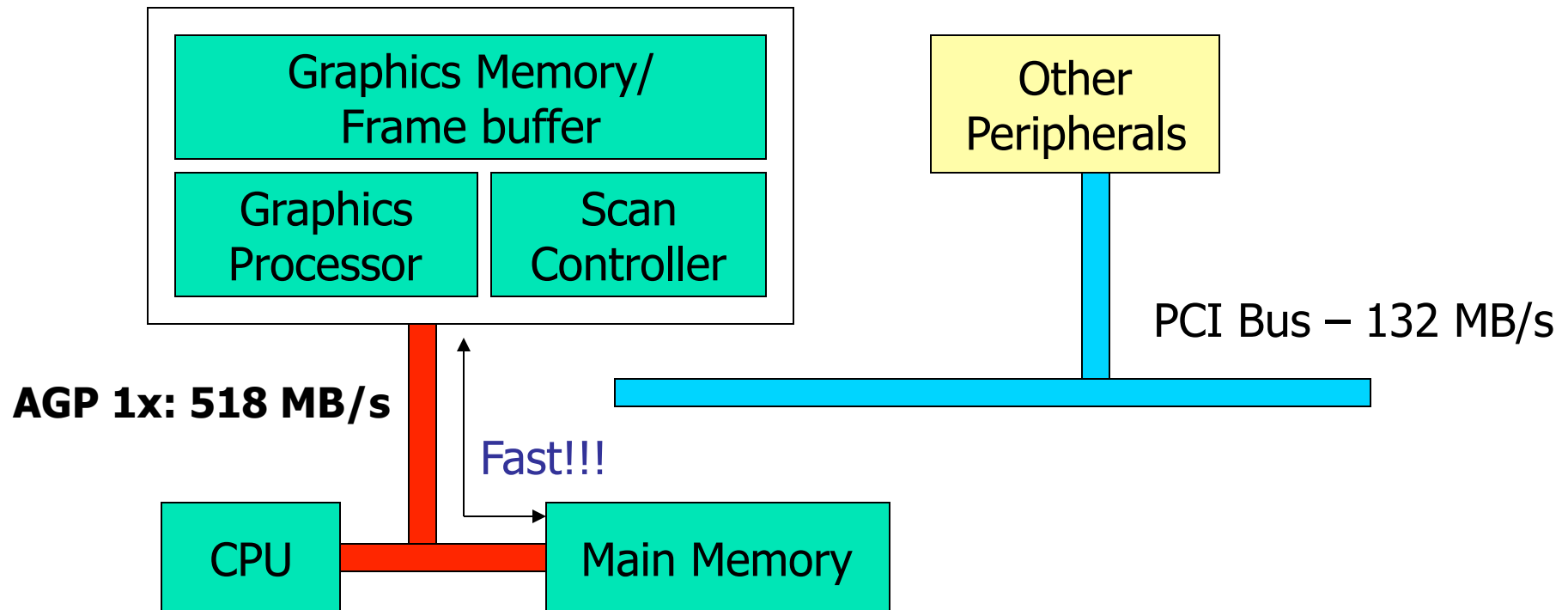


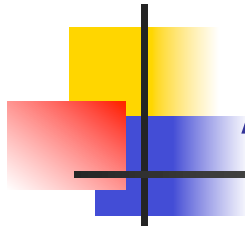
Graphics Bus Interface (2)

- PCI Bus becomes the bottleneck!
 - Many devices are using it
 - There is a lot of stuff needs to be transmitted from main memory to graphics memory (geometry, textures, etc)
 - Example: 2M triangle, 90 Bytes each – 180MB > 132 MB (PCI bandwidth)

Accelerated Graphics Port (AGP)

A dedicated bus that allows direct access of main memory





AGP

- AGP 1x is four times as fast compared to PCI! (later improved to AGP 8x)
- No more local bus congestion!
- More geometry can be processed!
- Direct execution of many graphics operations from main memory



PCI Express

- Bandwidth?





Reading and Lab0

- Textbook Chapter 1, 2

Lab 0: Compile and run the sample OpenGL program posted on the class web site