UNIT III

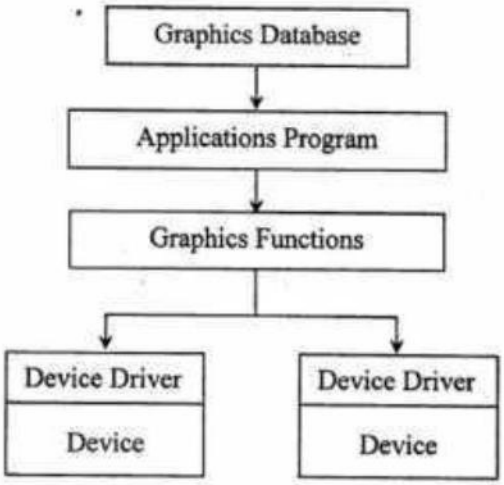
CAD STANDARDS

PRE-REQUISITE DISCUSSION

With the proliferation of computers and software in the market, it became necessary to standardize certain elements at each stage, so that investment made by companies in certain hardware or software was not totally lost and could be used without much modification on the newer and different systems. Standardization in engineering hardware is well known. Further, it is possible to obtain hardware and software from a number of vendors and then be integrated into a single system. This means that there should be compatibility between various software elements as also between the hardware and software. This is achieved by maintaining proper interface standards at various levels. Following are some of them.

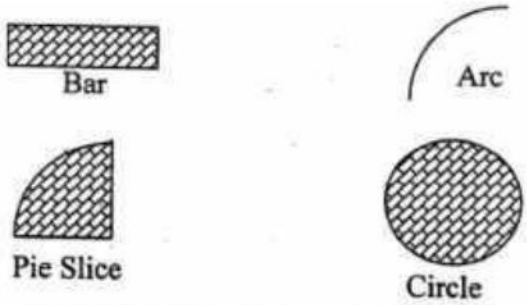
- **GKS** (Graphical Kernel Systems)
- **PHIGS** (Programmer's Hierarchical Interface for Graphics)
- **CORE** (ACM-SIGGRAPH)
- **GKS-3D**
- **IGES** (Initial Graphics Exchange Specification)
- **DXF** (Drawing Exchange Format)
- **STEP** (Standard for the Exchange of Product Model Data)
- **DMIS** (Dimensional Measurement Interface Specification)
- **VDI** (Virtual Device Interface)
- **VDM** (Virtual Device Metafile)
- **GKSM** (GKS Metafile)
- **NAPLPS** North American Presentation Level Protocol Syntax)

Schematically, the operation of these standards with application programs is depicted in Figure. Details of some of these standards are discussed in the following sections.



Various Standards in Graphics Programming

GRAPHICAL KERNEL SYSTEM (GKS)



Graphics Primitives in IBM GKS

For drawing lines, the concept of PEN is used. PEN has the attributes of colour, thickness and line type. Lines can be drawn with any PEN that can defined. The basic graphic primitives that were made available are.

- **POLYLINE** for lines after specifying in the line type, line width and line colour.
- **POLYMARKER** for specific marker types after specifying the type, size and colour.
- **GENERALISED DRAWING PRIMITIVES (GDP)** for specific graphic primitives such as arc, circle, ellipse, spline, etc.
- **TEXT** after specifying font type, precision, colour, height of the box, expansion factor , spacing up vector and the path (left, right, up or down).
- **FILL AREA** for hatching and filling of areas.

In essence, the GKS is essentially a set of procedures that can be called by user programs for carrying out certain generalised functions. In the interest of interchangeability, ISO has identified certain calling conventions for all these functions in various languages in order to take care of the variability of the programming languages.

GKS is defined in terms of a number of levels describing the level of support in terms of facilities. The highest level is 2c, though level 2b is the most commonly available facility with marginal difference in terms of the length of input queue (5 in case of 2c and 0 in case of 2b). A number of implementations are available for GKS on all types of computer starting from the micros to the main frame computers.

