156 pages.

UNIT - I

PART - A

① Mention some of the Network Management standards?

* OSI / CMIP (Open System InterConnection / Common Management Information protocol)
* SNMP / Internet (Simple Network Management protocol)
* TMN (Telecommunication Management Network)
* IEEE (Institute of Electrical and Electronics Engineering).

② What are the network Management Models?

There are four Network Management Models.

1. The organizational Model
2. The information Model
3. The Communication Model
4. Functional Model.

③ Define Agent.

* The managed elements have a management process running in them, called an agent.

* As agent, it transmits information to the top level manager & agent receives the information from the database.

4) State the purpose of Managed object.

* Managed elements have a management process running in them called an agent. The unmanaged element do not have a management processing running them.

* As manager, it collects data from the network elements, processes them & stores the results in its database.

5) What is MoM.

* Manager of Managers (MOM).

* Network domains can be managed locally, and a global view of the networks can be monitored by a manager of managers.

* It is also applicable to a configuration in which Vendor management systems manage the domains of their components, and MoM manages the entire network.

6) What is MIB.

* Management Information Base

* The MIB is used by both agent and management processes to store and exchange management information

* The MIB is associated with an agent is called the agent MIB and the MIB associated with a manager is designed the Manager MIB.

(7) What is the use of Management Information Tree.

* The managed objects are uniquely defined by a tree structure specified by the OSI model and are used in the Internet Model.
* Each managed object occupies a node in the tree.

(8) List the Management object's Types basic attributes.

1. object type
2. Definition
3. Syntax
4. Access
5. Status

(9) What are the characteristics of managed objects parameter.

* Object class – Managed object.
* Attributes – Attributes visible at the boundary.
* Operations – Operations that can be applied to it
* Behaviour – Behaviour exhibited by it in response to an operation.
* Notifications – Notifications emitted by the object.

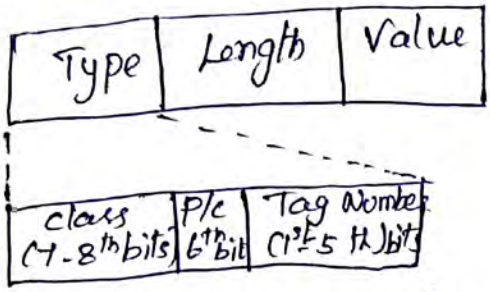
(10) Define Transfer syntax.

* Transfer syntax represents the set of rules for communicating information b/w systems.

(11) Define encoding structure.

* The ASN:1 syntax that contains the management information is encoded using the based encoding rules (BER) defined for the transfer syntax.

* One specific encoding structure, called TLV, which denotes type, length, and value components of the structure



TLV Encoding structure.

12) Write the syntax of ASN:1 Macro.

<Macro name> MACRO ::=

BEGIN

TYPE NOTATION ::= <Syntax of New Type>

VALUE NOTATION ::= <Syntax of New Value>

<auxiliary Assignments>

END.

13) State Network provisioning.

* Network Provisioning, also called circuit provisioning in the telephone industry, is an automated process.

* The design of a trunks and a ~~specific~~ special service circuit is done by application programs written in operation systems.

14) What is inventory Management.

* An efficient database system is an essential part of the inventory management system.

* Legacy inventory Management systems use hierarchical and scalar - based database systems. such db limit the addition of new components or extend the properties of existing components by adding new fields.

(15) How will you measure performance in Network management

1. Performance Metrics
2. Data Monitoring
3. Problem Isolation
4. Perform Statistics

16) Classify various types of Report Management.

Report Management categoried into 3 types.

① planning and management Reports.
② System reports
③ User reports.

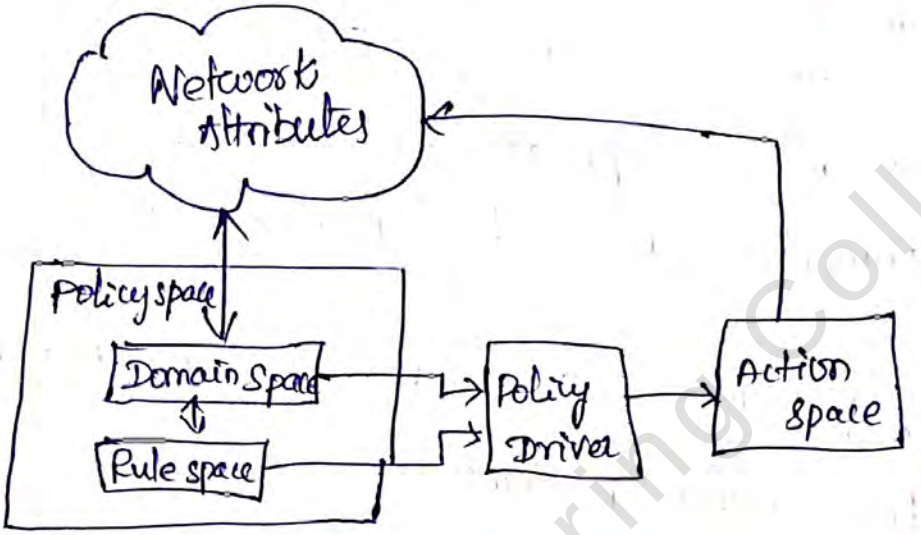
17) Define account Management.

* The cost of operations for an information. Management services department is based on the service

that it provides to the rest of the organization.

* The planning and budget purposes, this may need to be broken into administrative group costs.

18) Draw the Architecture of policy management.



19) * What are all Event Correlation techniques used in Network management?

There are 6 approaches.

(1) Rule based reasoning (2) Model based reasoning
(3) Case based reasoning (4) Codebook
(5) state transition graph model (6) finite state automa

20) ~~What is~~ How will you use objects and Data types in ASN.1 ?

* ASN.1 notation to define the various data types and apply them to describe objects in the context of SMI & MIB.

* The data type could be either a simple type or structured.

PART-B

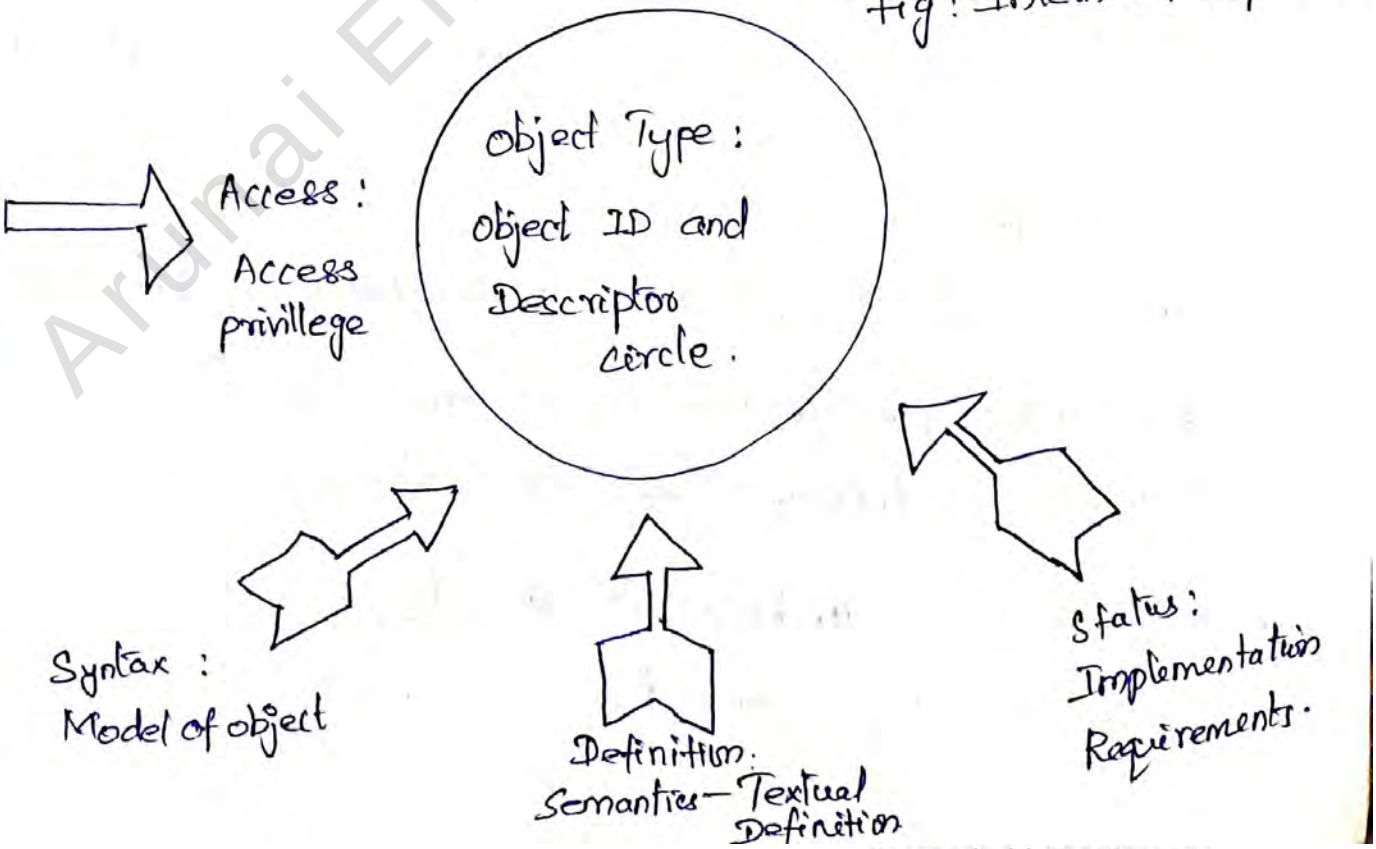
① Discuss conceptual views of managed objects with reference to Internet perspective and OSI perspective. (10 marks)

* A managed object need not be a physical object that can be seen, touched, or felt, it is convenient to use a physical representation to understand the characteristics and operations associated with a managed object.

* Consider an object, which is circular in shape. We can define the object in Englich language syntax as circle.

* To associate a meaning with the object name 'circle', we can use webster's dictionary definition "a plane figure bounded by a single curved line every point of which is equally distant from the point at the center of the figure.

Fig: Internet Perspective



* The access privilege could be viewed and its parameters changed by people who have access to it.

* The basic objects that are required of a group as the status of the object. whether it is mandatory or optional to have the object. This attribute of the object is defined as the status of the object.

* A managed object in the Internet is defined by 5 parameters, They are,

1. object Identifier and descriptor - Unique ID and name for the object.
2. Syntax - Used to Model the object.
3. Access - Access privilege to a managed object.
4. Status - Implementation requirements
5. Definition - Textual description of the Semantics of object type.

* The Internet object Model is a scaled ob. Model and is easy to understand. In contrast, the OSI perspective of a managed object is complex and has a different set of characteristics.

→ The attribute of an object defines the external perspective of the object. It undergoes an operation pur

push is not really an OSI operational entity, but is used here to illustrate the concept.

→ The behaviour of the object is to change its shape or attribute from a circle to an ellipse. It then sends notifications to the relavant commenely informing of its change.

→ Characteristics of an OSI managed objects are,

* object class — Managed object.
* Attributes — Attributes visible at its boundary.
* Operation — Operations that may be applied to it.
* Behaviour — Behaviour exhibited by it in responsible to an operation
* Notifications — Notifications emitted by the obj.

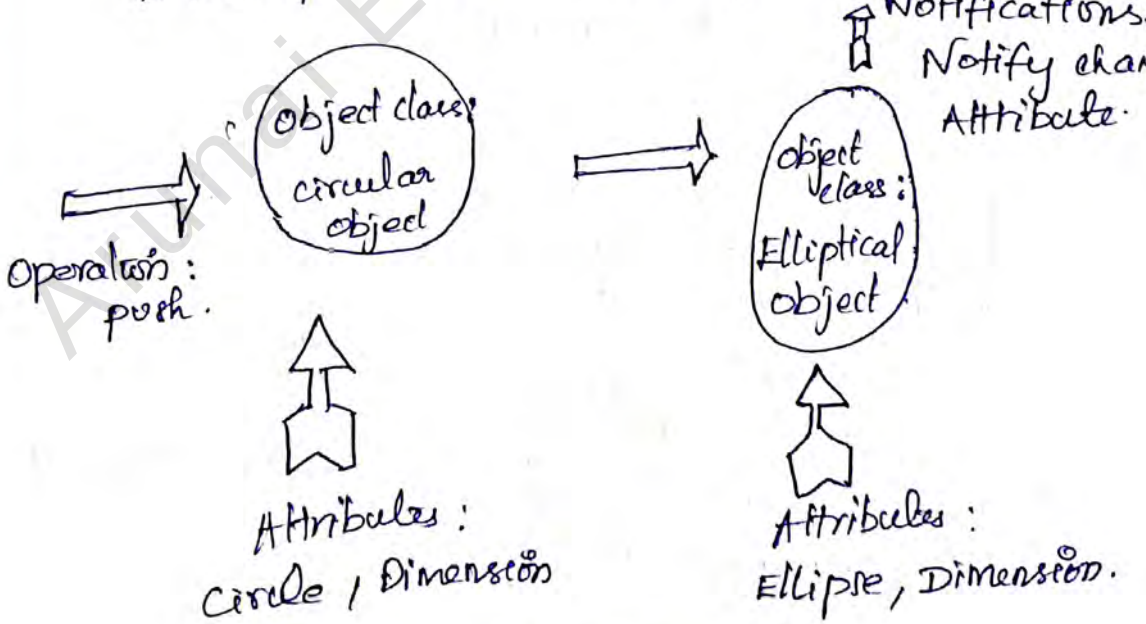


Fig: (b) OSI perspective.

