Multiple Virtual Storage

Lesson 4: Typical IBM Mainframe Systems

Lesson Objectives

- In this lesson, you will learn the following topics:
  - Typical Mainframe Configuration
  - Various components of IBM Mainframe System
  - Processors
  - Channels Concepts
  - Various I/O Devices used like DASDs and
  - Communication Devices, etc

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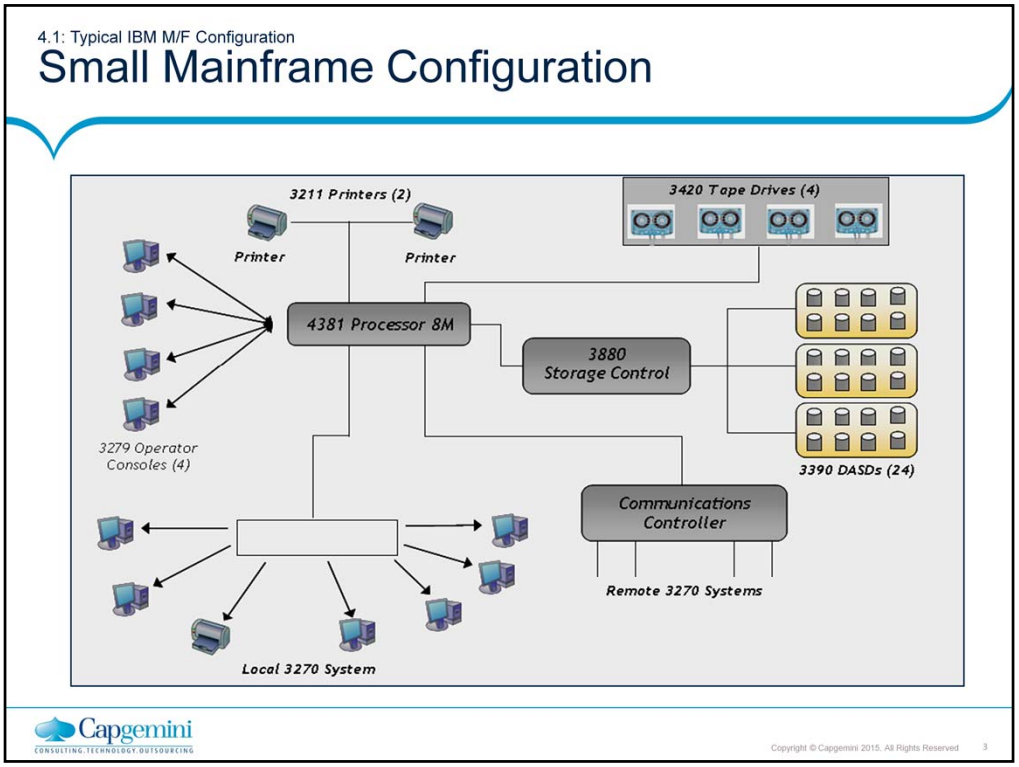
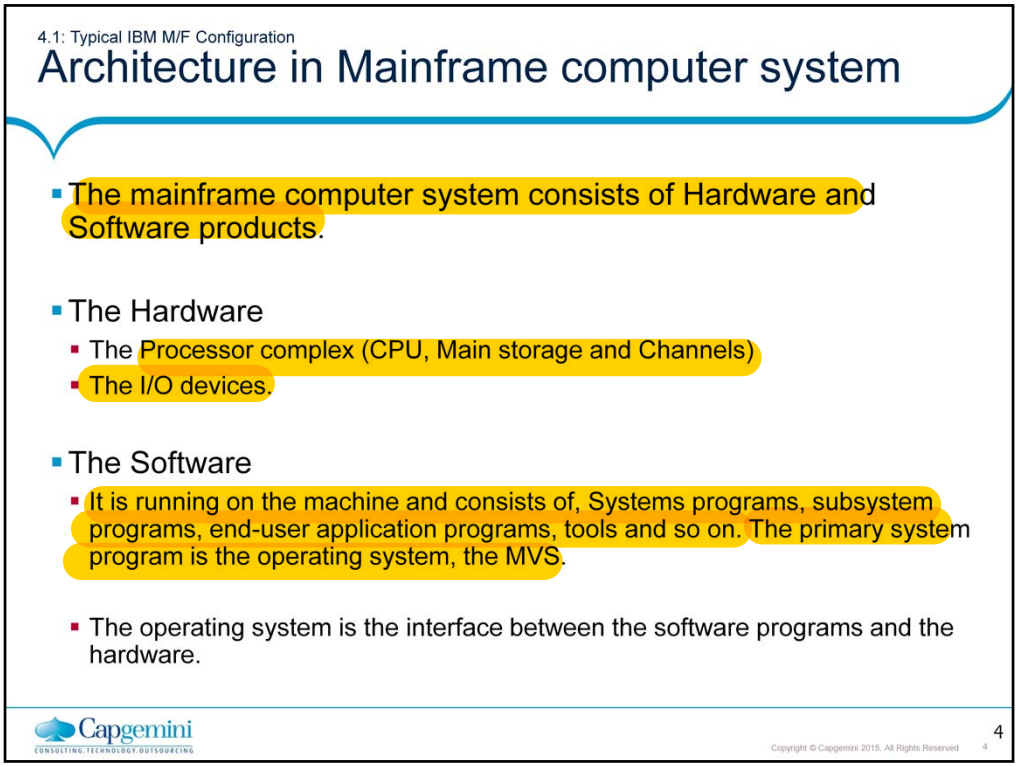


Note: The figure in the above slide shows a small mainframe computer system built around a 4381 processor. It is a Basic system/370 Architecture.

