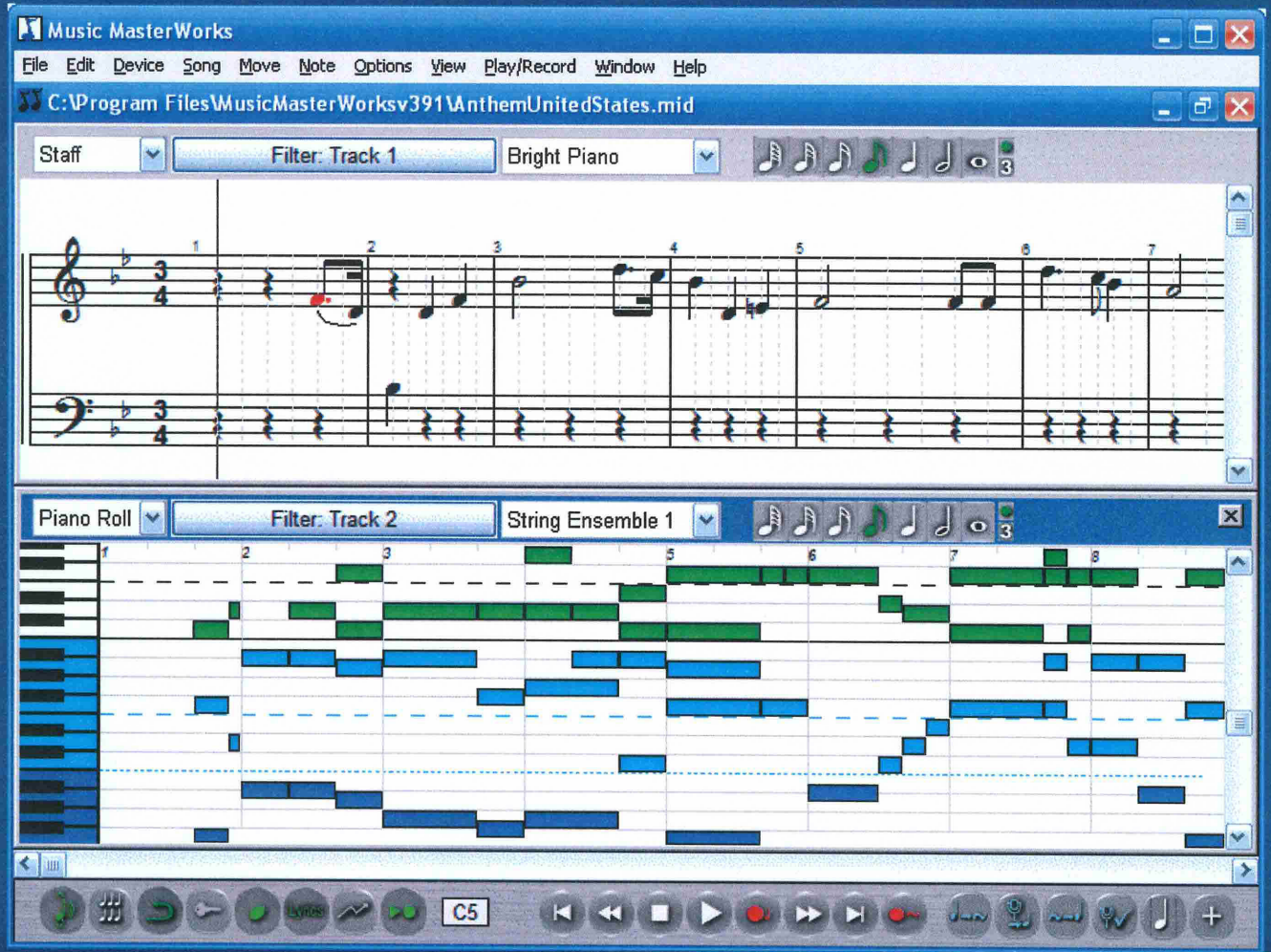
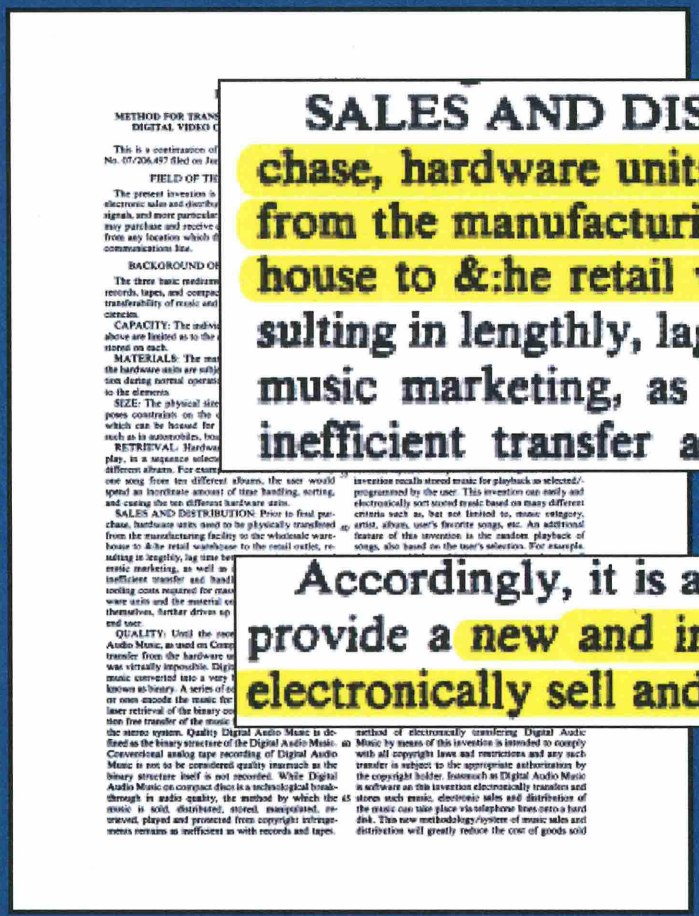
DIGITAL AUDIO VS. SHEET MUSIC