DATA EXCHANGE STANDA RDS

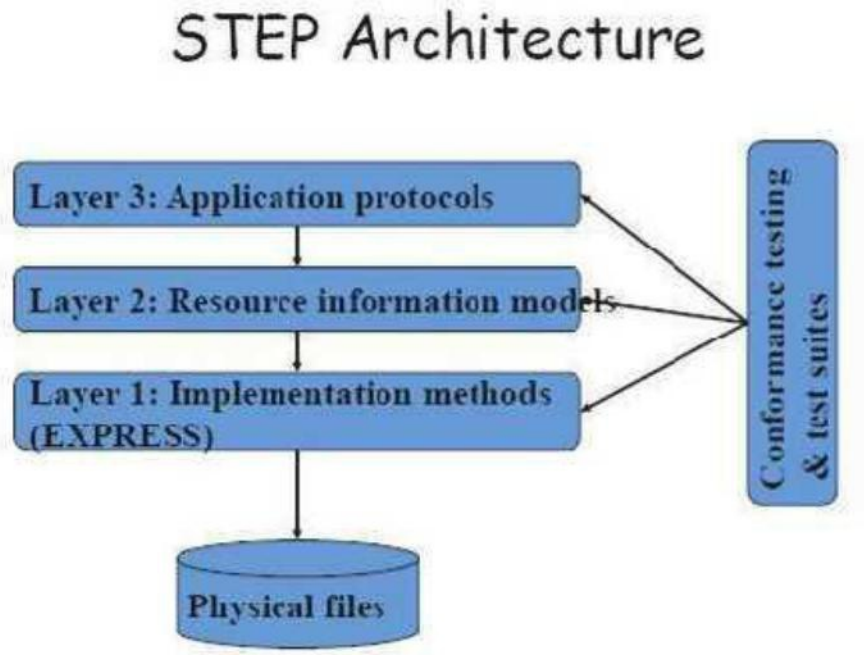
IGES STANDARD

However, the IGES is the most comprehensive standard and ***is designed to transmit the entire product definition including that of manufacturing and any other associated information.*** A brief description of the IGES version 3.0 is given below highlighting the philosophy of the conversion methodology.

In IGES the records are present with 80 column fields, with columns 1 to 72 providing the data and columns 73 to 80 providing a sequence number for the record with identification as to the location of the sub-section. This sequence number is utilized as a pointer for the data. The IGES file consists of the following 6 sub-sections.

STEP (Standard for the Exchange of Product model Data)

- Standard for Exchange of Product Model Data
- Uses a formal model f or data exchange
- Information is modeled using the EXPRESS language
- EXPRESS has elements of Pascal, C, and other languages
- It contains constructs for defining data types and structures, but not fo r processing data
- EXPRESS describes geometry and other information in a standard, unambiguous way



Classes of STEP Parts

•Introductory
•Description methods
•Implementation methods
•Conformance testing methodology and Framework
•Integrated resources
•Application proto cols
•Abstract test suites
•Application interpreted

constructs **Status of STEP**

•STEP has been under development for many years, and will continue for many more
•Over a dozen STE P parts have been approved as international standards
•Many others are under development

CONTINUOUS ACQUISITION AND LIFE-CYCLE SUPPORT (CALS)

- Developed by US Department of Defense
- Prescribes formats for storage and exchange of technical data
- Technical publications an important focus

Important CALS Standards

- Standard Generalized Markup Language (SGML) -developed in 1960s IBM

  i. document description language
  ii. separates content from structure (formatting)
  iii. uses —tagsǁ to define headings, sections, chapters, etc.
  iv. HTML is based on SGML

- Computer Graphics Metafile (CGM)

  i. Developed in 1986
  ii. vector file format for illustrations and drawings
  iii. All graphical elements can be specified in a textual source file that can be compiled into a binary file or one of two text representations

OpenGL (Open Graphics Library)