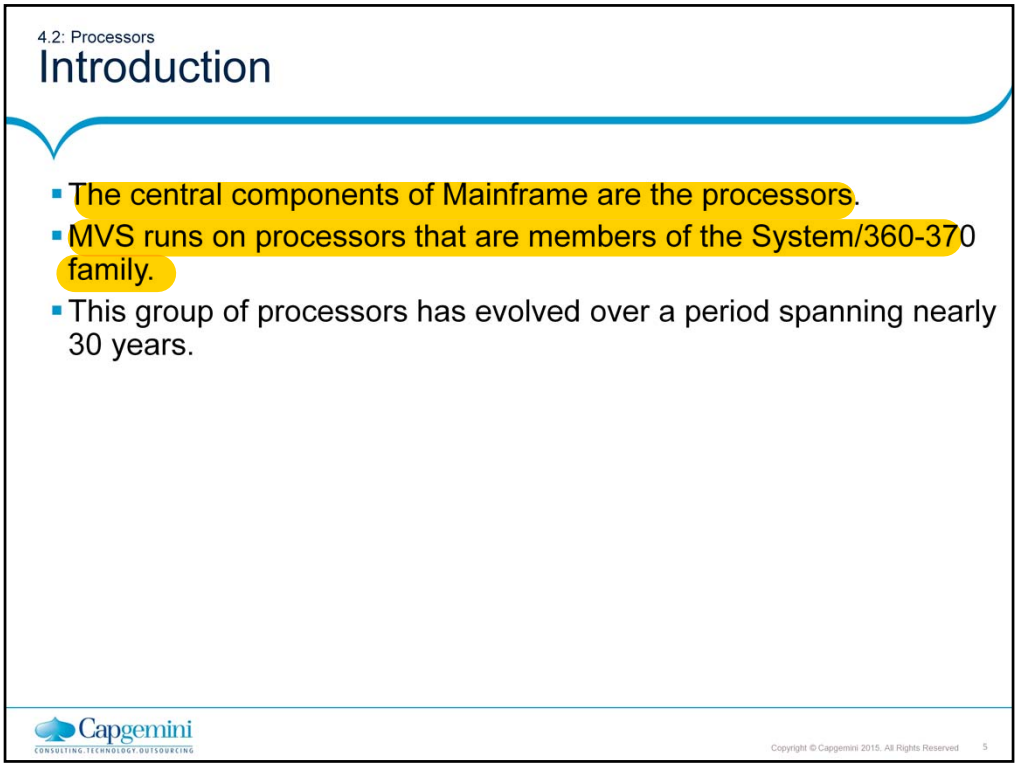


Typical IBM Configuration:

IBM Mainframe Systems:

With a variety of IBM Mainframe Processors and I/O devices, we can have a number of Mainframe configurations. So one Mainframe configuration is different from the other.

Let us understand each of these categories.


4.2: Processors
Introduction
The central components of Mainframe are the processors.
MVS runs on processors that are members of the System/360-370 family.
This group of processors has evolved over a period spanning nearly 30 years.
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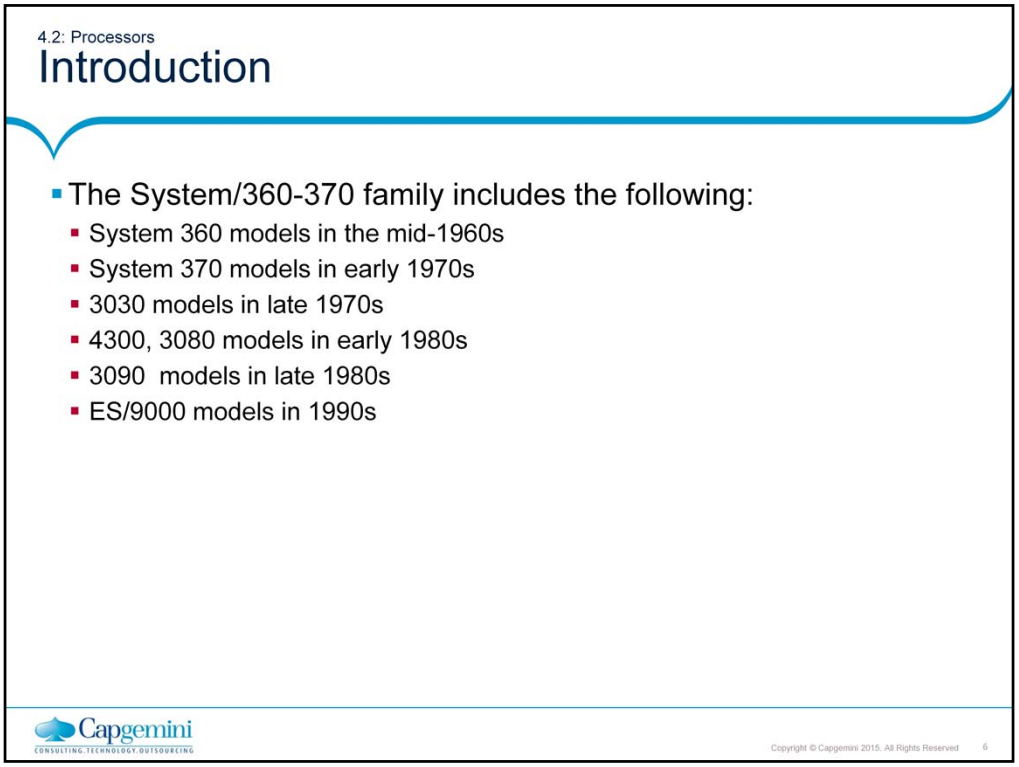

Processors:

Introduction to Processors:

As IBM has developed new models of System 360-370 processors, it has used contemporary technologies to create better, faster, and cheaper machines.

Although the older System/360 and System/370 models are obsolete, the current 4300, 3080, 3090, and ES/9000 processors are still generally called System/370s. This is because IBM has maintained a high degree of compatibility over its 30 year life.

4.2: Processors

PROCESSOR – CPU's – CHANNELS - MEMORY

PROCESSOR	CPU's	MAIN MEM	MAX CHANNEL
4381	1 OR 2	4 – 64MB	18
3084	4	32 – 128MB	48
3090	6	64 – 512MB	128
ES/9000	4 – 8	2048MB	256
S/390 G5/G6	4 – 12	1 – 32GB	256

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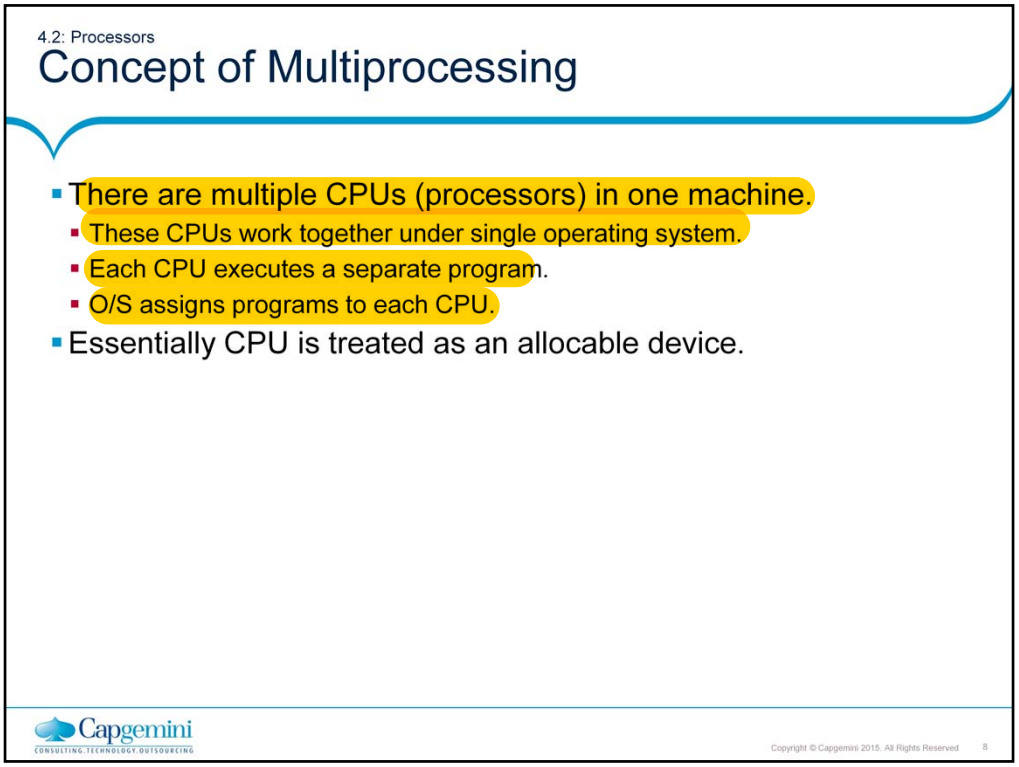


Processors:

Multiprocessing:

In the advanced System/370 family, more than one processor can be included. In multiprocessing system, two or more processors share access to main memory. The operating system determines how each processor is utilized.