- Sheet music provides a set of instructions to an artist to read and perform
- MIDI (Musical Instrument Digital Interface)
  - *Electronic sheet music*
  - *Stores instructions, as opposed to raw audio data*
    - Reflected in file size differences (KB vs. MB)
  - *Reliance on tones stored on playback computer*
    - i.e., playback computer is the artist
  - *Cannot accurately capture artist vocals*
  - *MIDI is not created by converting analog sound waves, it is an all digital creation of notes to play.*

DIGITAL AUDIO VS. SHEET MUSIC



DIGITAL AUDIO VS. SHEET MUSIC



SALES AND DISTRIBUTION: Prior to final purchase, hardware units need to be physically transfered from the manufacturing facility to the wholesale warehouse to &:he retail warehouse to the retail outlet, resulting in lengthly, lag time between music creation and music marketing, as well as incurring unnessary and inefficient transfer and handling costs. Additionally,

Accordingly, it is an objective of this invention is to provide a new and improved methodology/system to electronically sell and distribute Digital Audio Music.

'573 patent at col. 1:39-43, 2:10-12

DIGITAL AUDIO VS. SHEET MUSIC

MIDI

Elvis Presley, "Can't Help Falling In Love" (1961)

DIGITAL AUDIO VS. SHEET MUSIC

DIGITAL AUDIO

Elvis Presley, "Can't Help Falling In Love" (1961)

System to Transmit Digital Signals

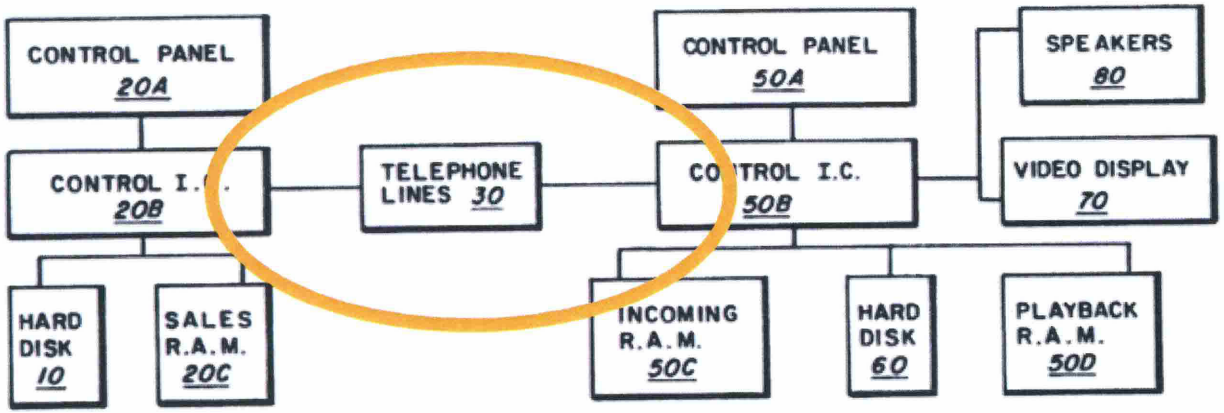
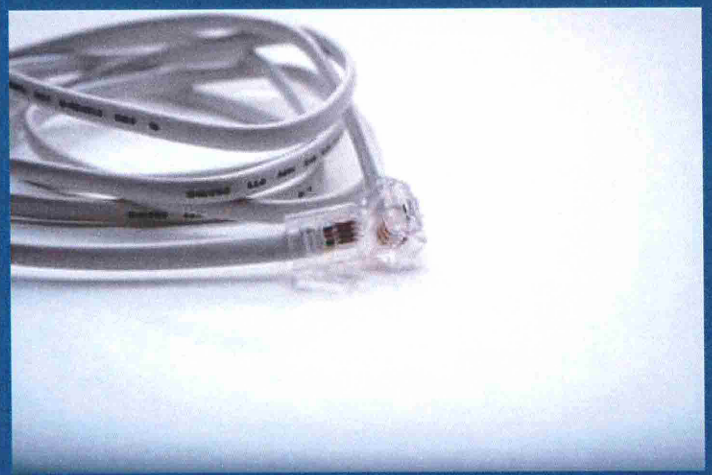