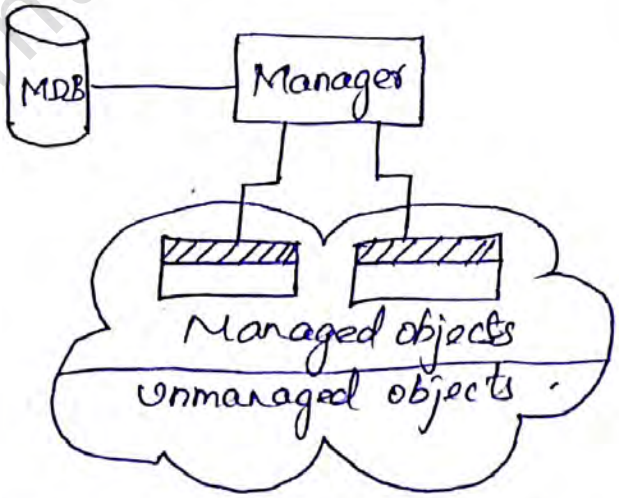
② Describe 2-Tier and three-Tier network management organization Model. (10).

* The organization Model describes the components of n/w management and their relationships. The below fig is representation of a 2-tier model.

* Network objects consist of network elements such as hosts, hubs, bridges, routers etc.

* They can be classified into managed and unmanaged objects (or) elements. The managed elements have a Management process running in them. for eg, one can buy a managed or unmanaged hub.

* The managed hub has management capability built into it and hence is more expensive than the unmanged hub, which does not have an agent running in it.



MDB – Management Database.

▨ – Agent Process.

fig: Two. Tier N/w Management organization Model.

→ The manager manages the managed objects (or) elements. There is a database in the manager, but not in the agent.

→ The manager queries and receives management data from the agent, processes them and stores them in its database.

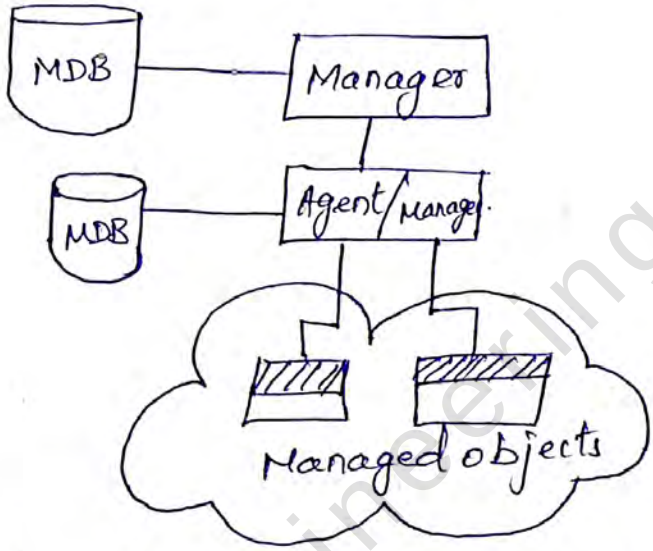


fig: Three-Tier Network management organization Model.

→ The above fig presents a 3-tier configuration. The intermediate layer acts as both agent and manager.

→ As the manager collects data from the n/w elements, processes them and stores the results in its database.

→ As agent, it transmits information to the top-level manager. For eg, an information to the top-level manager.

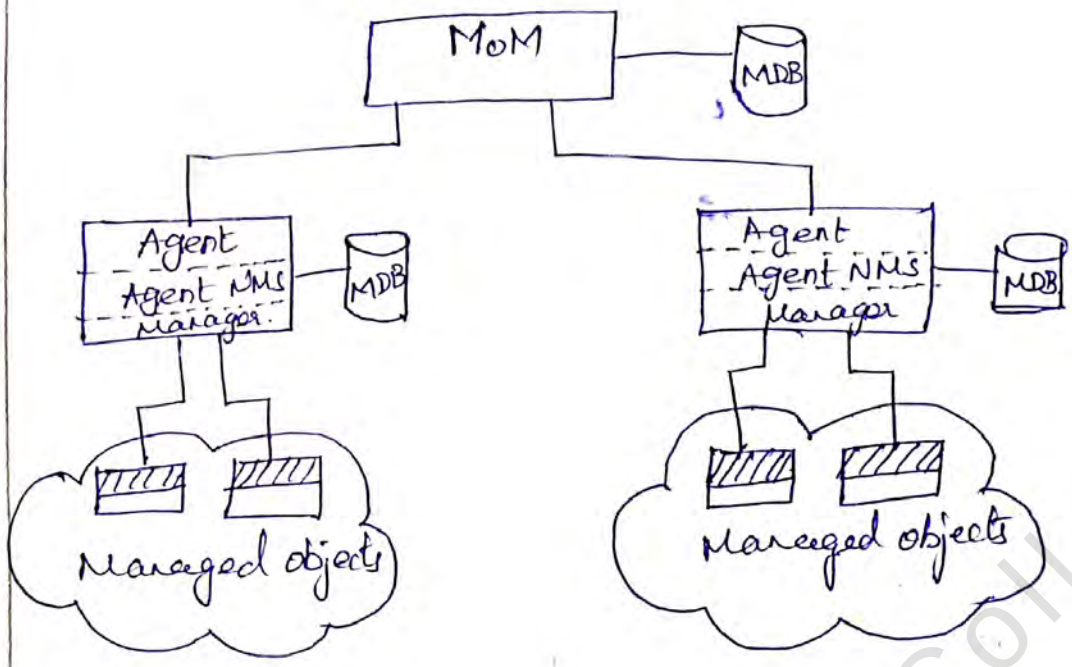


fig: N/w Management organization model with Mo

→ N/w domains can be managed locally and a global vie of the nlws can be monitored by a Manager of Manager.

→ It is also applicable to a configuration where vendor management systems manage the domains of their respective components and MoM manages the entire n/w.

→ N/w Management systems can also be configured on a peer-peer relationship.

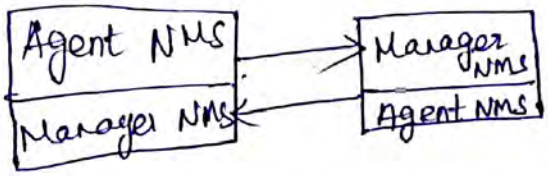


Fig: Dual Role of Management Process.

(3) what is Management Information Tree and explain in detail. (10).

* An information model is concerned with the structure and storage of information.

* The managed objects are uniquely defined by a tree structure specified by the OSI model and are used in Internet Model.

* The below fig shows the generic representation of the tree, defined as the Management Information Tree (MIT)

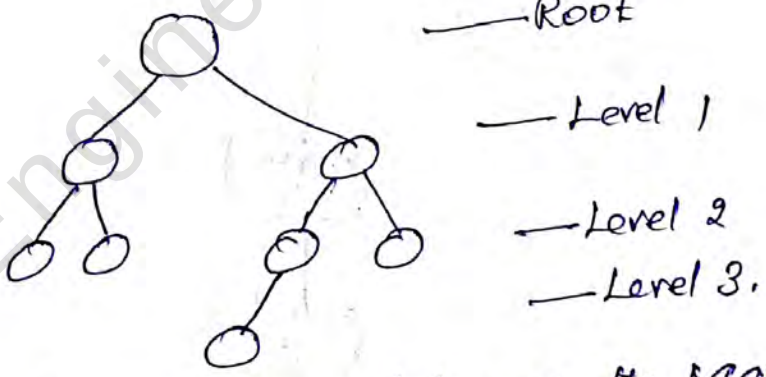


fig: Generic Representation of the Management Information Tree.

* There is a root node and well-defined node underneath each node at different levels, designed as Level 1, Level 2 etc. Each managed node object occupies a node in the tree.

→ In OSI MIT, The root does not have an explicit destination. The root has 3 nodes in the layer beneath it like iso, ccittu (itu) and iso-ccitt (iso-itu).

iso — Defines International standards organization

ccittu(itu) - Defines International Telecommunication Union.

iso-itu → 21 stds organizations are on the first layer defining managing objects under them.

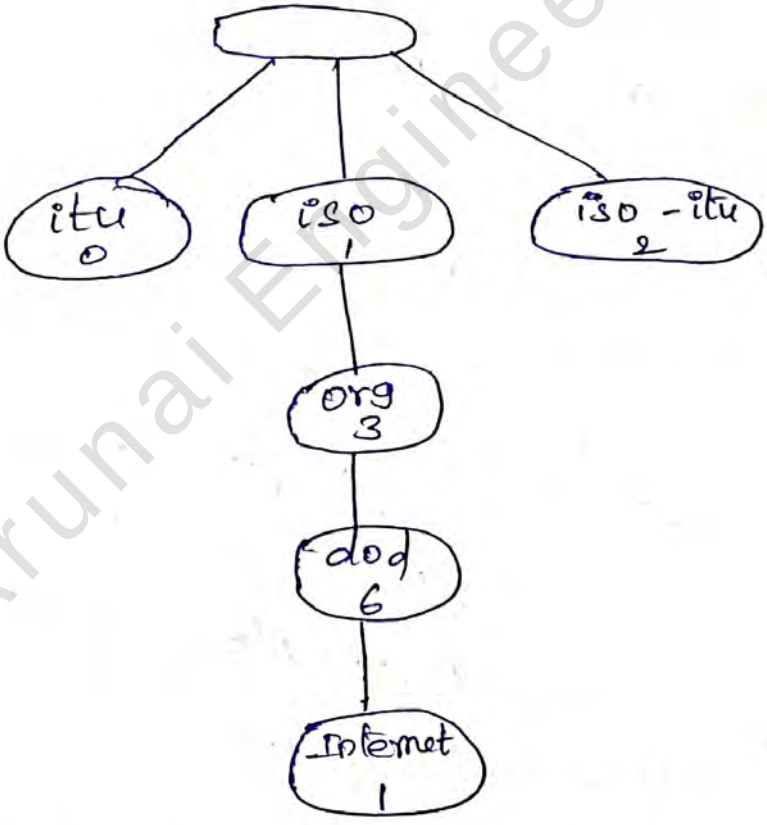


fig: OSI Magement Information Tree.

* The joint iso-itu node is for management objects jointly defined by the 2 organizations.

* The number in each circle identifies the destination of the objects ~~jointly~~ defined by in each layer.

* Thus iso is designed as 1 org as 1, 3, dod (Dept of Defense) as 1.3.6 and the internet as 1.3.6.1.

~~All iso is designed as~~ .

* All Internet - managed objects will be that number followed by more dots and numbers.

(4) What is fault Management ? Describe 5 steps process in fault Management (10).

Fault Management:

* Fault in a network is normally associated with failure of a network component and subsequent loss of connectivity.

* It ~~inclu~~ involves a five - step process.

① fault detection.
② Fault location
③ Restoration of services.

④ Identification of Root Cause of the problem.

⑤ Problem resolution.

* The fault should be detected as quickly as possible by the centralized management system.

* Fault location involves identifying where the problem is located.

* The Restoration of service takes the higher priority over diagnosing the problem and fixing it.

* Identification of the problems' root cause could be a complex process, which we will consider in greater depth shortly.

① Fault Detection:

* Fault detection is accomplished by using either a polling scheme or by generation of traps.

* An application program generates the ping command periodically and waits for response. Connectivity is declared broken when a present no. of. consecutive responses are not received.

* The frequency of pinging and the preset number for failure detection may be optimized for balance b/w traffic overhead and the rapidity with which failure is detected.

* The alternative detection scheme is to use traps. For eg, the generic trap messages linkDown and egpNeighborLoss in SNMPv1 can be set in the agents, giving them the capability to report events to the nw mgmt sys with the legitimate community name.

* Advantages of traps over polling is that failure detection is accomplished faster with less traffic overhead.

2. Fault Location and Isolation Techniques:

* Fault location using a simple approach would be to detect all the nw components that have failed.

* The orgin of the problem could then be traced by walking down the topology tree to where the problem starts.

* After having located where the fault is, the next step is to isolate the fault.

* First, we should determine whether the pbm is the i/f interface or failure of the component or failure of the physical link.

* Let us assume for the moment that the link is not the pbm and that the interface card is. We then proceed to isolated the pbm to the layer that is causing it.

* Excessive packet loss may causing the disconnection and we can measure the packet loss by pinging, if pinging can be used.

* The ideal solution to locating and isolating the fault is to have an artifical intelligence solution. By observing all the symptoms, we might be able to identify the source of the problem.

(5) what is role of event correlation technique for root cause analysis. (5)

* We have illustrated some simple methods of diagnosing and isolating the source of a pbm in fault and performance mgmt.

* when a centralized nlw mgmt s/m receives a trap or a notification, it is called receiving an event.

* A single problem source may cause multiple symptoms and each system detected is reported as an independent event to the mgmt s/m.

* The management s/m to correlate all these events and isolate the root cause of the problem. This method is called as event correlation techniques.

* Several correlation techniques are used to isolate and localize fault in n/ws.

(1) detecting and filtering of events.

(2) Correlating observed events to isolate and localize the fault either topologically or functionally.

(3) Identifying the cause of the problem.

Six correlation Techniques.

(1) Rule based reasoning
(2) Model-based reasoning
(3) Case-based reasoning
(4) Codebook
(5) State transition graph model
(6) Finite state machine Model.

(6) What is ASN.1 and explain in detail. (10 marks).

* In these Models, structure of mgmt information needs to be specified syntactically and semantically.

* It is a formal Notation and it is used for describing data transmitted by telecommunication protocol.

* Abstract syntax as the set of rules used to specify data types and structures for storage of information

* Transfer syntax represents the set of rules for communicating information between systems.

Terminology, symbols and conversions:

* ASN:1 is based on the Backus system and uses the formal syntax language and grammar of the Backus-Naur form (BNF),

<name> ::= <definition>

→ where the notation "<entity>" denotes an "entity" and the symbol "::=" represents "defined as".

* We define an entity <digit> in the following way,

<digit> ::= 0|1|2|3|4|5|6|7|8|9

→ '|' represents "or".

* We define an operation entity <op> in the following way,

<op> ::= +|-|x|/

→ The definitions on the right side are called primitives.

* The format of each line is defined as a production or assignment.

* Let us consider an eg with the following 2 assignments.