Multiprocessing provides two benefits:

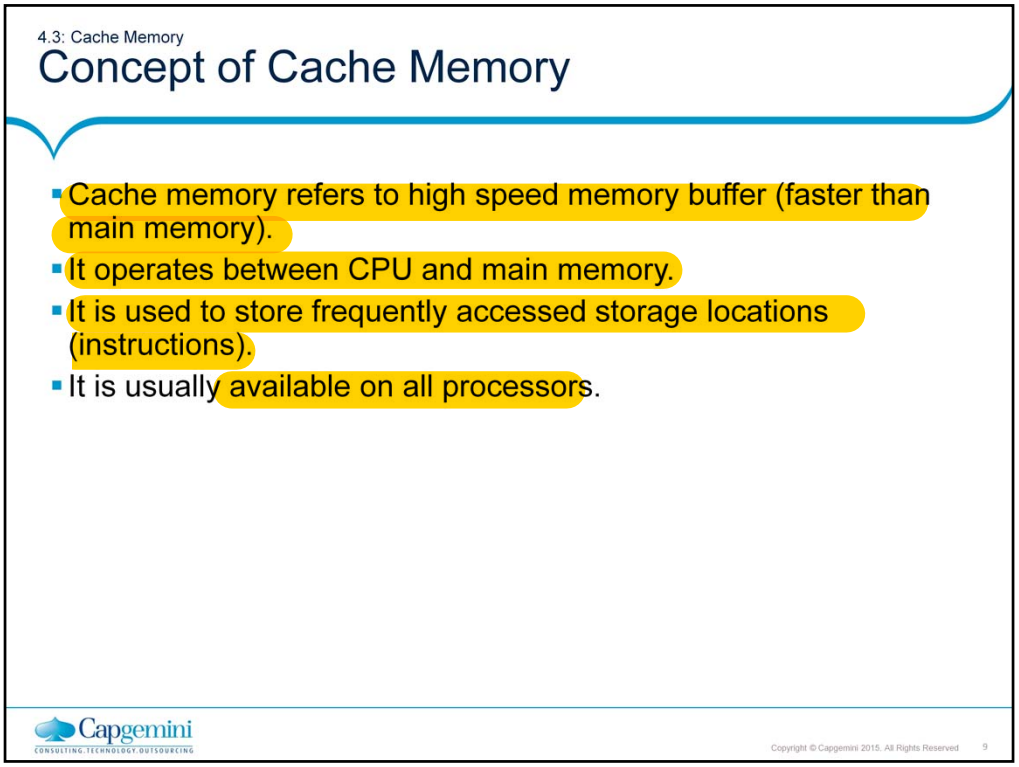
Processing rate is increased because of more number of CPUs will be executing the program instructions.

Systems availability is increased because if one CPU fails the other can take over.

Let us now look at the various I/O devices used in typical mainframe environment.

Firstly let us look at the system/370 architecture.

In multiprocessing, all CPUs share one real storage and channels . The operating system manages the processing ; it assigns work to the first available CPU; in case the CPU failed, work is routed to another CPU.


4.3: Cache Memory
Concept of Cache Memory
Cache memory refers to high speed memory buffer (faster than main memory).
It operates between CPU and main memory.
It is used to store frequently accessed storage locations (instructions).
It is usually available on all processors.
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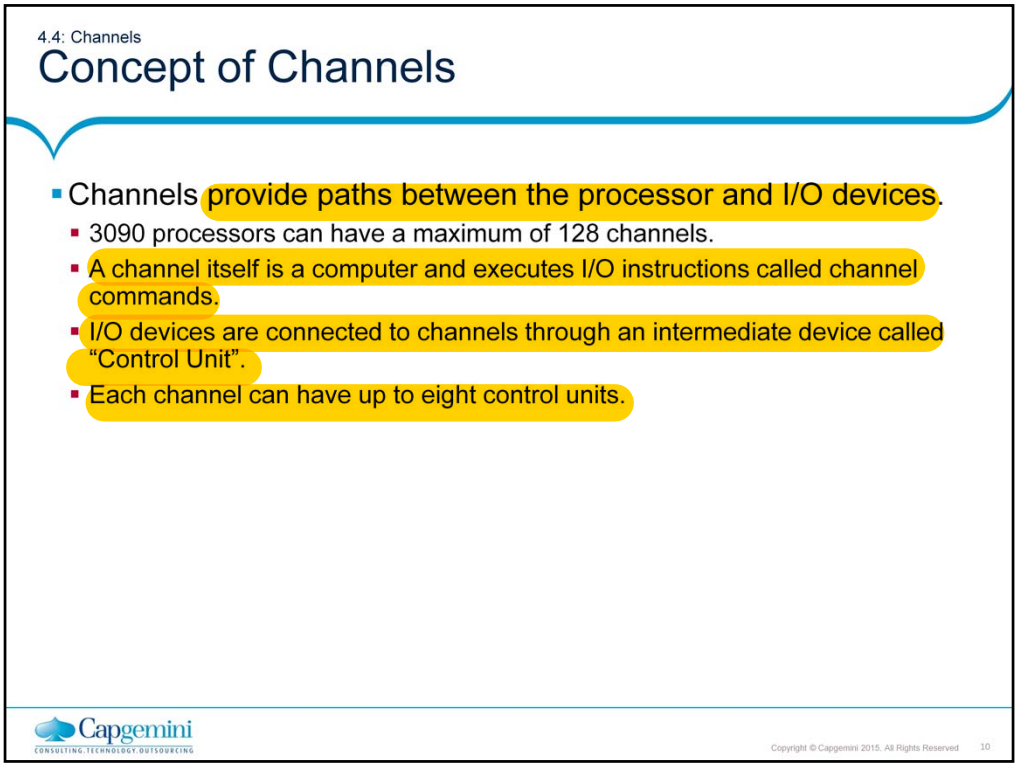


Channels:

Device Management concept is unique to IBM.