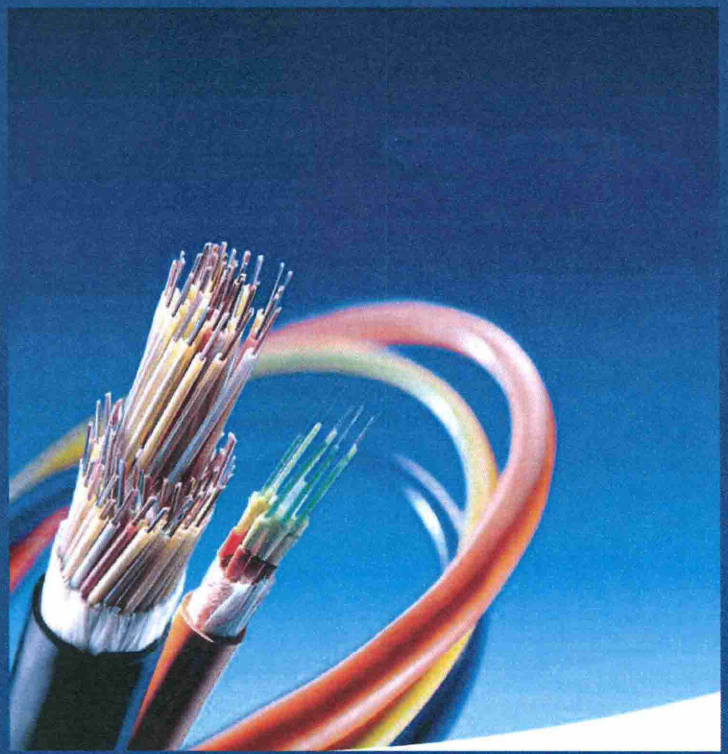
FIG. 1

Copper Wire



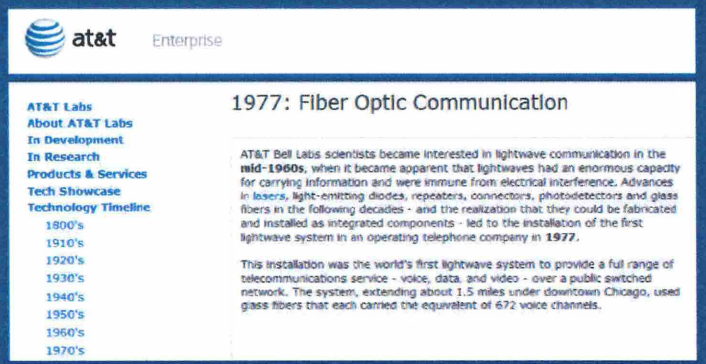
- Metal-based
- By 1988, was part of the backbone of telephone networks, e.g., "last mile"
- Provides for an electrical conduction path

Fiber Optics



- Composed of Fibers
- Data communication utilizing light/photons
- By 1988, utilized in phone networks, e.g., long-distance calls.