<BooleanType> ::= BOOLEAN

<BooleanValue> ::= TRUE | FALSE.

* The expression on the left side specifies the name of the type and the right side is the definition or value of the type.

→ Thus, BooleanType is defined as BOOLEAN and Boolean value is defined as either TRUE or FALSE. Here T or F are called keywords.

* A group of assignments make up an ASN.1 module for eg, a name consists of first, middle, and last names.

```
Person-name Person-Name ::=
{
 first "John",
 Middle "T",
 last "smith"
}.
```

ASN:1 DataType Definition Example.

```
PersonnelRecord ::= SET
    {    Name,
        title GraphicString,
        division CHOICE {
        Marketing [0] SEQUENCE
        {
         Sector,
         Country},
```

```
research [1] CHOICE
  { product based [0] NULL,
    basic         [1] NULL },
production [2] SEQUENCE
  { product-line,
    country } }
```

2. OBJECTS AND DATA TYPES.

→ ASN.1 notation to define the various data types and apply them to describe objects in the context of SMI and MIB.

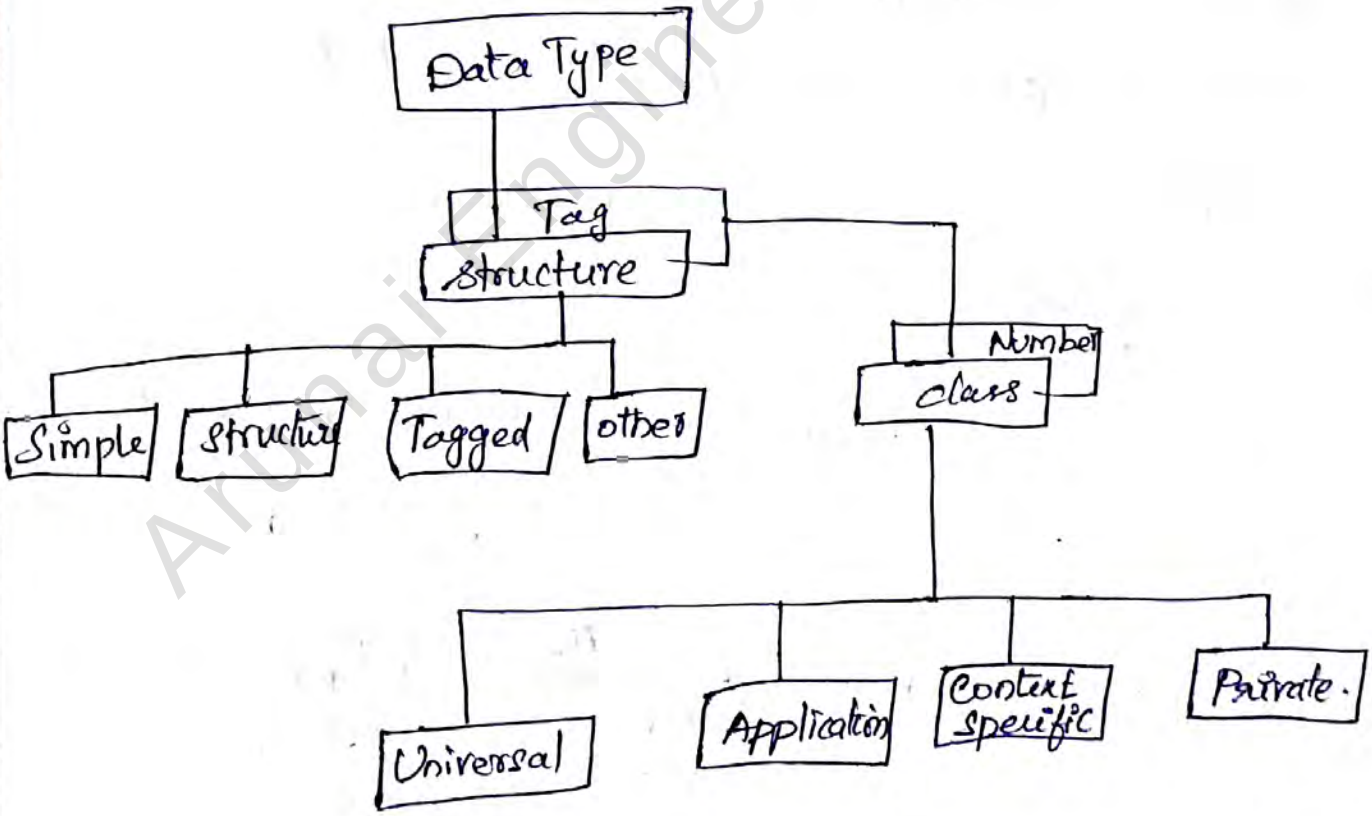


Fig: ASN:1 data type structure and Tag.

* The data type could be either simple type or structured. Tag designation, which uniquely identifies the data type irrespective of the syntax version.

* A simple type is one for which the values are specified directly. A structured data type that contains other types. Types that are within a structured type are called component types.

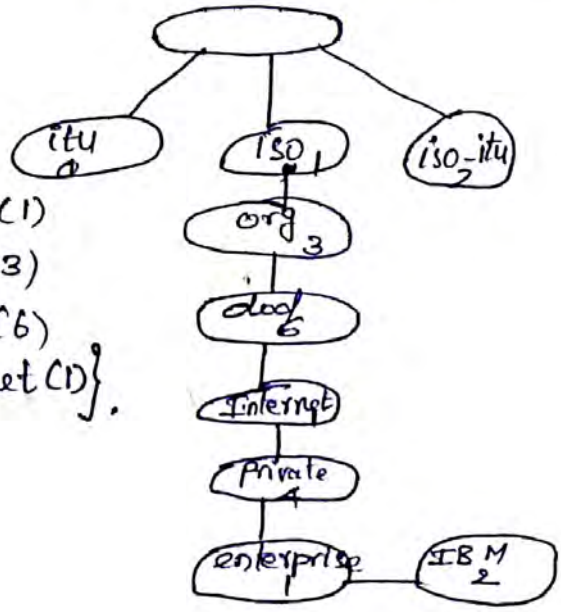
* Tagged type is a type derived from another type that is gn a new tag id.

* Other data type is not predefined one. It is chosen from CHOICE and ANY types, which are contained other types.

3. OBJECT NAMES.

* In a MIB there is an identifier for each occurence of an object.

Internet OBJECT IDENTIFIER ::= {iso(1)
org(3)
dod(6)
internet(1)}.



(7) Explain Information Model with a neat diagram?

* An information model is concerned with the structure and the storage of information. For eg, where information is structured and stored in a library and is accessed by all.

* A book is identified by an International Std Book Number (ISBN). It is a ten-digit number that identifies a specific edition of a specific book.

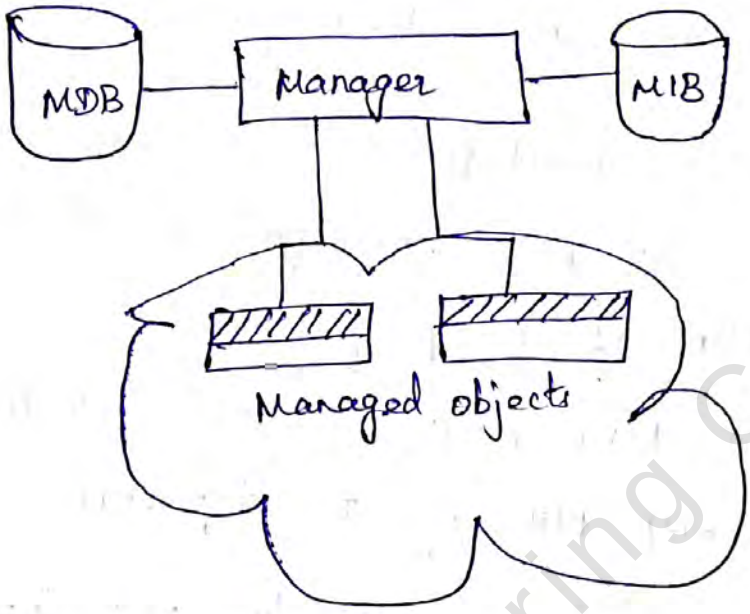
* For eg, ISBN 0-13-437708-7 refers to the book Understanding SNMP MIBs by David Perkins and Evan McGinnis.

* The representation of objects and information relevant to their management form the management information model.

* The information model specifies the information base to describe managed objects and their relationships. The Structure of Mgmt Information (SMI) defines the syntax and Semantics of management information stored in the Mgmt Information Base (MIB).

* The MIB is used by both agent & Mgmt processes to store and exchange the Mgmt information. The MIB associated with an agent is called the agent MIB and the MIB associated with a manager is designated the Manager MIB.

* A manager MIB consists of information on all the n/w components that it manages, whereas an agent MIB needs to know only its local information.



MDB = Management Database

MIB = Management Information Base

▨ — Agent process.

Fig: Network Configuration with Data and Information Base.

① Management Information Tree (Refer 3 question)

② Managed objects perspectives. (Refer 1 question)

→ Distinction between MIB and MDB by Considering the scenario of adding a component to the n/w -

(8) Describe different network management models & standards. (10 marks)

* Network Management is the process of administering and Managing Computer Networks. There are four standards.

1. OSI Model
2. Internet Model
3. TMN
4. IEEE LAN/MAN.

1. OSI Model:

* The open system Interconnection (OSI) Mgmt std. is the standard adopted by the International standards organization (ISO).

* The OSI Management protocol standard is common Management Information Protocol (CMIP), it has built-in services.

* Common Management Information Service (CMIS), that Specify the basic services needed to perform the various functions.

* It Deals with all seven layer of the OSI Reference Model.

* The specifications are object-oriented.
* Both LAN and WANs can be Managed using CMIP/CMIS.
* It consumes large resource in implementation.

Drawbacks.

* It is complex and that the CMIP stack is large.

2. SNMP / Internet:

* Simple Network Management Protocol (SNMP) is truly Simple, as its name indicates.
* It is Industry standard and has since become very much like the standard specifications of a standards-setting organization.
* The Internet Engineering Task force (IETF) is responsible for all internet specifications including network management.
* It is easy to implement
* It is most widely implemented.

3. TMN

* Telecommunication Management Network (TNM) is designed to manage the telecommunications nlw and is oriented towards the needs of telecommunications service providers.

* It is International Telecommunication Union (ITU) is based on OSI CMIP / CMIS specifications.

* It is used to manage telecommunication Networks.

* It is based on OSI network management framework.

* It Addresses both network and administrative aspects of management.

A. IEEE Standards.

* The IEEE standards for LAN and MAN specifications are concerned only with OSI Layer 1 and OSI Layer (2) .{physical & data link layer}.

* It is adopted Internationally.

* The IEEE 802.x series of specifications. defines the standards for the various physical Media and data link protocols.

* The IEEE 802.1 Specifications present overview, architecture and management.

* IEEE 802.2 Standard specifies the logical link control (LLC) layer.

for eg 802.3 specifications for Ethernet LANs

Web-Based Management:

* Web based mgmt, which is based on using web technology, a web server for the management system and web browsers for network mgmt stations.

→ Web-Based Enterprise Management (WBEM)

→ Java Management Extensions (JMX).

UNIT - II
(2 Marks)

① Explain Management operation and Notification?

* The model of CMISE is split into two aspects: command interface to the managed resources and asynchronous reports from managed resources. The former is referred to as operations and the latter is known as notifications.

* Management operation is used to refer to Operations initialed by the management system and management notifications is used for operations initiated by the managed system.

② List the various functional units in CMISE.

1. Kernel
2. Multiple object selection
3. Filter
4. Multiple reply
5. Extended service
6. Cancel get.

(3) List CMISE Services

* Event Report service
* Get Service
* Set Service
* Action Service
* Create Service
* Delete Service
* Cancel Get Service.

(4) Define CMISE

* CMISE is an application service element that defines a common structure for exchanging management information.

* The service and protocol structure are generic making it suitable for managing various resources in telecommunications and data communications networks resources and application such as directory.

(5) Define Scoping.

* The parameter scope is used to capture the a request may be issued to address multiple objects

* If the parameter is not present, the default value in the request is directed to the single object identified in the base object instance.

* If the scope parameter has a value of 2. This implies that all objects relative to the base object that are within two levels of the hierarchy are candidates to perform the requested operation.

* objects that are outside of this scope are not selected.

(6) Define filter feature.

* Database management systems often support the mechanism to request that an operation to be performed. if a criteria is satisfied.

* This criteria is specified in the filter parameter in terms of the test to be on one or more attributes

* The selection using filter parameter is applicable both in the case of single and multiple objects.

(7) Different types of error values.

* Duplication Invocation
* Invalid argument value
* Unrecognized operation
* No such event type
* Processing failure
* Access denied
* No such object class
* No such attribute
* Synchronization not supported
* No such invoke identifier.
* Invalid operator
* Class Instance Conflict.

(8) what is meant by synchronization?

* The synchronization parameter goes hand-in-hand with the scope parameter. Once multiple objects are selected (either using only the scope param. or a combination of scope & filter parameters), this parameter can be used to request that the management operation be performed on a best efforts or atomic manner.

(9) Define functional units service

* Grouping services into units of functionality that are negotiable for use during an association is present in OSI protocols at the session, presentation, and application layers.

* The basic services are grouped together into a functional unit. referred to as Kernel.

(10) what is Naming schema (or) How will you name the object in CMISE.

* The service definitions and protocol specifications indicate that all requests (except create) include the parameter for ident-

a specific managed object. The instance is given a name.

* CMIP standard specifies three choices for the name of the object. These are globally unique name, unique name relative to a known context (local name), and a nonspecific form which is a string of octets.

(11) Define conformance.

* Conformance specifications are defined in terms of static and dynamic requirements.

* The static requirements address the rules associated with CMIP.

* The dynamic requirements are associated with the procedures for exchanging the protocol data unit and handling of optional parameters when used in a PDU exchange.

(12) List out the parameters, that are defined in CMIS during an association.