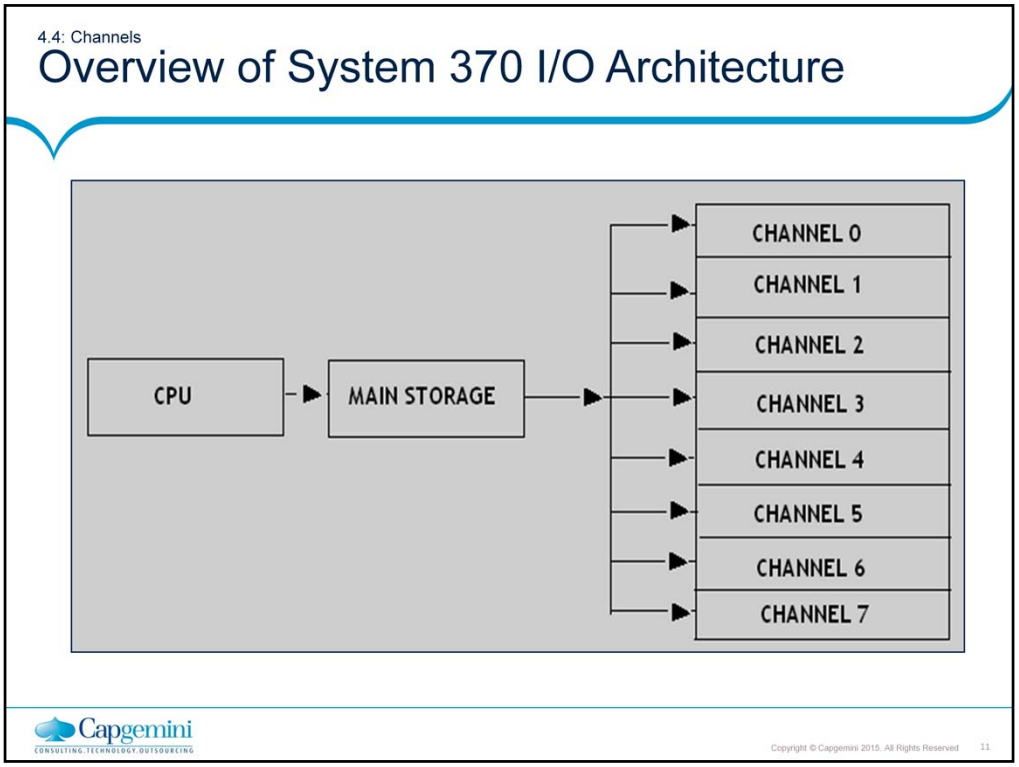
Channels provide access path between CPU and I/O devices (DMA).

We can connect up to eight control units to one channel.

We can connect up to eight I/O devices to one control unit.

A channel itself is a small computer. It executes I/O instructions called channel commands that control the operations of the I/O devices attached to it. As a result, the channel frees the processor to execute other instructions. Since channel processing overlaps CPU processing, overall system performance is improved.

Let us see an example of a typical I/O architecture for System/370.



Channels:

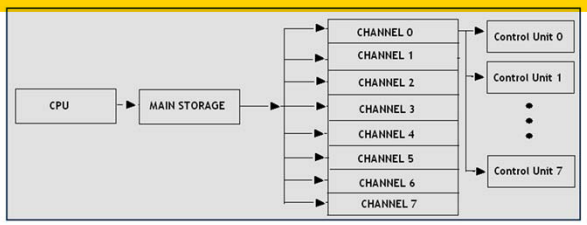
The figure in the above slide shows a typical I/O architecture for system /370.

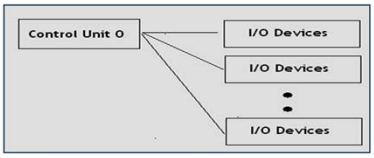
It consists of CPU attached to main memory and the various channels to which the memory is connected. Channels provide paths between the processor and I/O devices.

4.4: Channels

What are Control Units?

- Control units are DASD units. They can be connected to common control unit, called string, which in turn is connected to the “String Controller”.
- String Controller is connected to a channel directly or indirectly. Sometimes a control unit called “Storage Control” connects string controllers to a channel.





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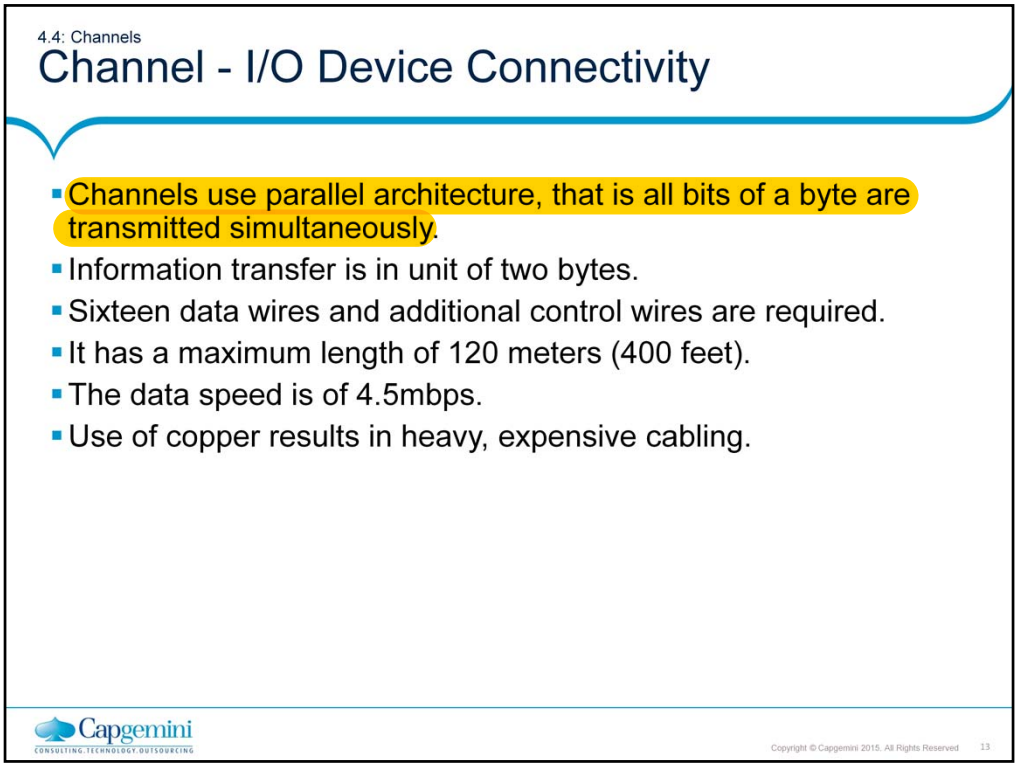
Note: DASD is a type of I/O device. To be covered later.



Channels:

Channel – I/O Device Connectivity:

I/O devices are connected to channels using heavy copper cables. They can be of a maximum length of 400 feet.