Fiber Optics


at&t Enterprise

AT&T Labs
About AT&T Labs
In Development
In Research
Products & Services
Tech Showcase
Technology Timeline
1800's
1910's
1920's
1930's
1940's
1950's
1960's
1970's

1977: Fiber Optic Communication

AT&T Bell Labs scientists became interested in lightwave communication in the **mid-1960s**, when it became apparent that lightwaves had an enormous capacity for carrying information and were immune from electrical interference. Advances in lasers, light-emitting diodes, repeaters, connectors, photodetectors and glass fibers in the following decades - and the realization that they could be fabricated and installed as integrated components - led to the installation of the first lightwave system in an operating telephone company in **1977**.

This installation was the world's first lightwave system to provide a full range of telecommunications service - voice, data, and video - over a public switched network. The system, extending about 1.5 miles under downtown Chicago, used glass fibers that each carried the equivalent of 672 voice channels.

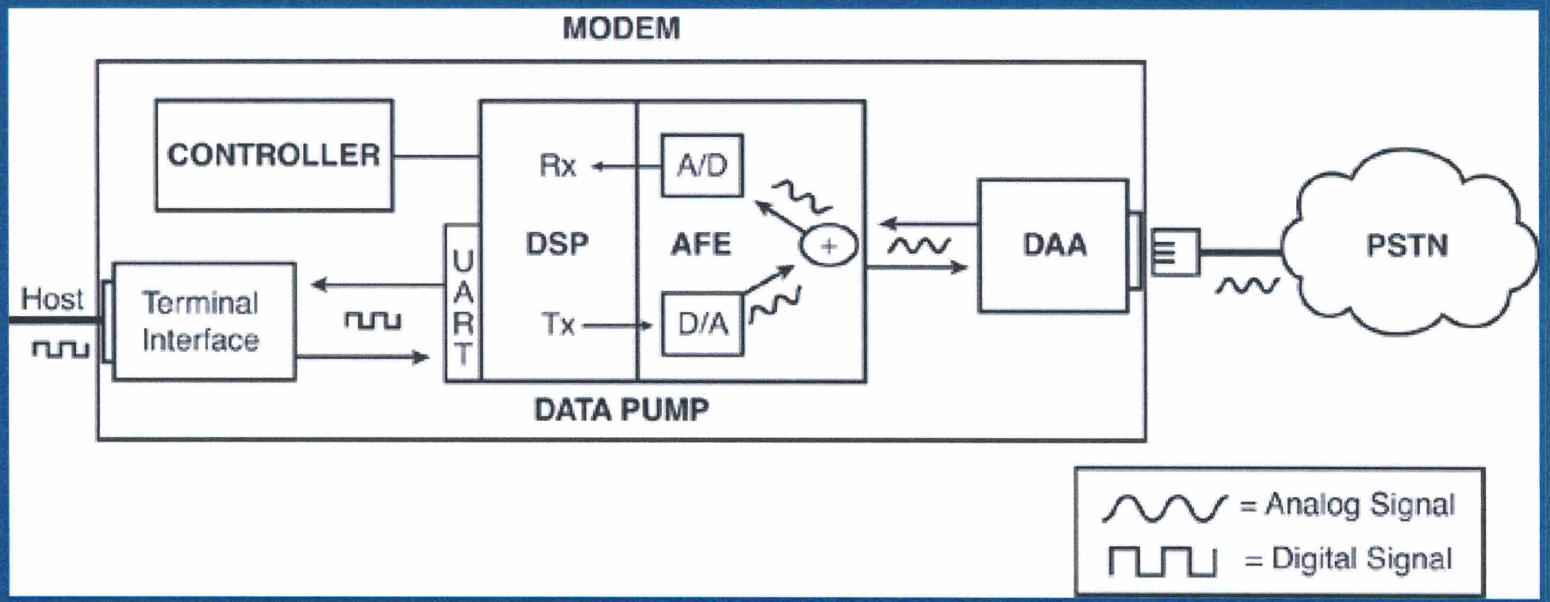
- 1977 – AT&T utilized fiber optics in their telephone networks

- 1987 – AT&T, British Telecom laid down TAT-8 fiber optic cables to facilitate long-distance telephone communications