* functional units
* Access control
* User information

13) what is error.

* when a servile is requested in a confirm mode, a response is sent indicating success or failure in completing the request.

14) Define event Report Servile.

Refer Question No. 3

15) Define Cancel get servile.

Refer Question No. 3

① Explain in detail about protocol specification?

* The Common management protocol (CMIP) is defined for exchanging the management information using the services. The protocol is defined in terms of the request reply paradigm offered by the Remote operation Service Element (ROSE).

* Service offered by ROSE are generic for any application using request/reply based interactions between the communicating systems.

* The generic definition of ROSE are specialized by CMIP for interactions specific to Management applications

* Both ROSE and CMIP are specified using the notation Abstract Syntax Notation one. This is a high-level language for specifying protocol data unit definitions.

ROSE Protocol structure:

* The request/reply paradigm of ROSE is defined using four protocol data units. Those are invoke an operation, reply with successful result of

Performing the operation, respond with error in performing the operation and reject the request because of problems in the data contained in the request or response.

* The invoke Id parameter is used to correlate request with the response. Because ROSE PDUs are generic for any application using the request/reply paradigm, the operation values are not specified even though the syntax is specified.

* The operation value is either an integer or a globally registered value. Depending on the application, values are assigned to the operation.

* The argument field is dependent on the value of the operation. At ROSE level, a placeholder is present for including parameters appropriate to be included in the request.

* The Linker Id parameter is optional and is shown as such by enclosing with a dotted line. ROSE included this parameter in the invocation request to inform the receiver that this is a called child operation.

Invoke Id	Linked Id	Operation value	Argument

(a) Invoke an operation

Invoke Id	Operation Value	Result

(b) Successful response.

Invoke Id	Error Value	Error parameter

(c) Error response.

Invoke Id	Problem. (Invoke pbm, return result pbm, return Error pbm)

(d) Reject a request or response.

* The successful result PDU structure requires that the invoke Id parameter be always present. This is used to correlate the request the response. Depending on the operation, the response may be just an acknowledgement or include result information.

* An error response must include Invoke Id and an error value. The error values are specified with the definition of operation. An error value is an integer with specific semantics.

* Any of the three (invoke, return successful, return error) protocol data units may be rejected

the receiver if invalid. The problem values are grouped into 3 categories as shown below table.

Category	Problem Values	Description.
Invoke Problem.	Duplicate invocation	*Invoke Id used vidates the rules for reuse. There is an outstanding request with the same value. for which a respon
	unrecognized operation	*The operation value is not valid for the application using ROSE.
	Resource limitation	*There are no resources availa to perform the request operation.
Return result problem.	unrecognized invocation	*The result is being retur with an invoke id that doe not correspond to an operati in progress.
	Return response unexpected.	*No response is defined for the operation in questio
Return error problem	unrecognized error	* The error value is not recognized in the contex the application using ROSE
	unexpected error.	* The error values is not valid for the invoked oper

CMIP Protocol structure:

* The various services described for CMISE are supported in CMIP as follows: assigning operation values and associated information in the argument field for invoke, defining the result information if valid for the operation.

Invoke Id	Operation Value	Managed / Base object class	Managed / Base object instance	operation Specific information

Fig: Generic Structure of CMIP request.

* The argument for invoking the operations, the result information and the error appropriate for each operation are specified.

* All operation requests include two parameters Class and instance of an object.

* The operation specific information is either completely defined or placeholders are left for further specification by the network management application using CMIP.

* The get operation is specified or defined in terms of the following components: get argument, information in the argument field of the RO-invoke id,

get result, information in the RO - Result PDU, list of errors values and reference to the linked reply Operation.

* The parameters of get arguments are, base object class, base object instance, access control, synchronization, scope, filter and list of attribute identifiers.

Operation value Assignments in CMIP

Name of service	Operation value.
Error Report	0
Confirmed event Report	1
Multiple Responses	2
Get	3
Set	4
Confirmed set	5
Action	6
Confirmed action	7
Create	8
Delete	9
Cancel get.	10

② List and explain various error value in CMISE.

	Error	Category	Description.
①	Duplication Invocation	General	* Invocation identifier has been reus prior to the completion of a assures that msgs are resent if acknowledge is not received. At the application level resending the same request to account for error in transmission is no expected.
②	Invalid argument value.	Notification and action operation	* Event or action information is not valic for eg, the values of some or all parameters may be out of the defined range.
③	Unrecognized operation.	General	* The requested operation is not one of the CMIS defined servies. (eg. event report, get, set etc).
④	No seech event type.	Notification	* Event type is not defind for the managed object class referrenced in the request.
⑤	Processing failure.	General	* An error has occured when processing the request - This error value without further augmenting does not provide enough information
⑥	Access denied	Management operations	* Depending on the servie, access is denied to reading the attributes,

			accessing the object itself, modifying the attributes or requesting an action be performed. This error is usually considered in the context of security support.
(7)	No such object class	General	* This error is used in management operations if the request refers to a class not recognized by the managed system.
(8)	No such attribute	Create, get and set operations	* The attribute is not recognized by the managed system. This does not mean the attribute does not exist. The object class (or the object instance) selected for the operation does not included this attribute.
(9)	No such attribute	Management operations except Create.	* This error is applicable only when the request is directed to select multiple objects. The type of synchronization requested is not supported.
(10)	No such invoke identifier	Cancel get	* The cancel of the previously issued get operation cannot be completed.
(11)	Invalid operator	Set	* The modify operator specified is not applicable for the attribute specified in the request.
(12)	Class Instance mismatch	Mgmt operations	* This error indicates that there is a mismatch between the name of the class specified in the value of the class specified in

(3) Explain in detail about various services defined by CMISE?

* The service column contains the name of the service primitive. Describing the services in terms of service primitives and parameters associated with each primitive is a common practice at all layer of the OSI Reference model.

* The services corresponding to various remote operations in management are specified using "M" as the first character.

* The service primitive in OSI standards fall into two classes - Confirmed and unconfirmed.

* The confirmed services imply that a response is required as opposed to the opposite case of unconfirmed.

* Services may be used in either confirmed or unconfirmed mode are M-Event-Report, M-set and M-Action. If requested in the unconfirmed mode no respons is generated by the performer.

Service	Type	Description.
M-EVENT-REPORT	Confirmed /unconfirmed	Report an occurance of an event to another open system.
M-GET	Confirmed	Retrieve attributes and their values from managed objects.
M-SET	Confirmed /unconfirmed	Modify attributes values of managed objects.
M-ACTION	Confirmed/ unconfirmed	Request an open s/m to perform an action on managed objects.
M-CREATE	Confirmed	Request an open s/m to create a new managed object.
M-DELETE	Confirmed	Request an open system to delete managed object.
M-CANCEL-GET	Confirmed	Request to cancel a previously invoked M-GET service.

Event Report Service:

* It is used to report an occurence of an event emitted by a managed object to another open system.

* Invoke identifier is used in all CMISE Service to identify a specific request. The same value must be present in the response., correlation can be done between multiple requests and responses.

* The mode parameter in the request column specifi if the event report is to be sent requesting confirmatio

* If the event report is confirmed, this implies an acknowledgement is requested from the receiving syste This parameter is not applicable in the response.

* The parameters managed object class and instan together identify the resource emitting the notificatio The class defines the type of resource and the insta identifies the specific entity emitting the notification

* The event type parameter identifies the type of event. Example of event types are communication ala state change, and object creation. If the event type error is generated if the event type is not defined for the class.

* Event time indicates the time of occurance of the event. This parameter is optional.

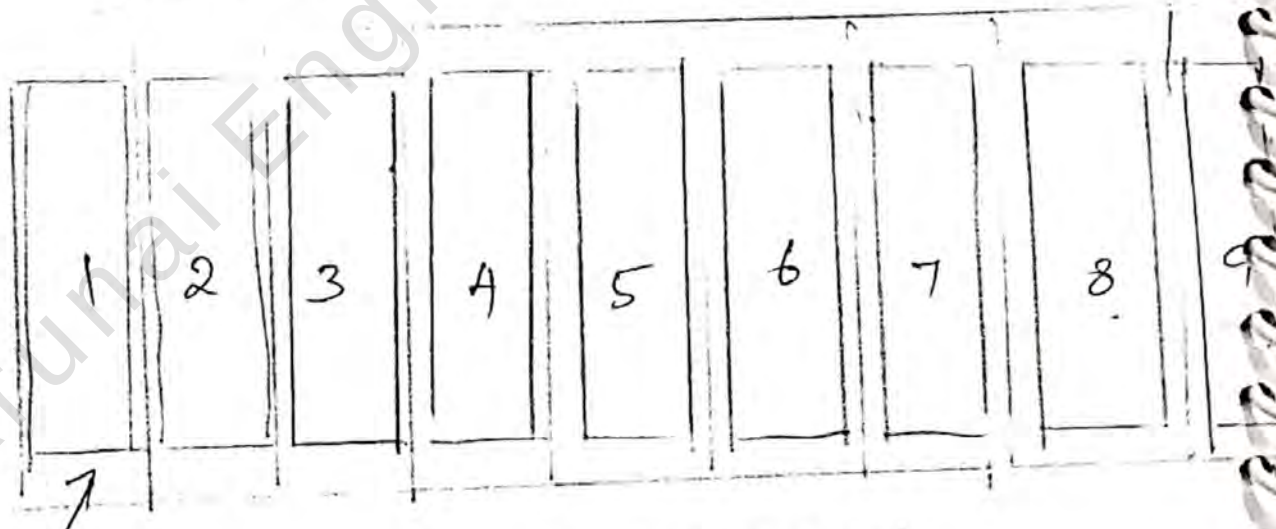
* The event information, though identified as U, falls into a different class of optionality. Then the event time.

* The current time in the response in the respons is sent optionally to time stamp the response.

Parameter Name	Req/Ind	Rsp/Conf.
Invoker identifier	M	M(=)
Mode	M	–
Managed object class	M	U
Managed object instance	M	U
Event type	M	C(=)
Event time	U	–
Event information	U	–
Current time	–	U
Event reply	–	C
Errors	–	C

M - Mandatory
U - User option
C - condition.

Network Element Id="ACME"



1. E1 Card
2. Protecting E1 card
3. Controller card
4. Time slot Enterchange card
5. Protecting TSI Card
6. Power supply card
7. Protecting power supply card
8. Transport card
9. Protecting Transport card

2. Get service:

* The Confirmed service enables the invoking open system to retrieve the attribute value of one or more managed objects from the managing system.

* This service by definition is a confirmed service where the request is not complete until a response is received.

3. Set Service

* This service enables the invoking open system to request modifications of the attribute values of one or more MOs in another open system. This service may be used as confirmed or unconfirmed service.

Example Use of M-SET service.

Parameter Name	value.
Invoke Identifier	5
Mode	Confirmed
Base object class	Circuit pack
Base object Instance	{equipmentId = A equipmentId = "75ICN"}
Modification list	{
Attribute Id	administrative state
value	locked
Modify operator	replace }.

4. Action Service:

*This service enables the invoking open s/m to request another open system to perform an action on more MOs in another open s/m.

*The action to be performed is defined as part of the information model for the resources.

5. Create service:

*This Confirmed service is used to request the creation of a new MO in the managed open system.

*Unlike the get, set and action services which may be directed to multiple objects, create has been defined to allow only one object to be created.

6. Delete service:

*This service is used to request that the managed objects in managed open s/m deletes one or more MOs. This service is confirmed service.

7. Cancel Get Service:

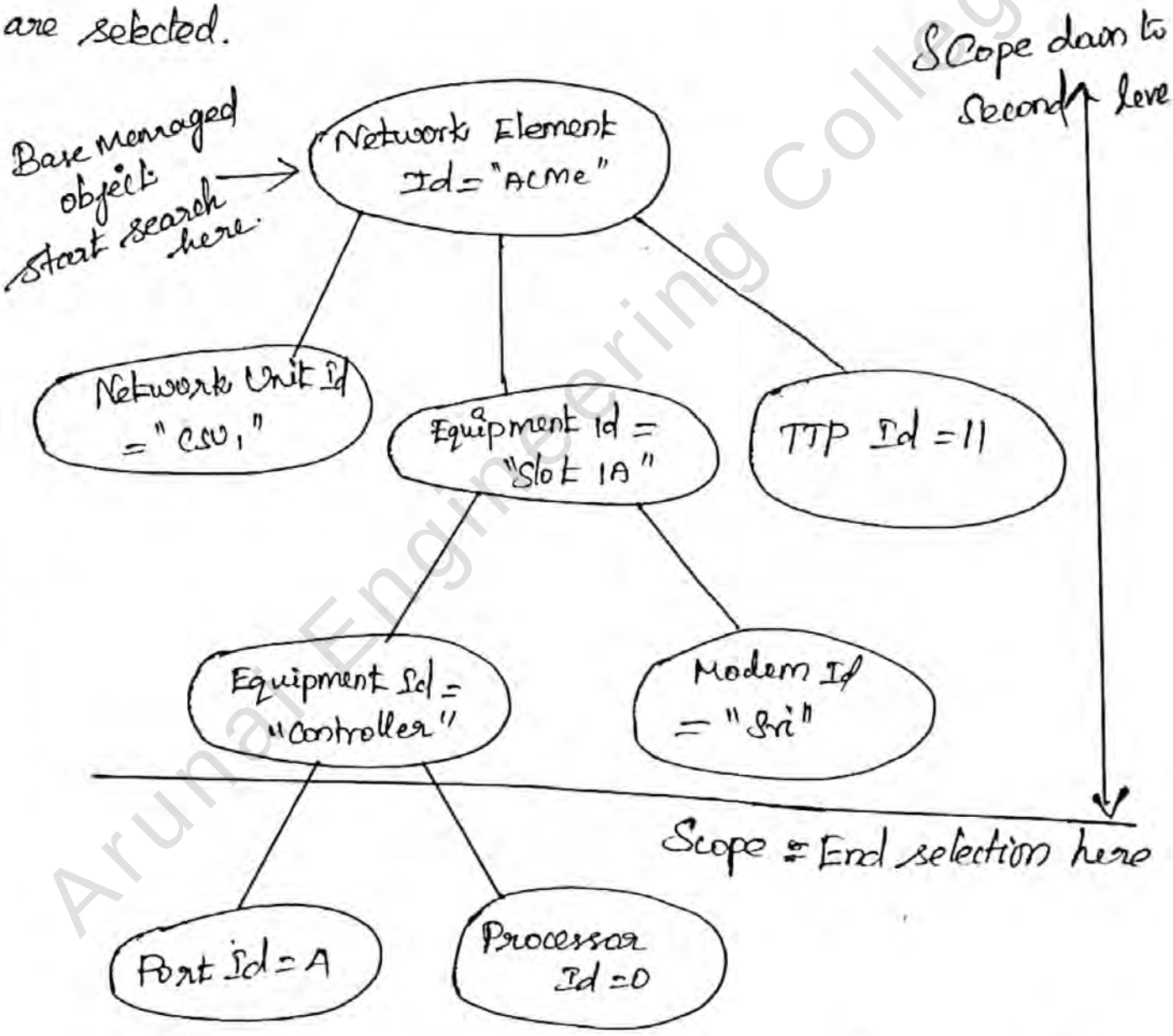
*This confirmed service is used to cancel a previously requested M-GET service for which the complete response has not been received. This service is meaningful to use in the following case:

Parameter Name	Req/Ind.	Res/Conf.
Invoke identifier	M	M(=)
Get invoke identifier	M	—

(A) Explain in detail about scoping and filtering feature?