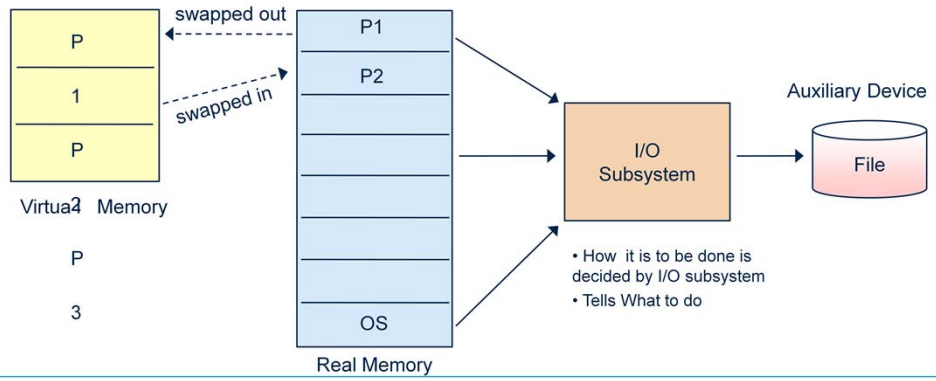
Channels use parallel architecture, that means the cable transmits all bits of a byte simultaneously. To do that, the cable must have a separate wire for each bit – 16 in all (the channel sends two bytes simultaneously) – plus additional wires for control signals.

The parallel channel cable is heavy, bulky, and expensive. A new channel architecture ESCON (Enterprise System Connection), based on fiber optics cable, is 80 times lighter and 50 times less bulky. It extends the 400-feet cable limit to 26 miles. Data transmission is much faster, from 4.5 MB/sec to 17 MB/sec.

4.5: Input-Output Management

Concept of Input-Output Management

- Input-Output Management:
  - **Problem:** Application should not worry about device characteristics. I/O device speed is 100 times slower than CPU.
  - **Solution:** Let all I/O be handled by a specialized system-I/O Subsystem.



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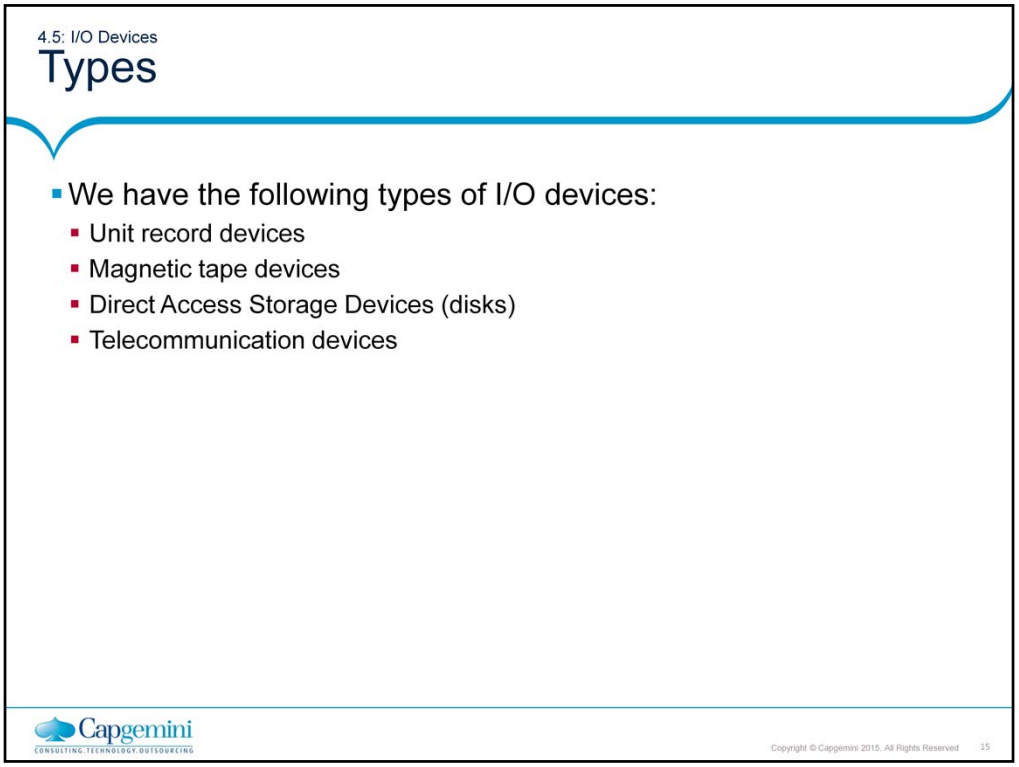
4.5: I/O Devices
Types
We have the following types of I/O devices:
Unit record devices
Magnetic tape devices
Direct Access Storage Devices (disks)
Telecommunication devices
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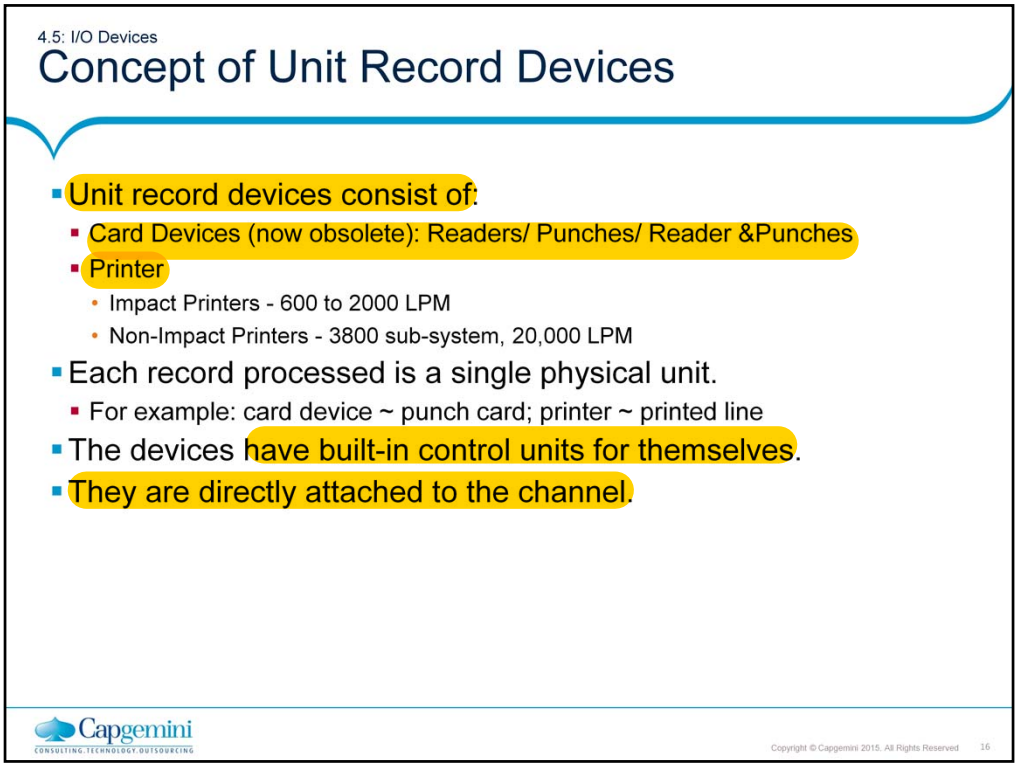


Unit Record Devices:

Unit Record Devices consist of card devices and printers.