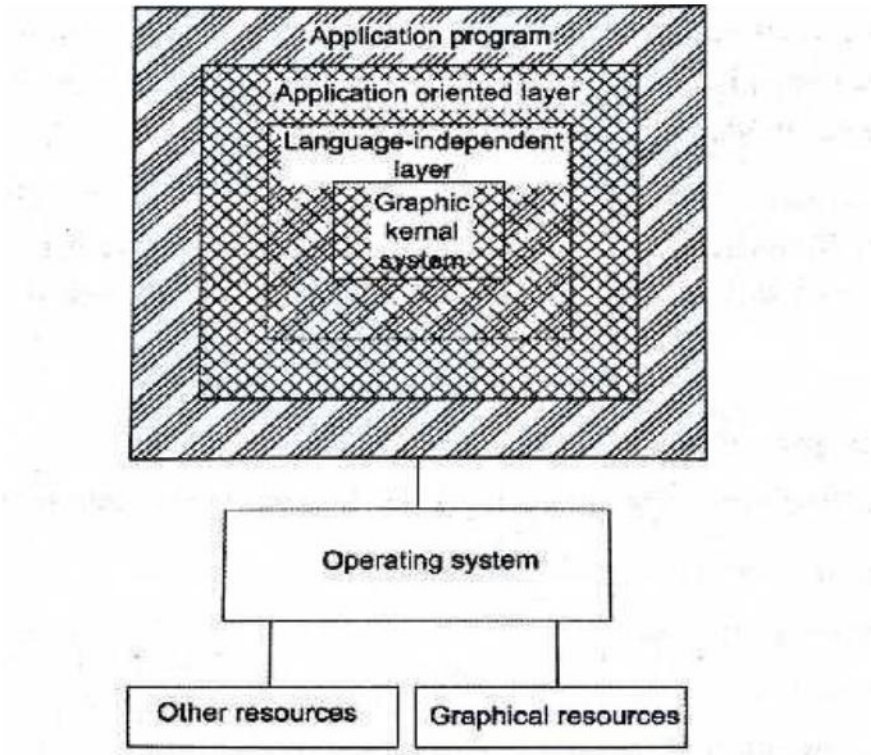
OpenGL is a cross- language, multi-platform application programming interface (API) for rendering 2D and 3D vector graphics. The API is typically used to interact with a graphics processing unit (GPU), to achieve hardware-accelerated rendering.

The OpenGL specification describes an abstract API for drawing 2D and 3D graphics. Although it is possible for the API to be implemented entirely in software, it is designed to be implemented mostly or entirely in hardware.

The API is defined as a number of functions which may be called by the client program, alongside a number of named integer constants (for example, the constant G L_TEXTURE_2D, which corresponds to the decimal number 3553). Although the function definitions are superficially similar to those of the C programming language, they are language- independent. As such, OpenGL has many language bindings, some of the most noteworthy being the Java Script binding Web GL (API, based on OpenGL ES 2.0, for 3D rendering from within a web browser); the C bindings WGL, GLX and CGL; the C binding provided by iOS; and the Java and C bindings provided by Android.

In addition to being language- independent, OpenGL is also platform- independent. The specification says nothing on the subject of obtaining, and managing, an OpenG L

context, leaving this as a detail of the underlying windowing system. For the same reason, OpenGL is purely concerned with rendering, providing no APIs related to input, audio, or windowing.