Wireless / Cellular

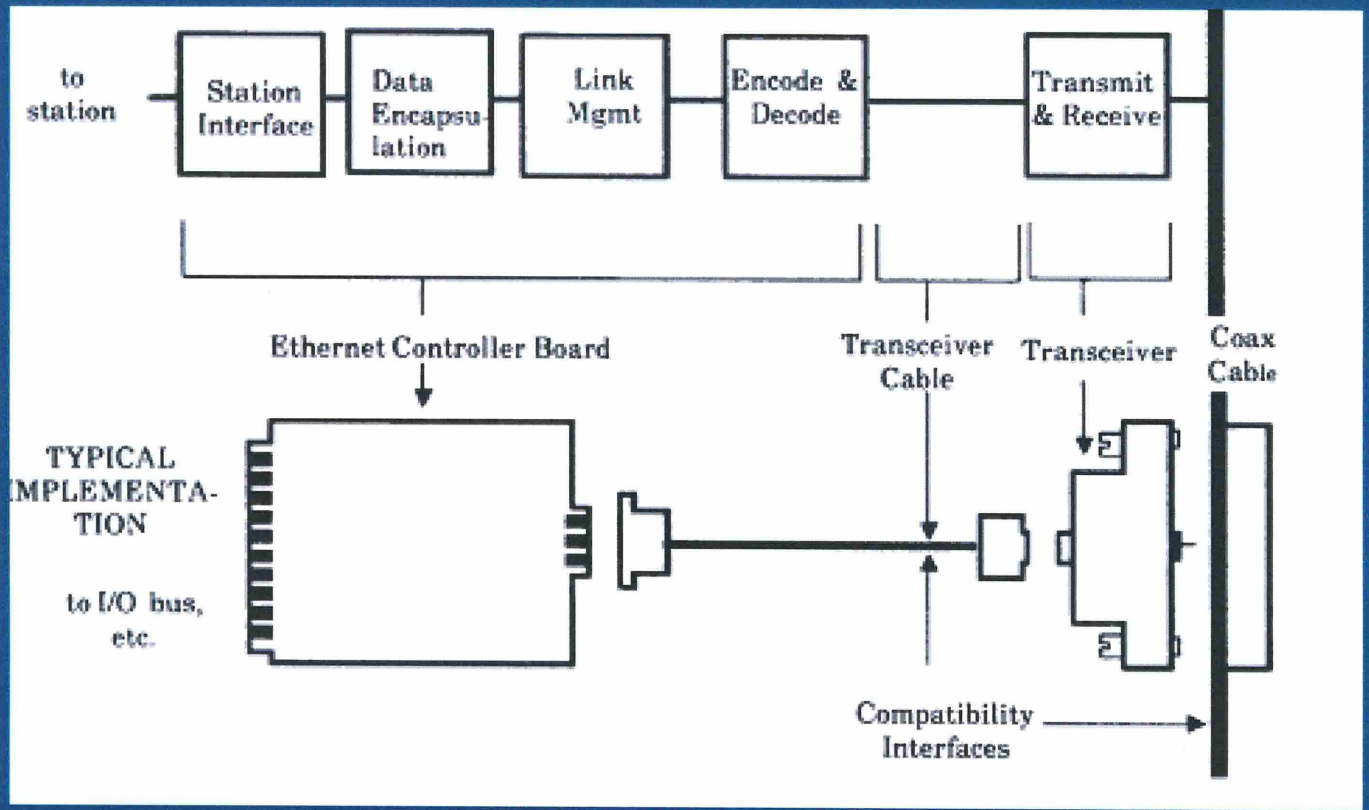
- Radiowaves / microwaves
- Antenna transmission from devices utilizes electricity

Connecting / Transmitting



- Modem converts digital signals from a computer to an analog signal s to be sent across copper wires as used in phone systems
- Computer bytes are converted to bits by a (transmitter/receiver)
  - "A" = 97 (decimal) = 01100001 (binary)
- Bits are represented in tones (Hz)