Here, each record processed by the device is a physical unit.

These devices are directly attached to a channel without any control unit, as each unit record device has its built in control units.

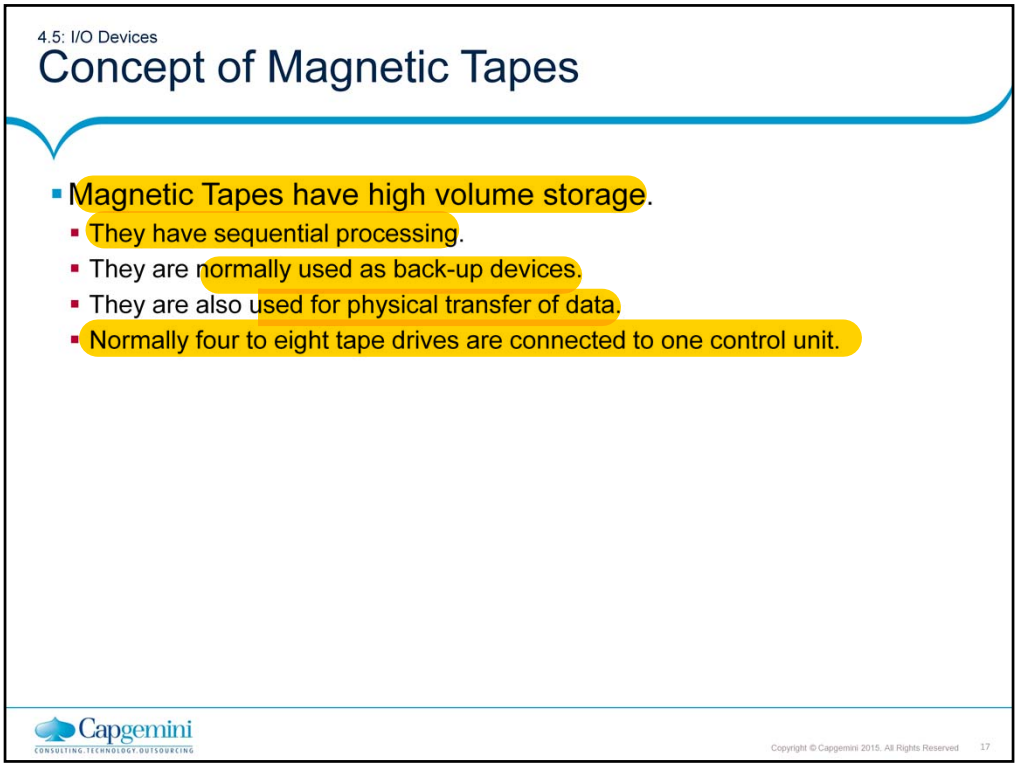
In Card devices, each record is a punched card. Example of card devices are Readers, Punches, Reader/Punches which are now obsolete.

In Printers each record is a printed line.

Printers can be of two types:

Impact printers : Impact Printers - 600 to 2000 LPM

Non-impact printers : Laser, 3800 Printing sub-system, 20,000 LPM


4.5: I/O Devices
Concept of Magnetic Tapes
Magnetic Tapes have high volume storage.
They have sequential processing.
They are normally used as back-up devices.
They are also used for physical transfer of data.
Normally four to eight tape drives are connected to one control unit.
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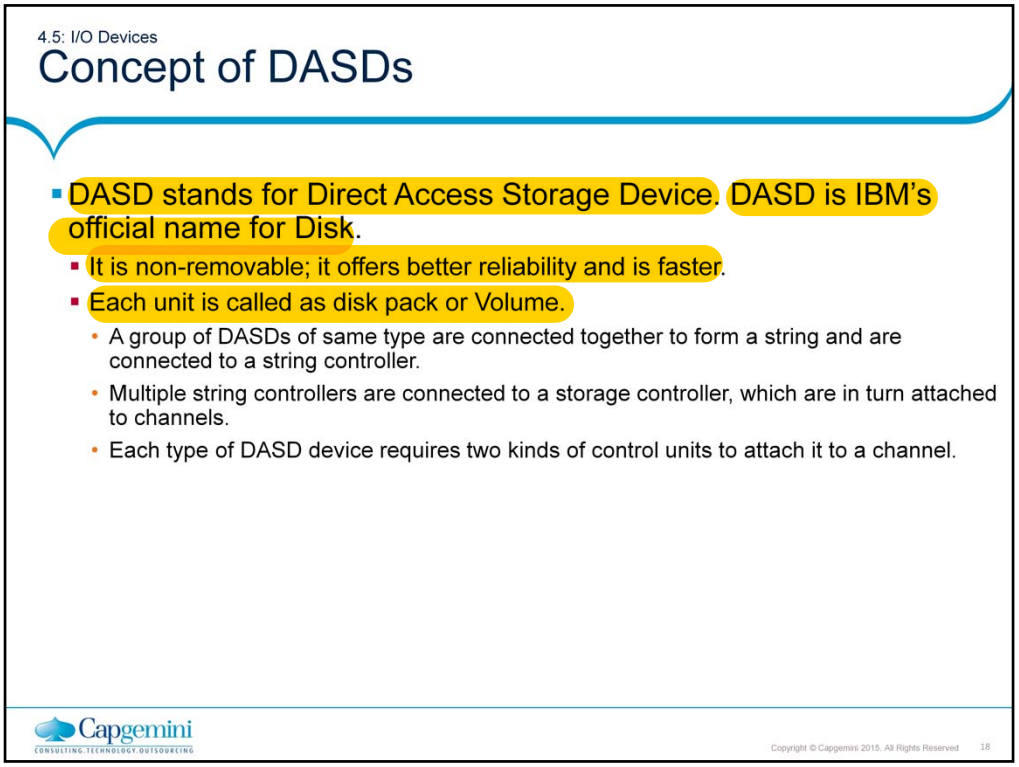


Direct Access Storage Device (DASD):