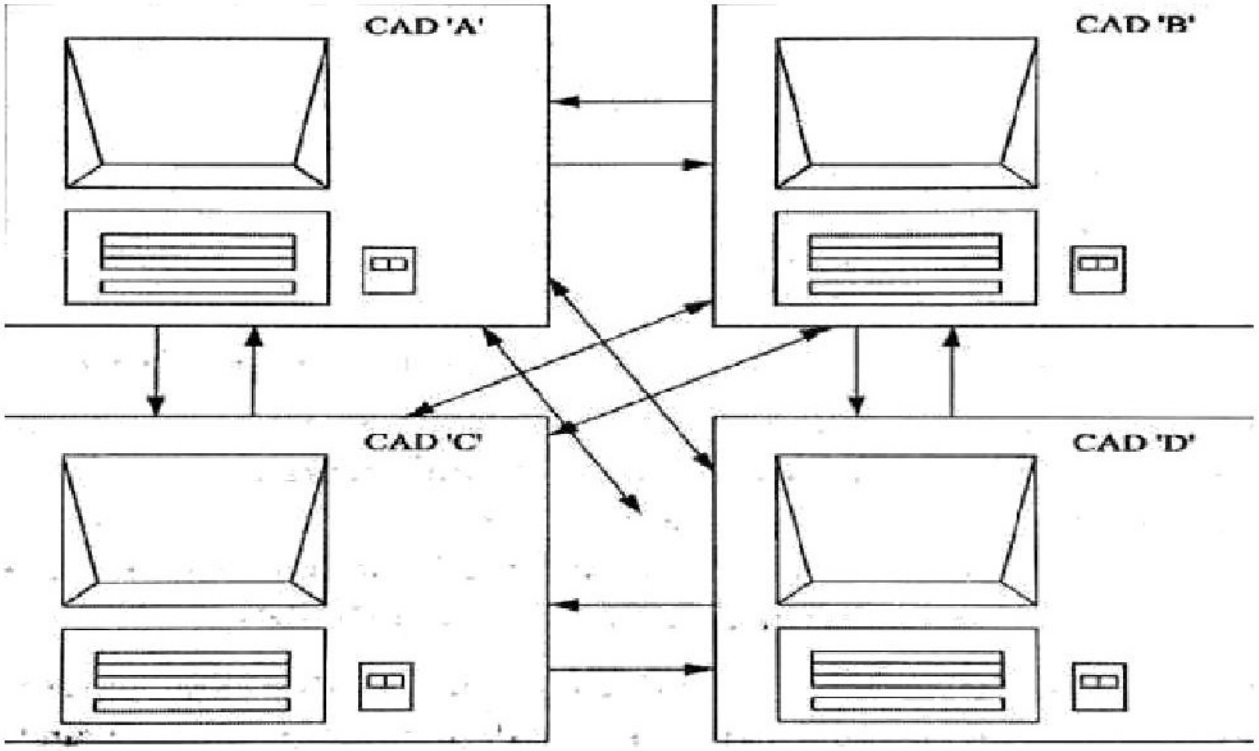


STANDARDS FOR EXCHANGE IMAGES:

- The purpose of GKS and other similar standards is to allow graphics to be drawn on a display device by an application program.
- The model is converted by the series of graphics primitives, and these are then displayed on the screen using the graphics procedures, typically by setting the values of the pixels in a rectangular raster array.
- The raster array is represented by a region of computer memory is known as bitmap.

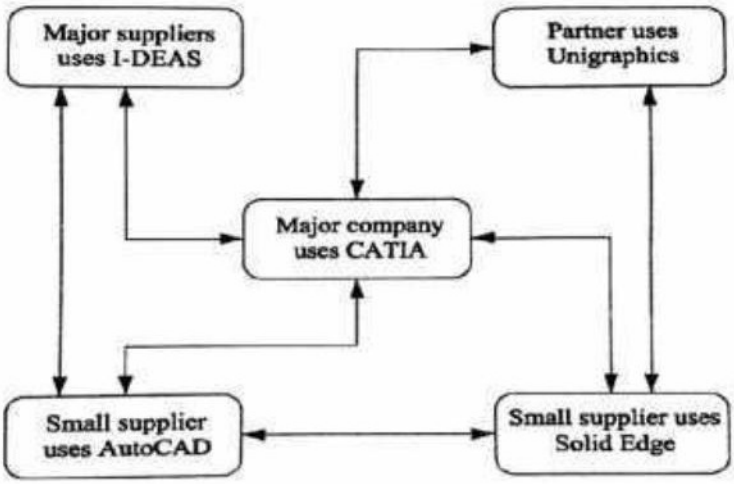
Data exchange standards:

- CAD data exchange involves a number of software technologies and methods to translate data from one Computer-aided design system to another CAD file format.
- The recent decades, the data transfer of data between the system has been made possible by the neutral format of data exchange.



The following reasons for exchanging the data are that

- All use the same cad package
- Special translator applications are used to change the data from one format to another format needed.
- A neutral format is used for data exchange.