* The parameter scope is not present, the default value in the request is directed to the single object identified in the base object instance.

* In order to understand how multiple objects are selected.



* The objects in the figure are shown as ellipse The value of the attribute used for naming the object is shown inside the text.

*In this example, the network element named as "Acme" contains one slot. The slot can hold two cards each one of which may be managed independently. One card is a controller card, and the other card performs modulation / demodulation of the transported signal.

* Another object considered as part of the network element is a subscriber unit located close to the customer.

* Using the tree every object gets a unique name.

* The Scope parameter in the above example has a value of 2. This if implies that all objects relative to the base object that are within two levels of the hierarchy are candidates to perform the requested operation.

* Object that are outside of this scope are not selected. If there is no further criteria to eliminate any of the object, then everyone with in the scope will perform the operation.

* The base object in the request may start at any point in the tree. If a managing system wants to retrieve the names of the all the cards contains in slot 1A, then the base object shall

be set at the object representing the specific slot.

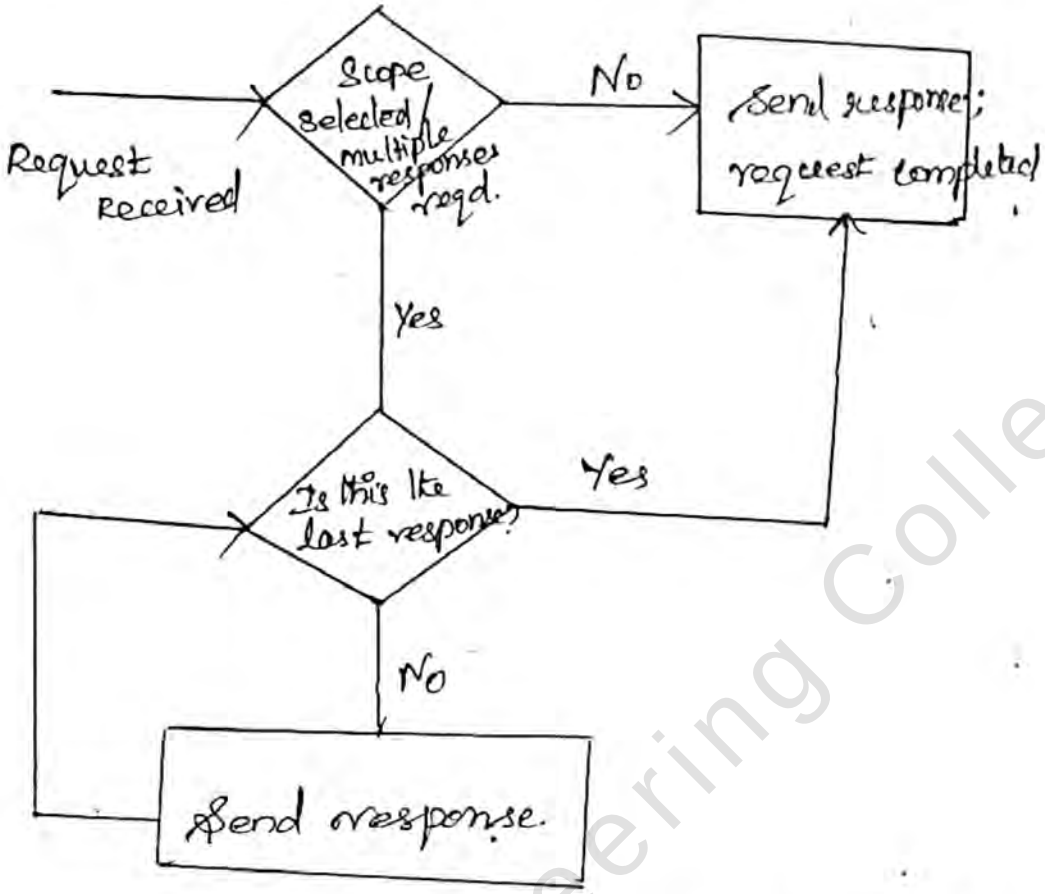


Fig: Flow diagram for multiple responses

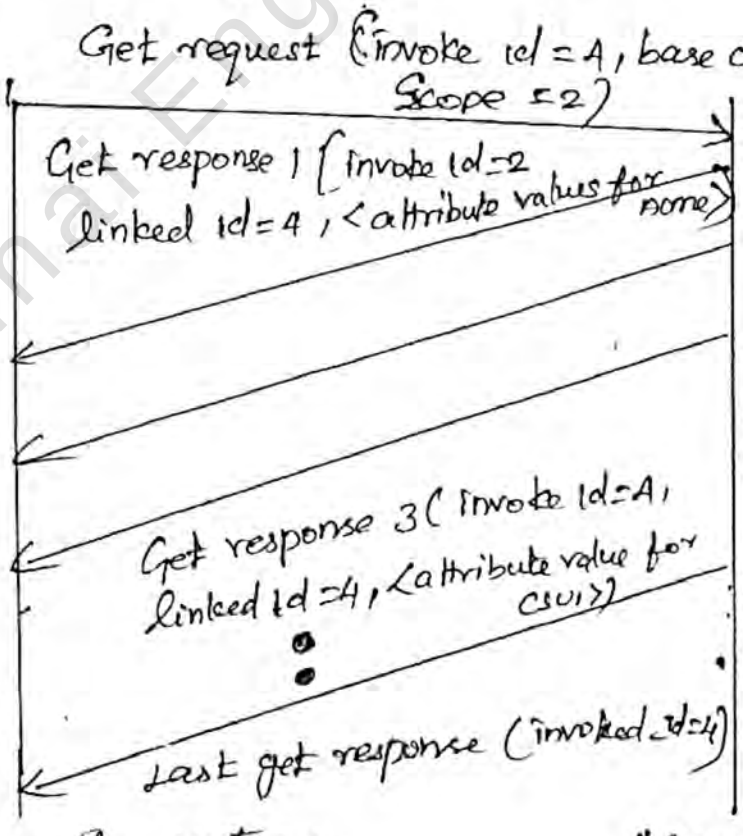


Fig: Correlation for multiple response to requests.

Filtering Parameter:

* Database management systems often support the mechanism to request that an operation be performed if a criteria is satisfied.

* The criteria is specified in the filter parameter in terms of the test to be one or more attributes.

* These tests are grouped as a logical expression using zero or more of the following operators — and, or, not.

→ Is the value of the attribute equal to a given values?

→ Is the value greater than or less than a given value?

→ Is attribute present or absent?

→ Are the values a subset or superset of the given set of values?

→ Is the intersection of the given set with the attribute an empty/non empty set.

* If the result of the testing yields a true value then the operation is performed on that object.

* The selection using filter parameter is applicable both in the case of single and multiple objects.

* The scope parameter indicates the subtree is to be included in the search. This implies the filter Criteria is to be applied on all the objects in the subtree.

{ (object class = equipment AND vendor name = "ADC")
OR (object class = processor AND operational state = disable
}

* Combining scoping and filtering features offers a powerful object selection mechanism with CMISE which is not available with other network management protocols.

* These features are very useful in network elements where there are several instances of objects such as termination points for the incoming and outgoing signals.

UNIT – III

PART-A.

① What is Management Information Model?

* A mgmt Information model defines the schema for the information visible across an interface between the managing and managed systems.

* The pharse "information model" has been used sometimes to identify the model of a specific function for a specific technology or a group of functions as applied to one or more resources

② What is MIB & DIB?

MIB

* A collection of instances represented in accordance with the templates for the corresponding resource types forms a respository. This repository in the case of mgmt is called Mgmt Info^n Base (MIB).

DIB

* Info^n models have been used in other applns even though details differ based on the appln. A repository of instances in the case of directory appln, for eg is know as Directory Info^n Base (DIB

(3) Define the term structure of mgmt Information?

* The term structure of mgmt Information (SMI) is used in both OSI mgmt based applications as well as in Internet n/w mgmt.

* Even though there are differences in modeling principles, the fundamental goal remains the same in both cases - the concepts and techniques used to represent how mgmt information is structured for developing an interoperable interface.

(4) what is Managed object class?

* A resource may be physical or logical. Taking the example of the channel unit, different instances of channel units may exist from multiple suppliers.

* The schema of a channel unit applicable to multiple instances is defined as managed object class.

(5) Define packages.

* A package is just a substructure and is a collection of characteristics (behaviour, attributes, operations and notifications). for the managed object class.

* A managed object class in turn consists of one or more packages. When a package is included as an instance, all properties of the package are made available

(6) What is conditional and mandatory package?

* A mandatory package, "as expected", includes properties that are always present in every instance of that class.

* A "conditional package", "on the other hand, defines a group of properties that are included in an instance when a condition is satisfied.

(8) What is behaviour and attribute?

*Behaviour definitions may be included at different levels – package, attribute, action, notification and attribute group.

*They describe the semantics and Integrity constraints associated with that level.

Attribute

* The characteristics of the resources that are present for the lifetime of the object are modeled as attributes

* An attribute is defined by the combination of identifier and value assigned to an occurrence of it in a managed object.

(9) List the types of Attribute Group.

They are two types of attribute group.

① fixed
② extensible.

Fixed

* The fixed group is formed by an explicitly defined set of attributes.

* An example where a fixed group may be used is in performance monitoring.

Extensible

* The extensible group, as it to be expected, refers to a collection of zero or more attributes where new members may be added after the group is defined.

(10) What is NMS?

* Nlw mgmt s/m is appln or set of appln that lets nlw administrators manage a n/w's indepen components inside a bigger nlw mgmt framework.

* NMS may be used to monitor both s/w & h/w

PART-B

(1) What is object oriented paradigm and explain it in detail.

Object Oriented paradigm:

* The message based approach is simple and has been widely deployed, it lacks rigor in specification. The msg defines only what is exchanged across an interface.

* The object oriented approach, concentrates on all the properties and allowed operations from the perspective of the resource instead of what is transfered across an interface.

Object-oriented Methods:

* O-O Methods have been accepted since mid-1970 for developing information models in many areas such as distributed processing, S/w development, telecommunications and data comms mgmt, directory services and msg handling systems

* Today in the industry three O-O methods are prevelant for object-oriented analysis & design.

*Booth 93
* Object Modeling Technique (OMT)
* Object oriented Software Engineering (OOSE)

→ The OOSE Method defines usecases to describe business level requirements and analysis. The usecase cases have been adopted in defining the business level requirements on within Network Mgmt fourm.

→ The OMT approach is suitable for data intensive applications. Bcos the mgmt information models are data intensive, a mapping is provided by NMF b/w the representation technique used in n/w mgmt stds and OMT.

→ Booch '93 approach is found to be more suited for the design phase and has been applied in engineering intensive applications.

→ The Fundamental concepts used in developing object-oriented models are encapsulation, modularity, extensibility and reuse.

Encapsulation:

* In O-O Methodology, unlike the structured Methods provides an abstraction that combines data and functions that use the data and operate on them into an object.

* The channel unit represented as an object encapsulates all the relevant properties visible to the management interface.

* Irrelevant details such as the signaling pattern not relevant to mgmt are supressed, thus providing mgmt abstruction.

* Encapsulation is associated with how the object is responsible for maintaining the integrity of the encapsulated data when it receives requests to perform an operation.

Modularity:

* The O-O Methodology naturally lends itself to modular specifications. In defining objects, one encounters the issue "what constitutes an object". This is often subjective and depends on how modular the specification should be thus providing for flexibility and future extensions.

* This approach offers a simple model where one object has all the information for the functio identified at a given time.

* However this is not a modular specification and does not apply the advantage of the O-O methodology effectively.

* The disadvantage with the simple model is it makes it difficult to use the equipment terminating at the network interface for another application. for eg, to determine the usage on the subscriber line.

* Another disadvantage is if the traffic measureme are to be discontinued for a period of time.

* A more modular specification is to collect the traffic measurement parameters together as a sepa object and define a mechanism to relate to the corresponding objects.