Connecting / Transmitting



The Ethernet, 1982

System to Transmit Digital Signals

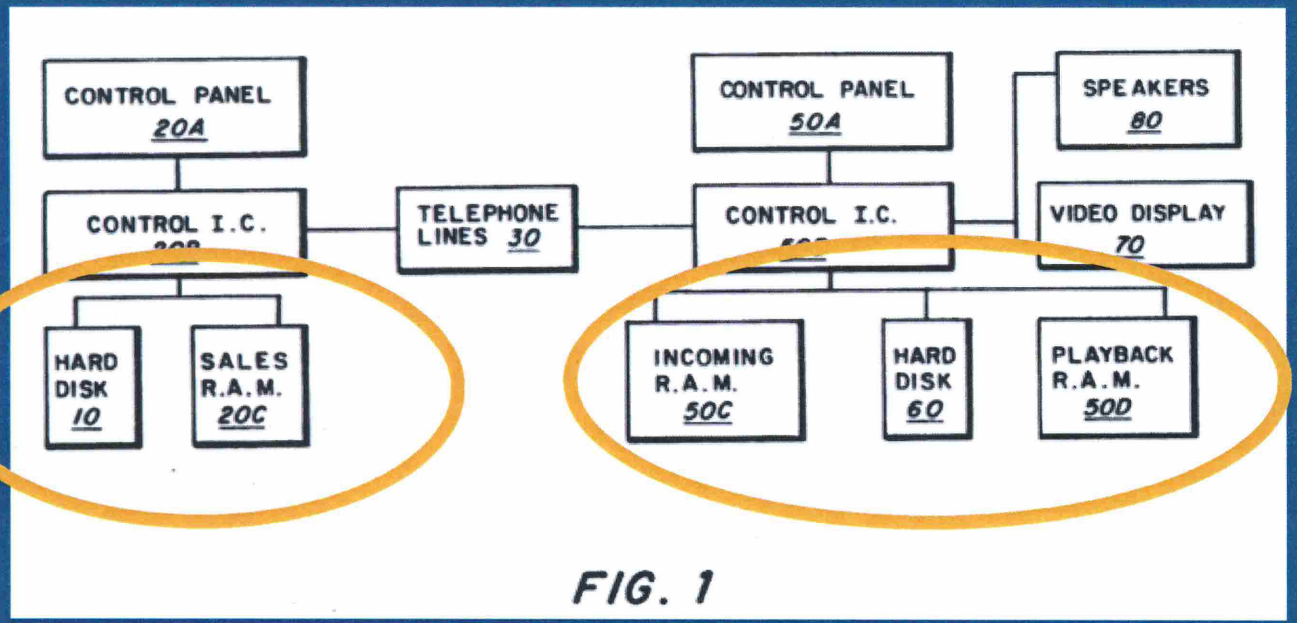


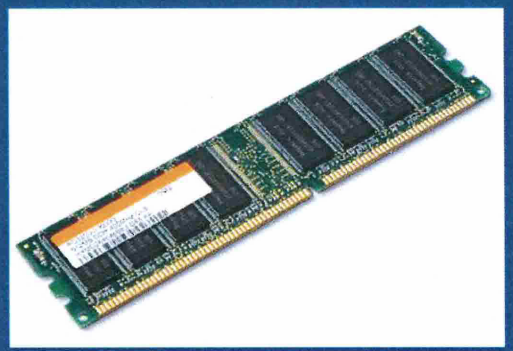
FIG. 1

STORAGE

- Volatile Memory
- Non-volatile memory

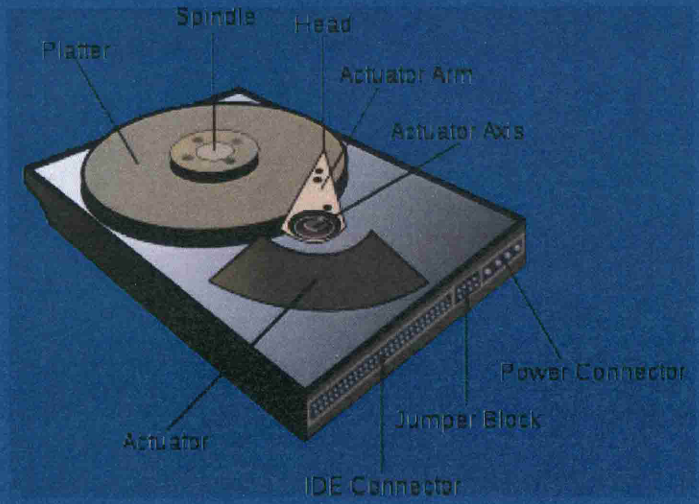
Volatile Memory: RAM

- Random Access Memory



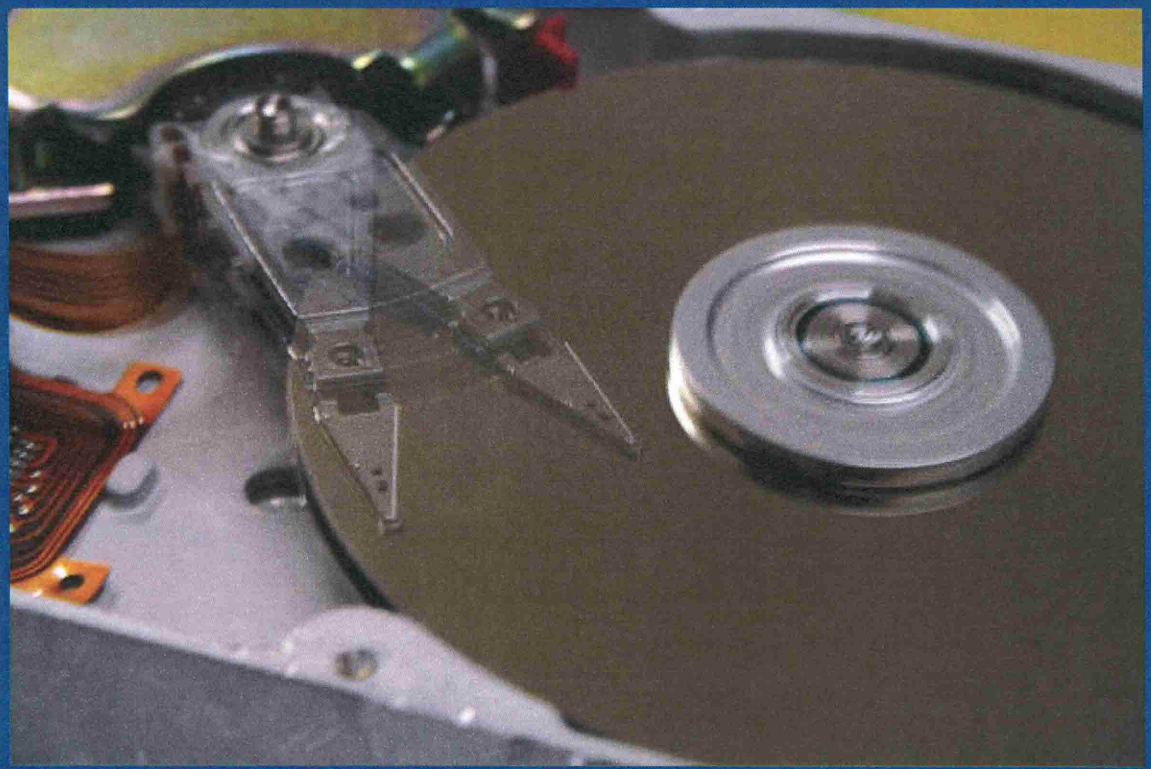
  - Composed of integrated circuits (transistors)
  - Loss of contents or state when power is removed