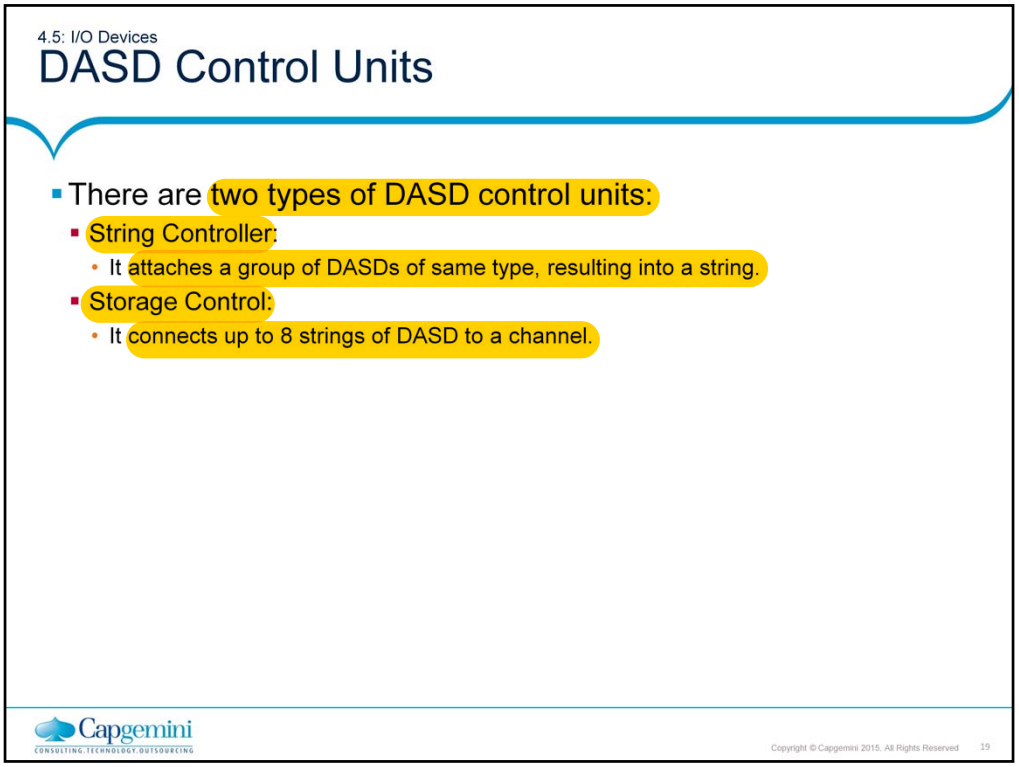
DASD is IBM's official name for Disk. It is non-removable, offers better reliability, and is faster.

Each unit is called as disk pack or Volume. Volume is a specific unit of storage. For example: Disk pack or DASD, Tape

Each pack has multiple circular surfaces. Each circular surface has multiple concentric tracks. Same track number of all surfaces together constitute a cylinder.

DASD capacity ranges from 100 MB (3330) to 8514MB (3390/9).

A group of DASDs of same type are connected together to form a string and are connected to a string controller. Multiple string controllers are connected to a storage controller. Storage controller is connected to channel.



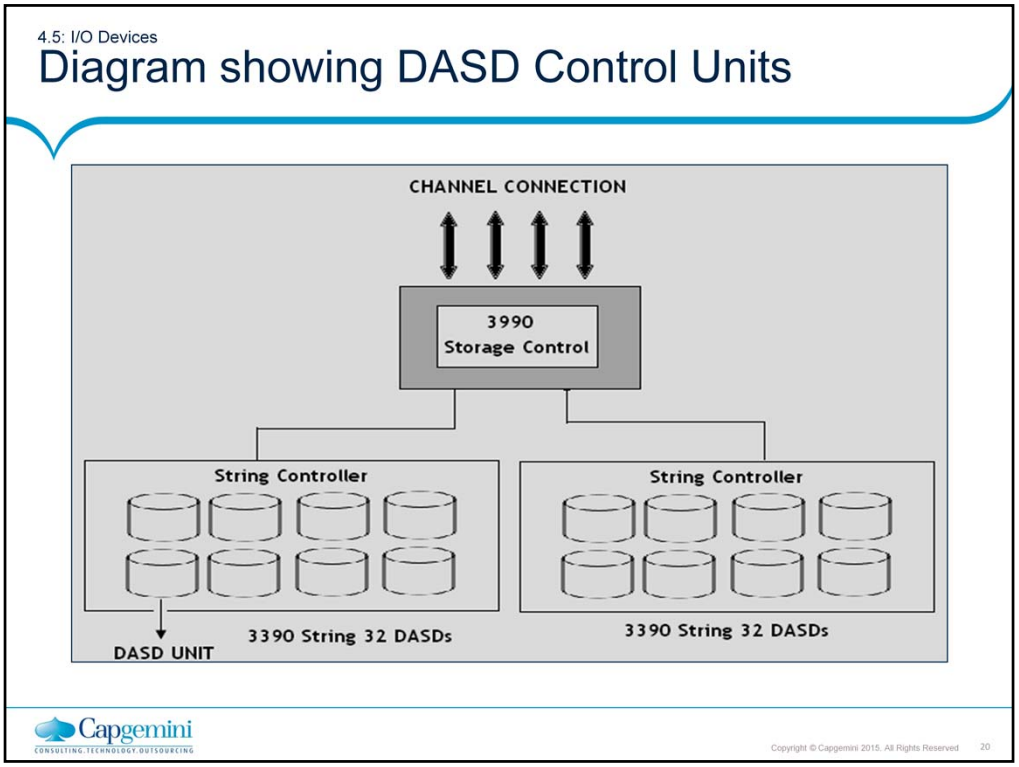
Direct Access Storage Device (DASD):

DASD Control Units:

DASD device requires two kinds of control units attached it to a channel.

The first, that is string controller, attaches a group of DASDs of same type that results into a string.

The second, that is storage control, connects up to eight strings of DASD to a channel.



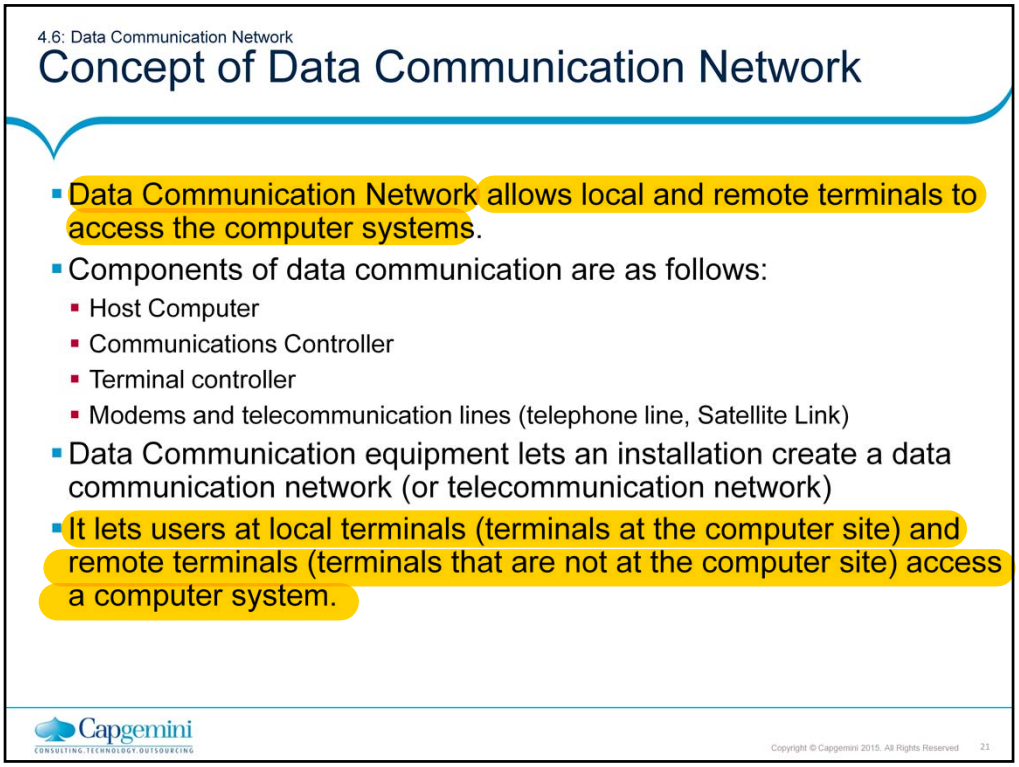
Direct Access Storage Device (DASD):