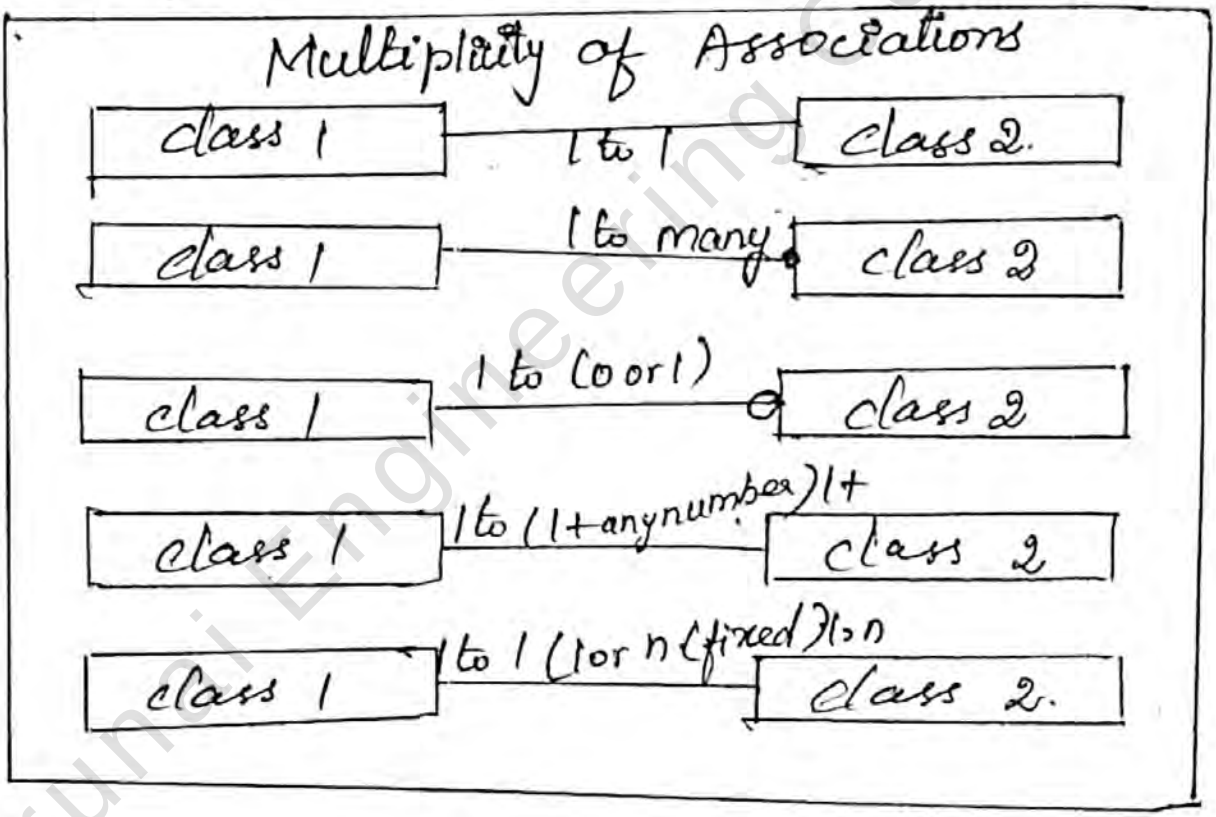
Extensibility and Reusability:

* Extending a specification implies building on existing specifications. The original definition of the object is reused and extended to includ new parameters.

* Reusability at the specification level can also be extended to software development of the objects

Relationships:

Relationship b/w objects:



* The type of the object is referred to as class.
* The association between these 2 object classes may be one to many bcos a channel unit can support, for eg, 4 subscribers.

(2) Explain the Types of operations directed at the object Interface in detail?

* An object - oriented design methodology defines interactions with the object in terms of the operations issued at the object boundary.

* These operations directed at the object i/f are further classified into object - oriented attribute oriented operations -

1. Attribute oriented operations

* The following operations are possible on an attribute which may be either single valued or set valued: read, replace.

* Replace with any appropriate value, replace with a default value.

* Read only but may be set at creation time. In the case of set valued attributes, operations to add and remove members to the set.

* It is also allowed to specify an attribute such that once defined for an object class it may be allowed to be modified in any specific

* Attribute - oriented operations are specific to reflect whether, in the context of a specific managed object (or) the value of an attribut is read only.

* It is possible that the same attribute may be allowed to be modified within one managed object class, and this operation is not permitted in another object class.

* Consider the following eg to illustrate how the same attribute may be defined with different operations.

* The performance monitoring (PM) parameter such as severely errored seconds are modeled as attributes.

* Two classes of objects are defined to contain the PM parameters. One class, called current data is used to contain the values corresponding to the current collection interval and another class, history data contains values collected in the previous interval.

* When an attribute is default, a value for that attribute is not provided in the create request. An operation associated with the default value is "replace with default".

* When an attribute is set valued, two other operations in addition to those mentioned earlier as possible. These are adding and removing values to the set.

* Adding an existing value while not an error will not include a second copy. Similarly, removing a non existing value is not considered an error.

* When an attribute-oriented operation is requested, errors may be defined to explain failure to complete the request.

* The errors may be generic such as the Invalid value provided in the request or specific

* Depending on the attribute and the resource being modeled, the package specification includes all possible operations.

2. Object-Oriented operations

* Request to create or delete an object and perform an action are considered object-oriented operations.

* The request to create an object is not directed at the object itself as this does not exist until the object is created.

* There are 3 object-oriented operations

1. ACTION
2. CREATE
3. DELETE.

1. ACTION:

* Action definitions are used to model operations that a resource is capable of performing when requested by the Management system.

* The definition is specified using an action type, information sent with the request to perform the action, response data if any & behaviour describing Constraints and conditions to perform the action.

* Multiple responses may be required in some cases when performing the action. Errors may also be defined if the action is not executed successfully

→ eg; when performing a test to indicate the progress of the test and conclude the final response with a pass / fail indication.

2. CREATE.

* The object level operation create is used to instantiate an object following the schema definition for that specific class.

* A create operation, unlike action and delete cannot be directed at an existing object.

* Even though many of the object oriented modeling techniques include creation of the object as part the schema for the class.

* The object class schema does not include create. The creation operation is defined as part of the rules for naming.

* The result of this separation of the create operation from the class definition is to offer flexibility in how an object is created depending on the environment, physical architecture and policies

3. DELETE:

* The delete operation is used to remove an instance of a class from the managed s/m. Similar to create, this operation is also not defined as part of the class definition.

* Deletion of an object may result in one of the following cases; The object and all its contained objects are deleted or it is deleted only if there are no objects included in it.

Eg * The network unit contains equipment holder and circuit packs. If the network unit is deleted, then either the containing equipment holder and circuit pack objects are deleted or as long as the equipment holders and circuit packs are present, the deletion request is rejected.

* Behaviour and error specifications may be included with the delete operation definition

(3) what is a management information model and explain it in detail?

Management Information Model

* A management information model defines the schema for the information visible across an interface between the managing and managed systems.

* The phrase "information model" has been used sometimes to identify the model of a specific function for a specific technology or a group of functions as applied to one or more resources.

* An information model is associated with several of the functions. For eg, the logging functions define a model to manage a log and the records contained in them.

* A mgmt information model addresses only information that is relavent within the management context.

* The modeled resources may be physical (a line card, video module) or logical (log, cross connection map).

* For eg: Logging alarms in a log facilitates the mgmt sln to retriere history information. The log itself is not used for providing a telecommunication service but a mgmt service.

* The two types of mgmt abstractions are sometimes distinguished by using the terms managed object and support managed object.

Managed Properties for channel units.

Property	Representation	Example Value.
channel unit Id	Integer	0
Vendor name	Printable string	"LGR"
Type	Printable string	"POTS and DOTD"
Number of ports	Integer	A
Assigned ports	Integer	2
Working status	Boolean (Yes/No)	Yes
Replaceable	Boolean (Yes/No)	Yes
Alarm status	Critical(0), major(1), minor(2), clear(3)	3
Version	Printable string	"Version 1.5"
Serial Number	Printable string	"LGR-PART_loss"

* An information model may therefore be considered as a representation for the collection of resources and functions) to meet some requirements for an application, the specific case here being network mgmt.

* A channel unit is identified by the value of channel unit Id in order to distinguish one from another in the n/w element.

* The CU is developed by a supplier as indicated by vendor name. The channel unit can be used to offer services to four subscribers.

* The type of channel unit contains this info. The channel unit operating or not is determined from the value of working status.

* The replaceable property indicates the CU to be changed as a unit instead of its components.

* The alarm status is used to denote if there are any outstanding alarms on the channel unit.

* If a channel unit has a failure, the working status combined with alarm status may be used to determine the corrective action.

* The channel unit may be tested by perform a loop back test where a specific stream of data is sent and if this stream is received with no errors then the channel unit is considered to be functioning correctly.

* In above fig 2 columns may be considered to specify a template to represent the management abstraction of a channel unit.

* A collection of instances represented in accordance with the templates for the corresponding resource types forms a respository. This respository in the case of mgmt is called Mgmt Information Base (MIB).

* Information models have been used in other applications even though details differ based on the Application. A respository of instances in the case of directory appln. is known as Directory Information Base. (DIB).

(4) Explain in detail about managed object class diagram.

Managed object class.

* A resource may be physical (eg. equipment holder, circuit pack, video tap) or logical (e.g. cross connection, or customer line, call forwarding features).

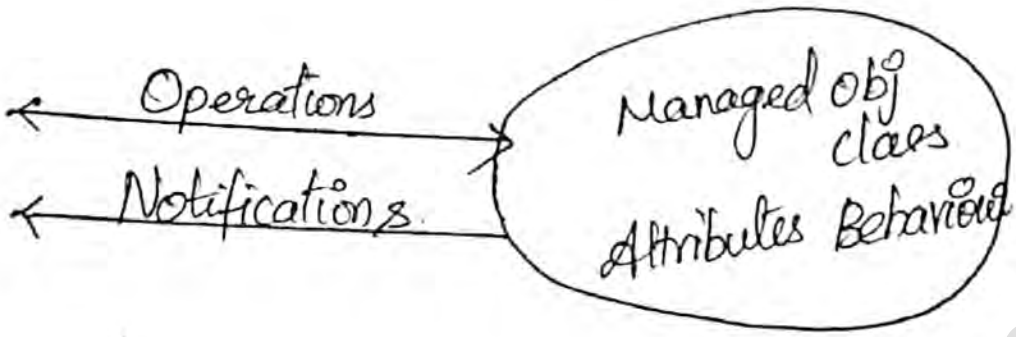
* Taking the eg of the channel unit, different instances of channel units may exist from multiple suppliers. The schema of a channel unit applicable to multiple instances is defined as a managed object class.

Class Versus Instance:

* A managed object class is defined in terms of the characteristics that are present in multiple instance of that class.

* The properties are defined using a substructure called packages. Leaving aside for simplicity this substructuring mechanism, an object class is determined by the operations it supports, notifications emitted, attributes & behaviour.

Managed object class.



* The object class is characterized by behavi of the management aspects of the resource, attributes that assume different values during the existence of the object.

* An eg is a state attribute that indicates if the resource is working or not.

* Notifications such as an equipment alarm to indicate the failure of the resource or a state change are used to describe events emitted by the resource.

* Requested operations may include a request to perform a test and returning a response after the test is executed by the resource.

* Taking the eg of channel unit, it can be represented by a managed object class called circuit pack.

* Different instances of a circuit pack may represent not only different channel units, but also other types of cards - processor, line interface power unit, cards that performs cross Connection.

* The template for circuit pack with a set of characteristics, referred to as attributes.

* The behaviour definition is not shown in the fig. The template also includes a notification called equipment alarm and an action operation called reset.

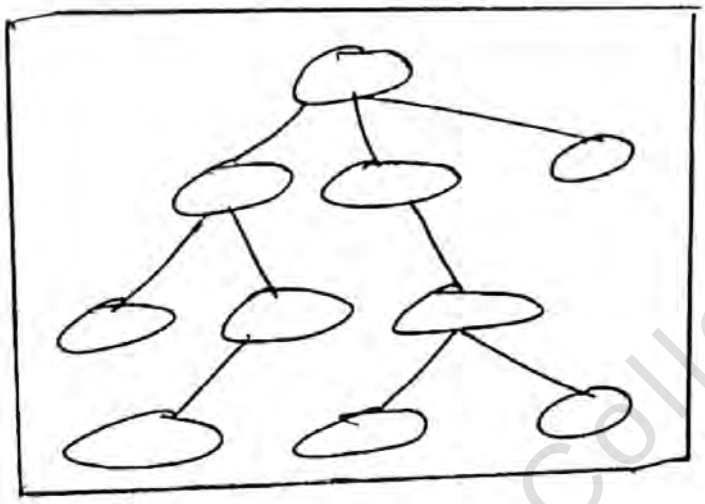
Management Information Base.

* The managed object class definition is part of the information model. Managed objects are created in a s/m to represent the resources managed according to the managed object class definition.

* For eg, in TMN a no. of circuit pack objects may be created to represent the various cards, channel units in the s/m.

* The respository of these managed objects in a s/m like an NE is called MIB.

Management Information Base representation



* Even though the MIB is shown as a tree. this is not strictly correct. An MIB includes all the mgmt information which is a collection of the managed objects and the info contained in them.

* The tree structure is conventionally used bcos it represents the managed objects arranged according to how they are referenced or named

* Both the schema and the repository of instances with values assigned to the data items are both referred to as MIB.

* This is possible bcos of the simple modelling principles used to define the schema.

UNIT - IV

PART - A.

① What is organization model in SNMPV1?

* The initial organization model of SNMP management is a simple two-tier model.

* It consists of a network agent process, which resides in the managed object, and a network manager process, which resides in the NMS and manages the managed object.

* Both the manager and the agent are software modules. The agent responds to any management system that communicates with it using SNMP.

② Mention the aspects of SNMP communication Model.

⇒ There are four aspects of SNMP communication model.

① Architecture
② Administrative model (It defines data access policy)
③ SNMP protocol.
④ SNMP MIB

(3) Write the goals of the SNMP architecture.

⇒ There are 3 goals of the architecture in the original specifications of SNMP.

i) It should minimize the number and complexity of management functions realized by the management agent.

ii) It should be flexible for future expansion.

iii) The architecture should be independent of architecture and mechanisms of particular hosts and gateways.