  - Consistent access time for different locations

Non-volatile Memory



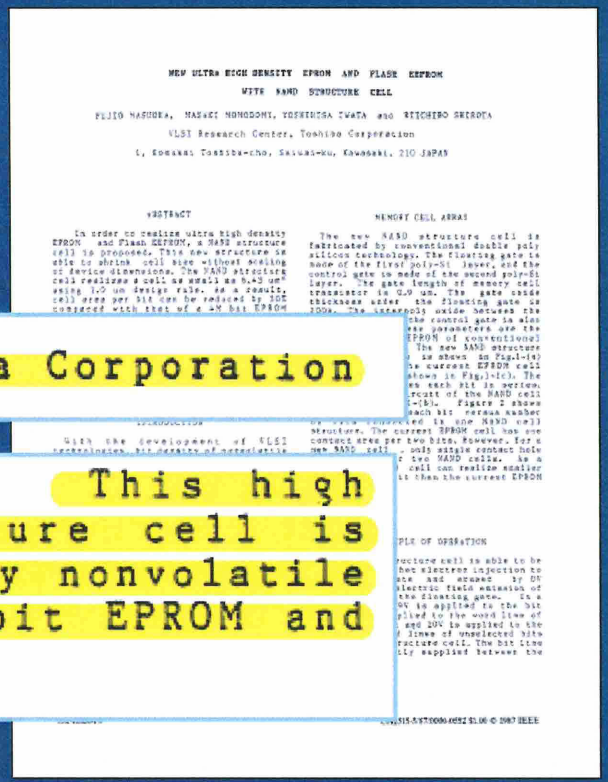
- Retain information even when power is removed
- Long-term persistent secondary storage
- Hard Disks
  - *Rotating disk*
  - *Movable actuator arm*
  - *Read/write head*
- Solid State Drives
  - *Integrated circuits*
  - *Less susceptible to physical shock*
  - *Faster access*
  - *Quieter*