IGES has three types of entity:

- Geometric – it defines the product shape and include curves, surface and solids
- Annotation – it included various types of dimensions (linear, angular, ordinate), centre line , notes, general labels, symbols and cross hatching
- Structure – it includes views, drawing , attributes(such as line and text fonts, colors and layers), properties (mass), subfigures and external cross reference entities (for surface and assemblies)

Entity number	Entity description	Entity number	Entity description
100	Circular arc	132	Connect point
102	Composite curve	136	Finite element
104	Conic arc	138	Nodal display and rotation
106	Copious data	140	Offset surface
108	Plane	142	Curve on a parametric surface
110	Line	144	Trimmed parametric surface
112	Parametric spline curve	146	Nodal results
114	Parametric spline surface	148	Element results
116	Point	150	Block
118	Ruled surface	152	Right angular wedge
120	Surface of revolution	154	Right circular cylinder
122	Tabulated cylinder	156	Right circular cone
124	Transformation matrix	158	Sphere
125	Flash	160	Torus
126	Rational B-spline curve	162	Solid of revolution
128	Rational B-spline surface	164	Solid of linear extrusion
130	Offset curve	186	Ellipsoid

Error handling

- While importing IGES file, error handling is very important
- There are two major error sources when processing IGES files
  - Program errors in the processors
  - Misinterpretation of the IGES standard itself.
- The way an IGES processor report error is – the processor should report the entity type, number of unprocessed entries, reason for un-processing and other relevant database information of these unprocessed entities.

- IGES should also report any invalid or missing data encountered in reading IGES files especially those that were edited.

STEP:

- STEP (standard for Exchange of Product Data) is an exchange for product data in support of industrial automation

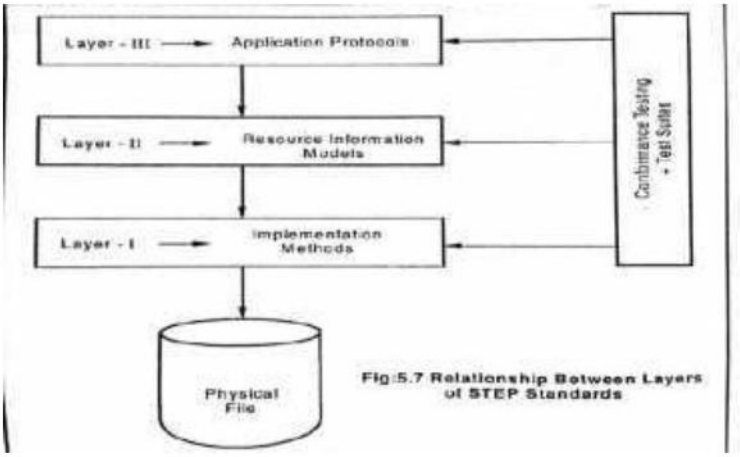
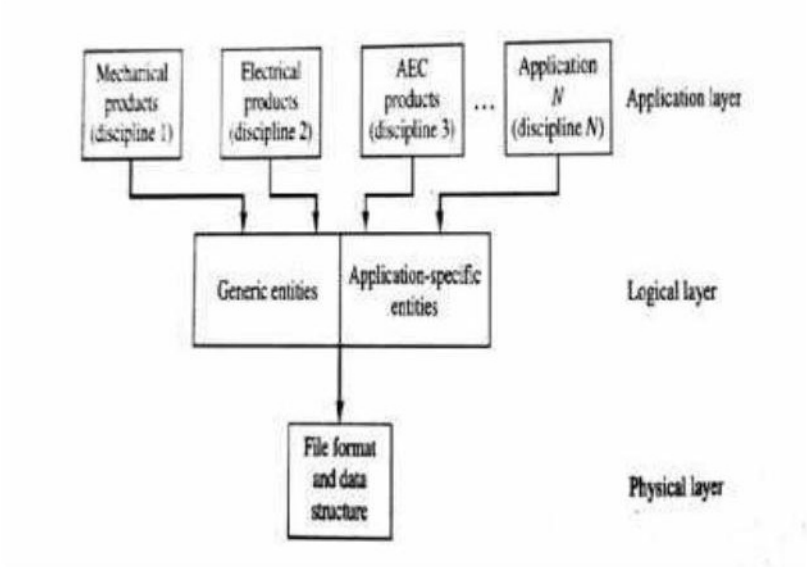