(4) Define community MIB View.

* A network element comprises many managed objects, Both standard and private.

* However, a management agent may be permitted to view only a subset of the network elements managed objects. This is called the community MIB

(5) Define Community Profile.

* The SNMP agent has a MIB View of objects associated with a network element.

* In addition to the MIB View, each community name

is also assigned an SNMP access mode, either READ-ONLY (or) READ-WRITE.

* A pairing of SNMP MIB views with an SNMP access mode is called a community profile.

(6) Define Community and Variable binding?

Community

The pairing of two entities is called an SNMP Community. The SNMP Community name, called the community, is specified by a string of octets. Multiple pairs of can belong to the same community.

Variable binding

A managed object is a scalar variable and is simply called a variable.

Associated with the variable is its value. The pairing of the variable and value is called variable binding (or) VarBind.

(7) Classify structure of mgmt information in SNMPV2?

SNMPV2 is divided into three parts:

1) Module definitions

*) Object definitions
*) Notification definitions

*) Module definition describe the semantics of an information module and are formally defined by an ASN-1 macro, MODULE-IDENTITY.

* Object definitions are used to describe managed objects .. OBJECT-TYPE. Conveys both syntax and semantics of the managed objects.

* Notification definition is specified by an ASN.1 macro, NOTIFICATION-TYPE, and conveys both its Syntax and semantics.

8. What are all the information models that are defined in SNHPV2?

There are 3 kinds of information modules

i) MIB modules
ii) Compliance statements for MIB modules
iii) Capability statements for agent implementation.

Thus, if a network component vendor claims that it management agent is SNHPV2 Compliants,

these groups as they are defined in SNMPV2 should be implemented.

9. What is meant by sparse dependent table?

The possible scenario in appending an aggregate object to an existing aggregate object is the case where the augmented table has fewer rows than that of the base table. This is called a sparse dependent table.

10. Write the uses of textual conventions?

Textual conventions are designed to help definition of new data types following the structure defined in SMIV2.

It is also intended to make the semantics consistent and clear to the human reader.

The new data types could have been created using new ASN.1 class and tag, the decision was made to use the existing defined class types and apply restrictions to them.

11. Draw the configuration of SNHPV2 proxy server?

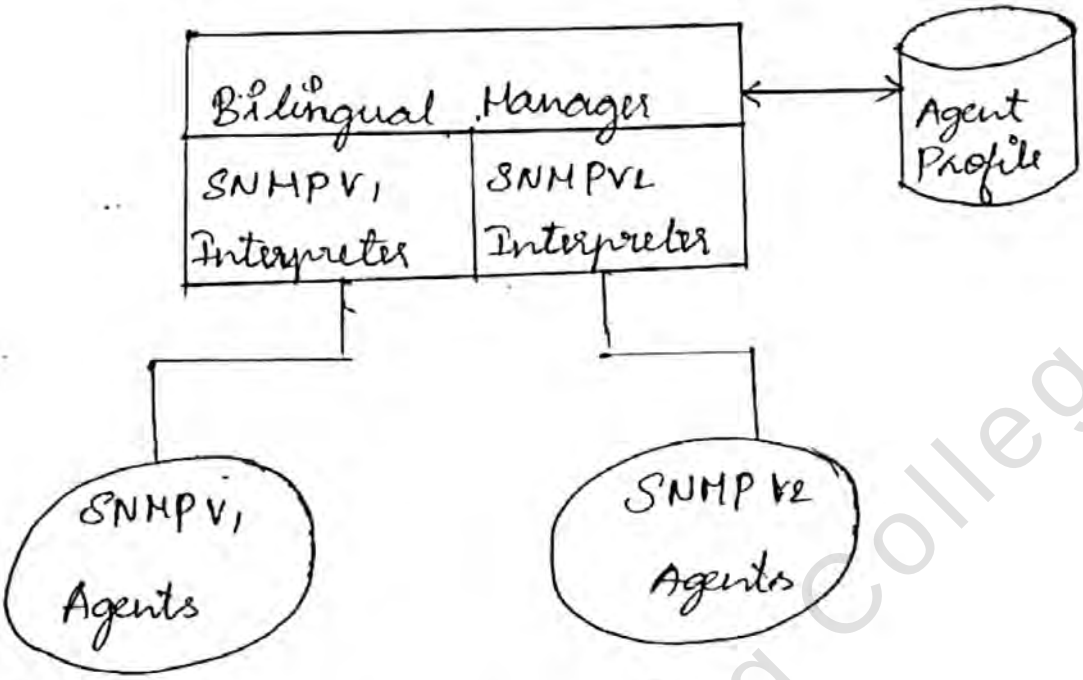


Fig SNMP Bilingual Manager

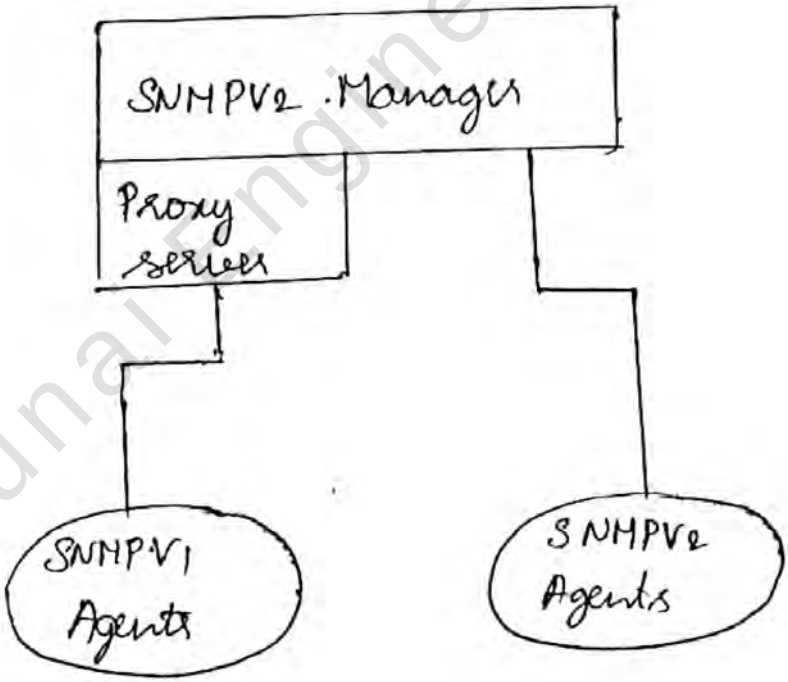


Fig SNHPV2 proxy server Configuration

12. Write the functions of SNMP V3

* There are 3 sets of functions.

⇒ 1. It sends msg to and receives msgs from the network.

⇒ 2. It determines the version of the msg and interacts with the corresponding MPM.

⇒ 3. It provides an abstract interface to SNMP applications to deliver an incoming PDU to the local application and to send a PDU from the local application to a remote entity.

13. Mention the application of SNMPv3.

There are five types of applications in SNHP

* Command generator
* Command responder
* Notification originator
* Notification receiver
* Proxy forwarder.

14. Discuss what is proxy forwarder?

* The term "proxy" is used to refer to a proxy forwarder application that forwards SNHP

requests, notifications, and responses without regard for what managed objects are contained in those messages.

* The proxy forwarder handles four types of messages: message generated by the command generator, Command responder, notification generator, and those that contain a report indicator

15. List the protocol operations in SNMPV2!

* The message, get-request, get-next-request, set-request and get response are in both SNHPV1 and SNMPV2 versions.

* Two additional messages that are in SNHPV2 which are not in version 1, are the GetBulk Request and Inform Request.

UNIT-IV

PART-B

(1) What is RMON? and explain it in detail.

Def.

* The Monitored Information gathered and analyzed locally can be transmitted to a remo nlw mgmt station.

* In such a case, remotely monitoring the nlw using a probe is referred to as remote nlw Monitoring or RMON.

⇒ There are two remote LANs, one a token ring LAN and another, an FDDI LAN, connected to the backbone nlw.

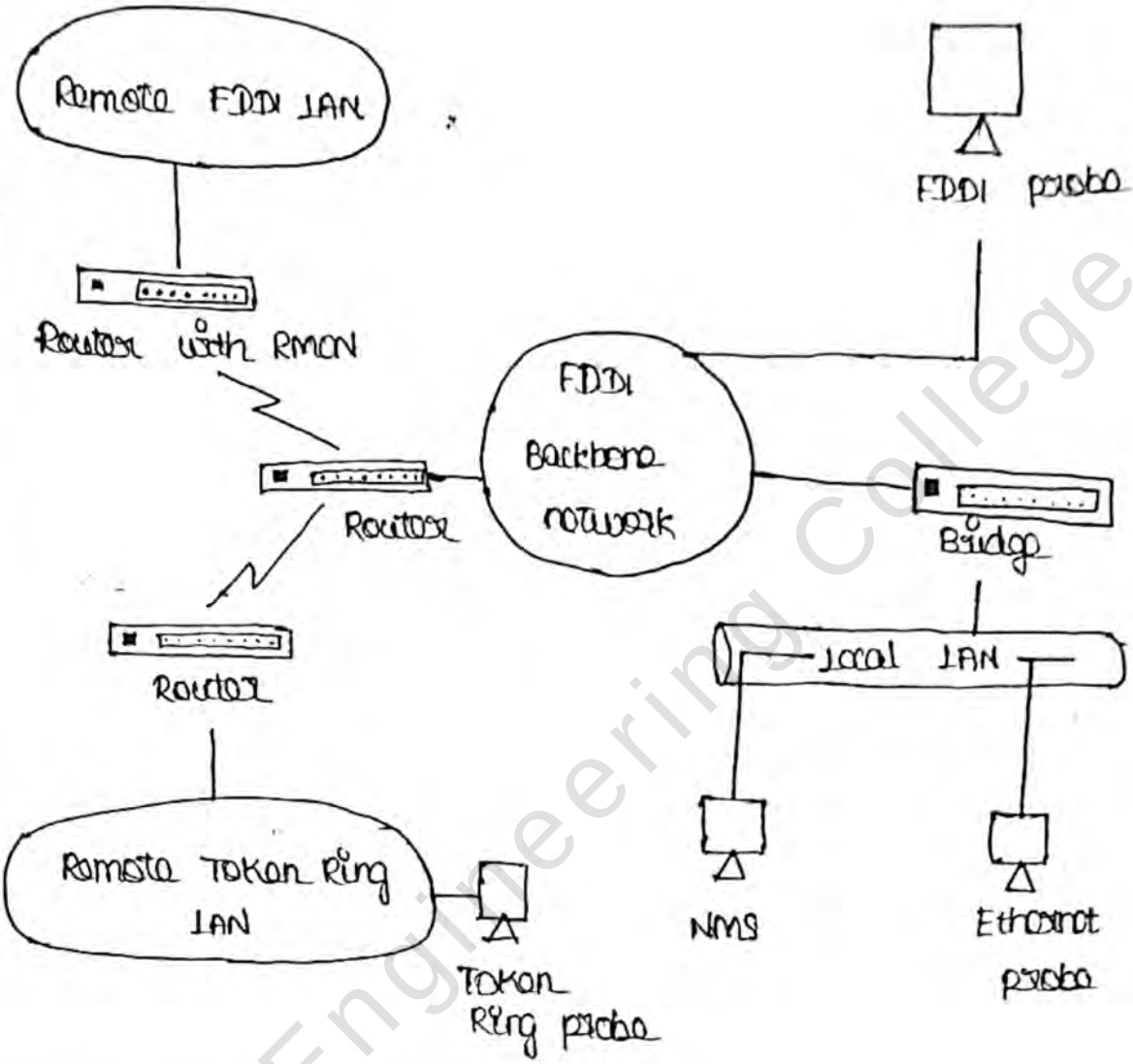
① The nlw mgmt s/m (NMS) is on the loca Ethernet LAN. There is either an Ethernet probe or an RMON on the Ethernet LAN monitoring the local LAN.

② The FDDI backbone is monitored by an FDDI probe via the bridge and Ethernet LAN.

Advantages

* Each RMON device monitors the local network segment and does the necessary analyses.
* It relays the necessary information in both solicited and unsolicited fashion to the NMS.
* If it detects an abnormal condn, such as heavy packet loss or excessive collisions, it would send an alarm. Bcos the polling is local, the information is more reliable.
* RMON reduces the necessity of agents in the n/w to be visible at all times to the NMS.
* Local monitoring using RMON is that individual segments can be monitored on a more continous basis.
* The overall benefits of implementing RMON technology in a n/w are higher n/w availability for users and greater productivity for administrators.

N/W Configuration with RMON.



RMON SMI AND MIB.

* The communication of n/w mgmt information stds need to be established for common syntax and semantics for the use of RMON devices.