The diagram in the above slide is for a 3390 configuration with two strings attached to a 3990 storage control.

Here, a channel connection is connected to a 3990 storage control (first control unit) which is then connected to the DASD string using the string controller (second controller).

- In 3390 DASD string: up to 32 drives can be connected in one string
- 3990 storage control: attaches two DASD strings
- 3990 storage control supports multiple channel connections to the processor

This enables several simultaneous disk operations to be processed at once.



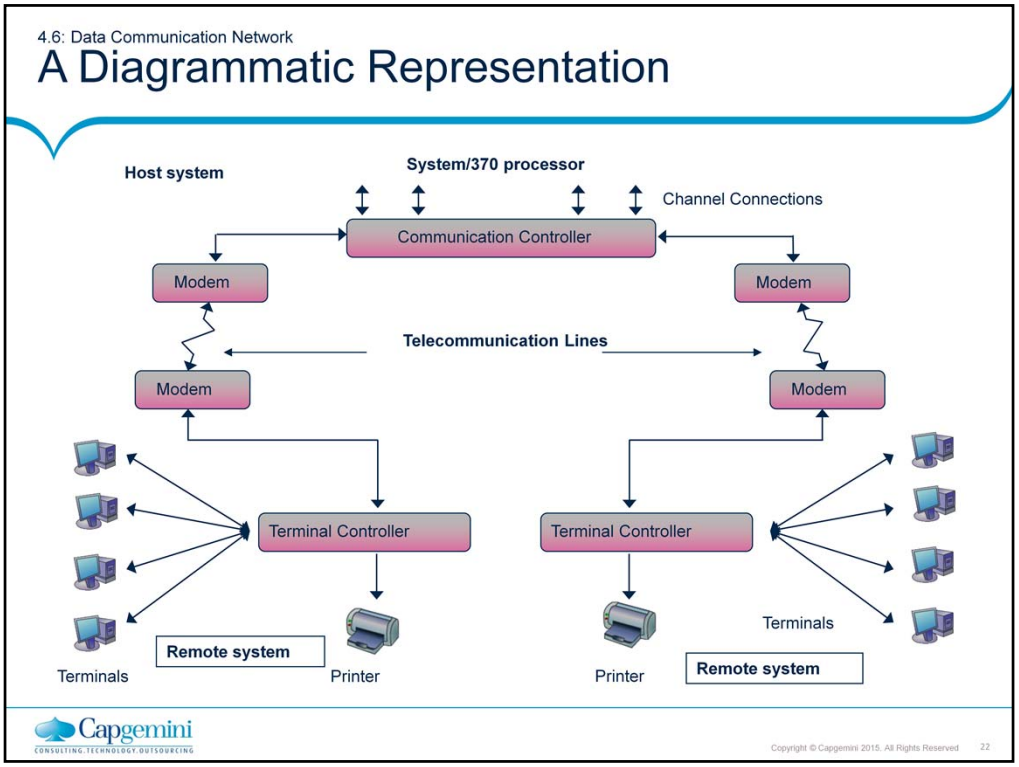
Data Communication Network:

Consider a center of the network in which the host system is a system/370 processor.

The control unit that attaches to the host system's channels is called a communication controller. It manages the communications functions necessary to connect remote terminal systems via modems and telecommunication lines.

A modem is a device that translates digital signals from the computer equipment at the sending end into audio signal that are transmitted over a telecommunication line. The telecommunication line can be a telephone line, a satellite link, or some other type of connection.

At the receiving end of the line, another modem converts those audio signals back into digital signals.


4.6: Data Communication Network
A Diagrammatic Representation
Host system
System/370 processor
Channel Connections
Communication Controller
Modem
Modem
Telecommunication Lines
Modem
Modem
Terminal Controller
Terminal Controller
Terminals
Remote system
Printer
Printer
Terminals
Remote system
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Data Communication Network:

- The diagram on the earlier slide shows the various components of data communication network.
- Consider the example of a data communication for a system/370 processor. Here the components of data communication will be:
  - Host Computer: a System/370 processor
  - Communications Controller: attached to the system /370 process via channel connection
  - Devices (terminals and printers): connected to the terminal controller (also known as cluster controller)
  - Terminal Controller: connected to communications controller. Terminal Controller managing Local terminals / printers can be connected directly to the channel.
  - Modems and telecommunication lines (telephone line, Satellite Link)
  - Remote terminals / printers: connected to terminal controller (at local site)
- Terminal controller is connected to modem. Modem is connected to telecommunications line. At the receiving end telecommunications line is connected to modem. Modem is connected to communication controller.
- A 3270 Information Display System consists of the following:
  - Sub-system of terminals, printers, and controllers connected to Host computer:
    - Locally through communications controller or directly to channel
    - Remotely through communications controller, modem, and telecommunications line
- A typical 3270 terminal controller (3274) controls up to 32 terminals / printers.
- Emulator programs (Shine Link, Erma Link) allow computers (typically PCs) to mimic 3270 devices.
- These are useful since they allow upload / download of data between MF and PC.

Summary

- In this lesson, you have learnt about:
  - The typical mainframe system and its main components.
    - Processors is the main component
    - System/370 is a multiprocessing system.
    - Various I/O devices can be used like cards /punches, tapes and disk storage.
    - DASD is the disk storage that is used.
    - Remote communication can be achieved using the Communication device.

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Review Question

- Question 1: ___ is a specific unit of storage used in DASDs.
  - Option 1: Volume
  - Option 2: Memory
  - Option 3: Cache
- Question 2: DASD does not require any control unit to connect to processor.
  - True / False
- Question 3: The terminal controllers are attached to the ___ via modems.
  - Option 1: Control Unit
  - Option 2: Communication Controller
  - Option 3: Terminals

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