Fig:5.7 Relationship Between Layers of STEP Standards

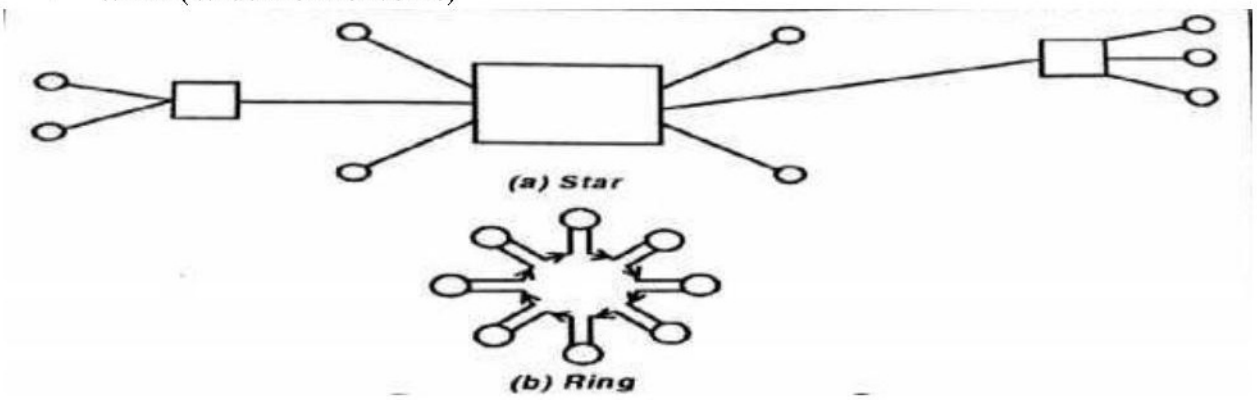


CALS:

- Continuous Acquisition and Life cycle support is CALS.
- CALS was originally called Computer Aided Acquisition and Logistics Support.

COMMUNICATION STANDARDS:

- Data exchange depends not only on the compatibility of the applications data formats between the communicating systems.
    - LAN (Local area networks)
    - WAN (Wide area networks)