Non-volatile Memory: Hard Drives



Non-volatile Memory: Hard Drives

- Solid State Drives are non-volatile and use NAND-based flash memory



NEW ULTRA HIGH DENSITY EPROM AND FLASH EEPROM WITH NAND STRUCTURE CELL

FUJIO MASUOKA, MASAKI MOMODOMI, YOSHIHISA IWATA and HIICHIRO SHIRAOTA

VLSI Research Center, Toshiba Corporation

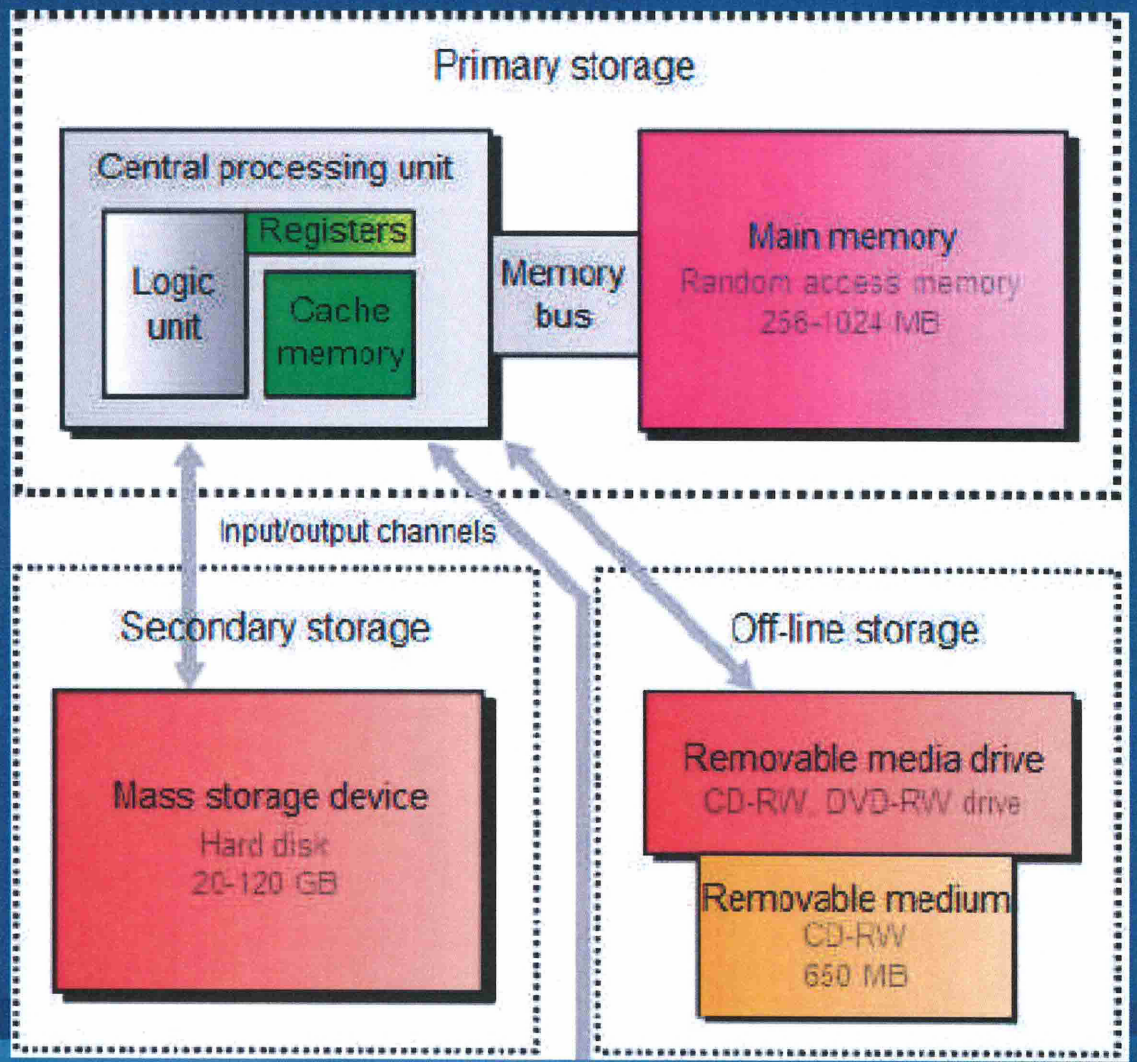
1, Komukai Toshiba-cho, Saiwai-ku, Kawasaki, 210 JAPAN

VLSI Research Center, Toshiba Corporation

programmed selectively. This high performance NAND structure cell is applicable to high density nonvolatile memories as large as 8M bit EPROM and Flash-EEPROM or beyond.

1987, IEEE

Storing in Memory



END