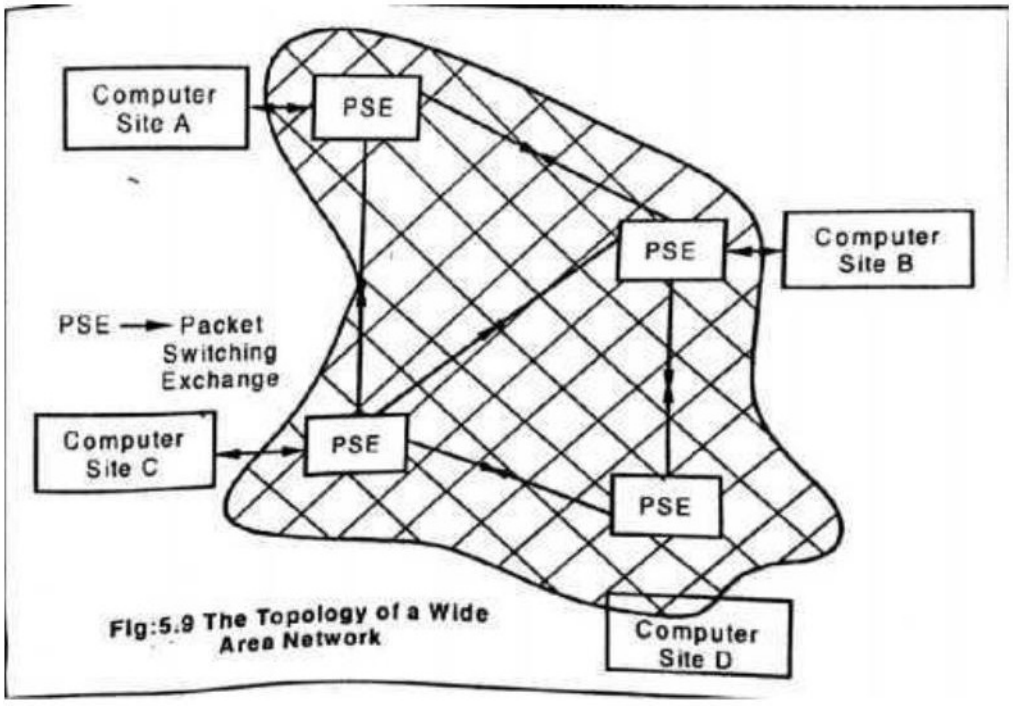
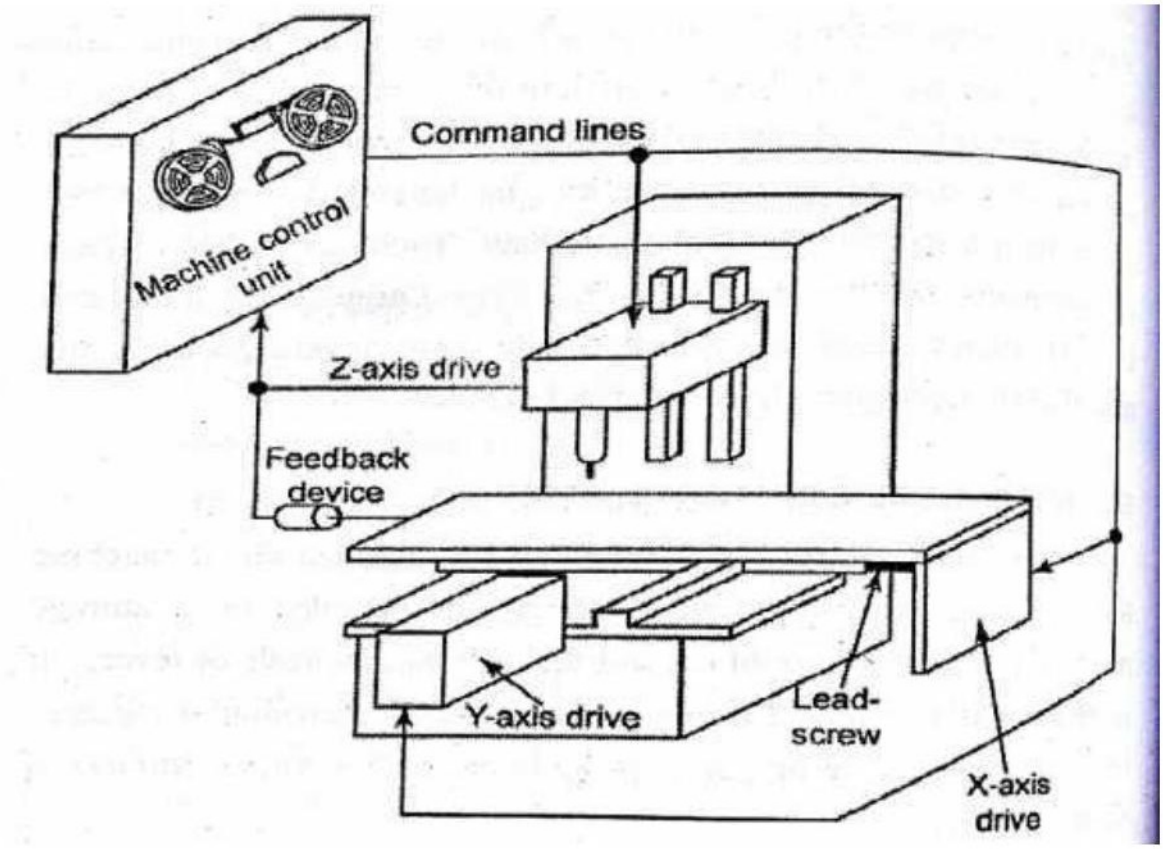


Fig:5.9 The Topology of a Wide Area Network

UNIT IV
FUNDAMENTAL OF CNC AND PART PROGRAMING

Definition of NC System:

– A system in which actions are controlled by the direct insertion of numerical data at some point is known as NC system.



TYPES OF NC SYSTEM:

- Traditional numerical control (NC)
- Computer numerical control (CNC)
- Distributed numerical control (DNC)