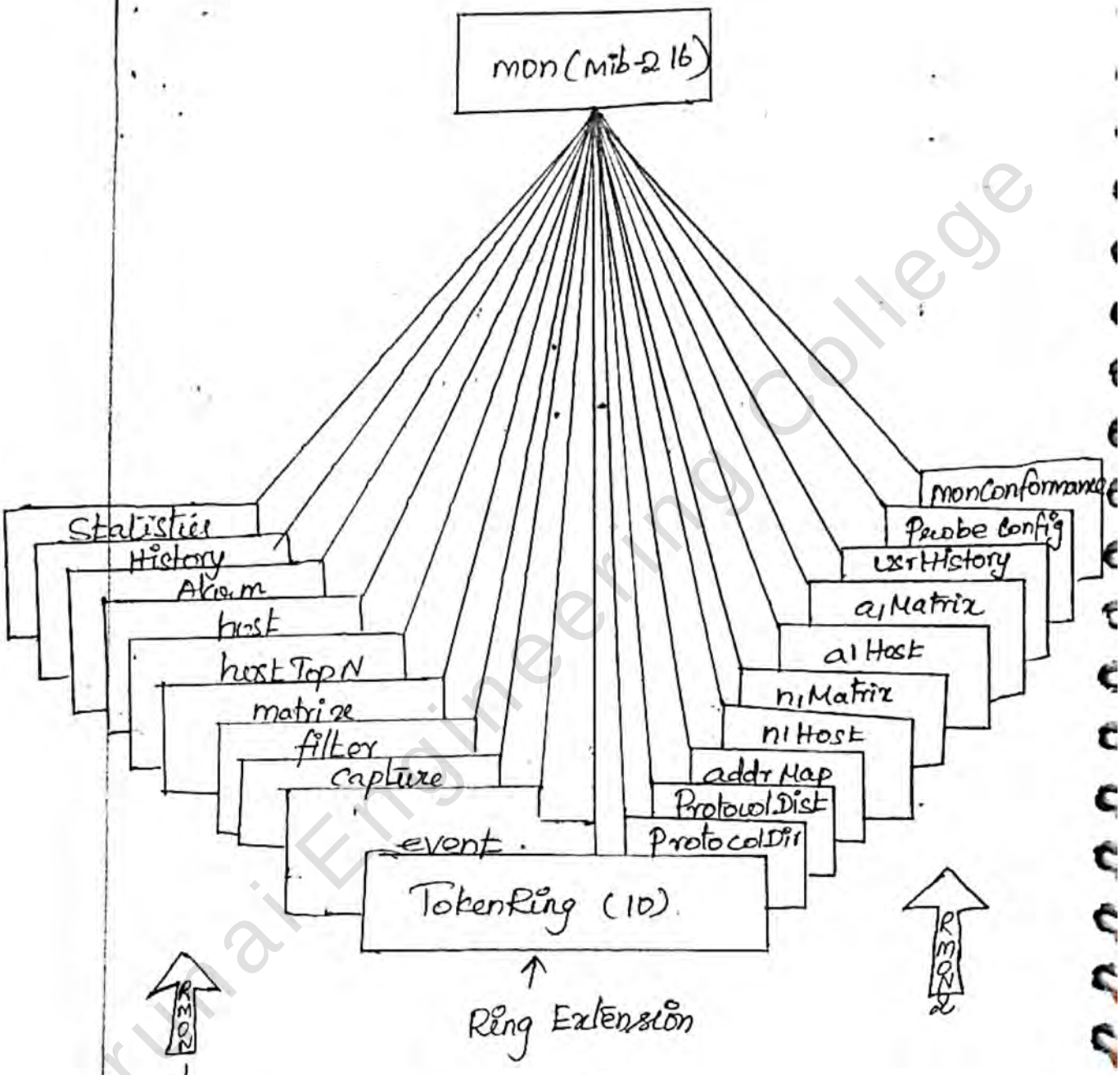
* RMON groups has been developed and defined in 3 stages.

① RMON MIB ② Token-Ring Extensions to RMON 1.

③ RMON 2.

RMON1

There are 2 data types introduced as textual conventions and ten MIB groups.



RMON1 Textual Conventions

* Two new data types that are defined in RMON1 textual conventions are OwnerString and EntryStatus.

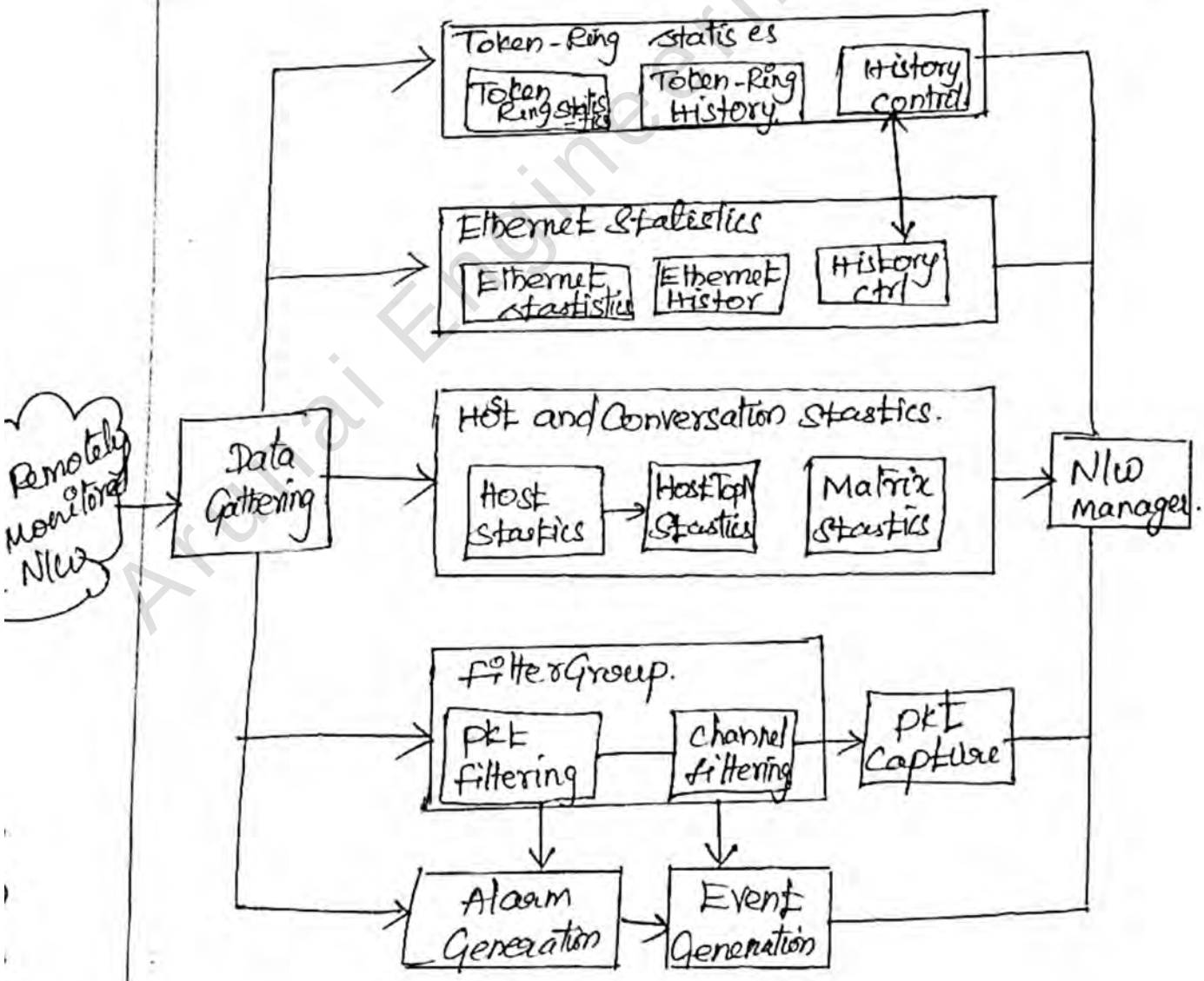
* The owner identification is made part of the ctrl table defined by the OwnerString data type.

* The EntryStatus is used to resolve conflicts between mgmt stn in manipulating ctrl tables.

* The information content of OwnerString contain information about the owner : IP addr, mgmt station name, nlw manager's name, location or telephone no.

* The Entry Status data type can exist in one of four states : (1) Valid (2) CreateRequest (3) UnderCreation (4) inValid.

RMON, Groups and functions.



→ The data can serve as i/p. to 5 sets of functions. Three of those comprise monitoring of traffic statistics.

→ The host and conversation statistics group deals with traffic data associated with the hosts, ranking of traffic for the top N hosts and conversation b/w hosts.

RMON 1 Common and Ethernet Groups:

① Statistics Group ② History Group ③ Alarm Group
④ Host Group ⑤ Host Top N Group ⑥ Matrix Group
⑦ Filter Group ⑧ packet capture Group ⑨ Event Group

RMON Token Ring Extension Groups:

* It an extension to RMON1 MIB and is specified in RFC 1513.

* There are two token ring statistics groups, one at the MAC Layer and a second on packets collected promiscuously.

* They both contain statistics on ring utilization and ring error statistics.

RMON 2.

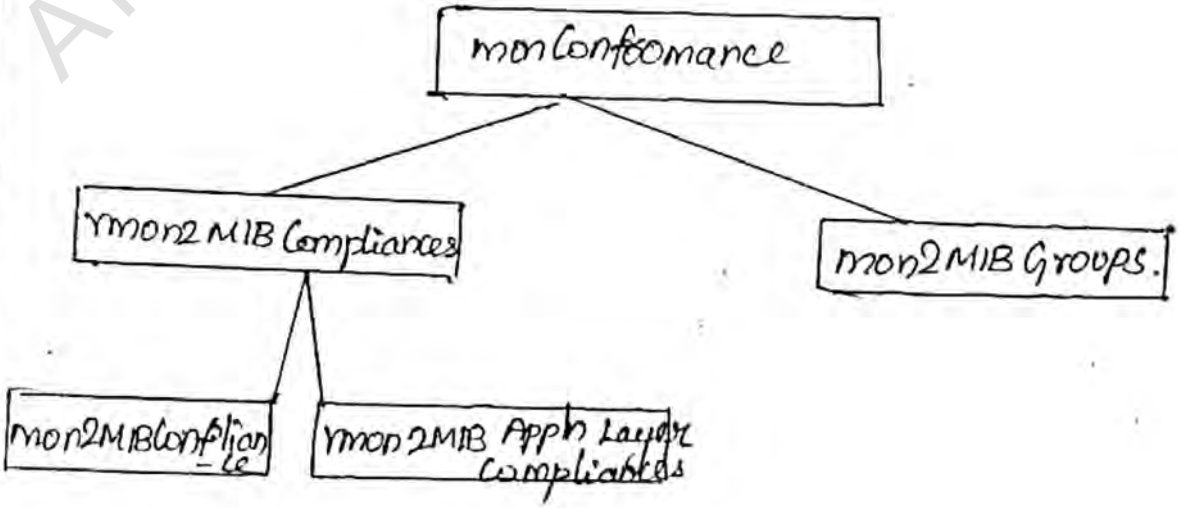
* RMON 2 extends the monitoring capability to the upper layers, from the n/w layer to the appl. layer.

* Several of the groups and functions in RMON2 at higher layers are similar to that of the data link layer in RMON 1.

RMON2 MIB

* The architecture of RMON2 is the same as RMON RMON2 MIB is arranged into 10 groups.

① Protocol directory ② Protocol distribution
③ Addr map ④ N/w layer host ⑤ N/w layer matrix
⑥ Appln-layer host ⑦ Appln-layer matrix
⑧ User history collection ⑨ probe config ⑩ RMON conformance



(2) Explain in detail about Managed objects in SNMPV1

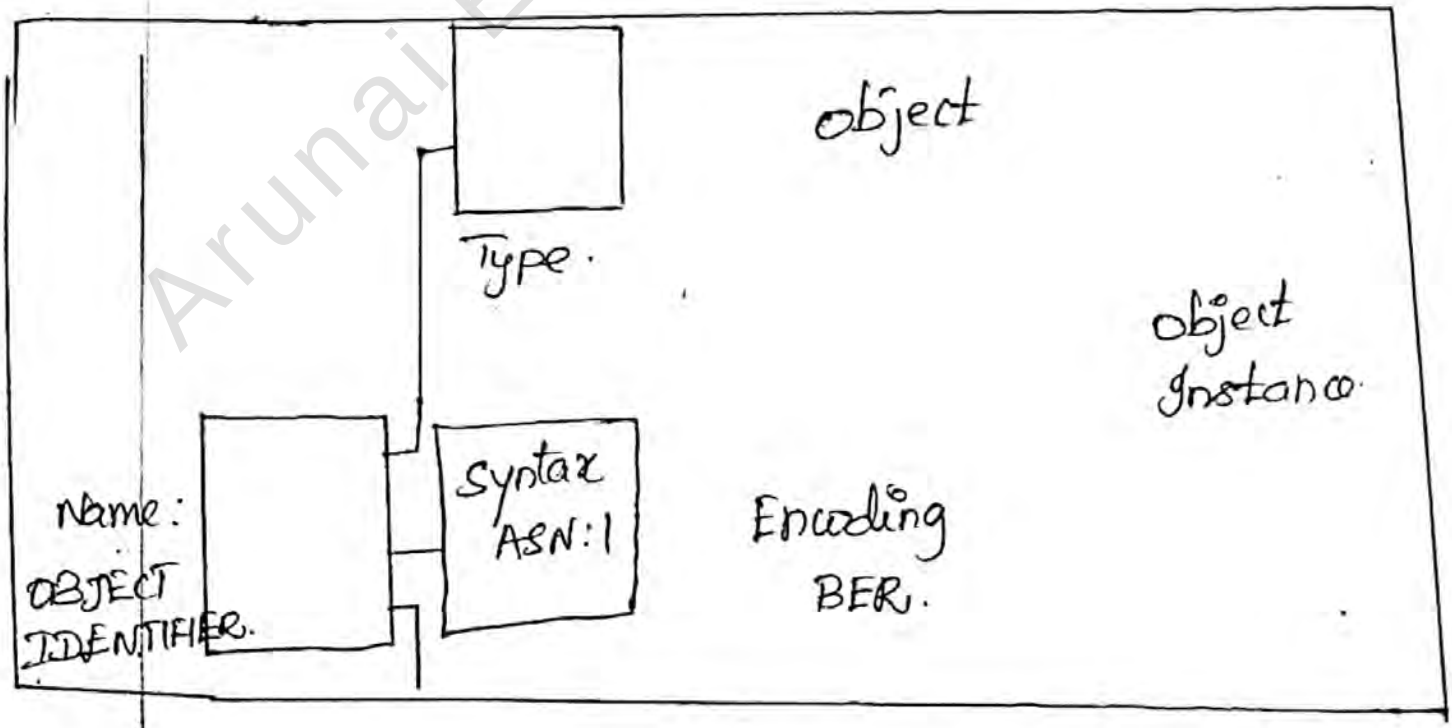
Definition:

Managed object has both a Type and a value For eg. The SNMP system group variable syslocation has the type. Display string as the value.

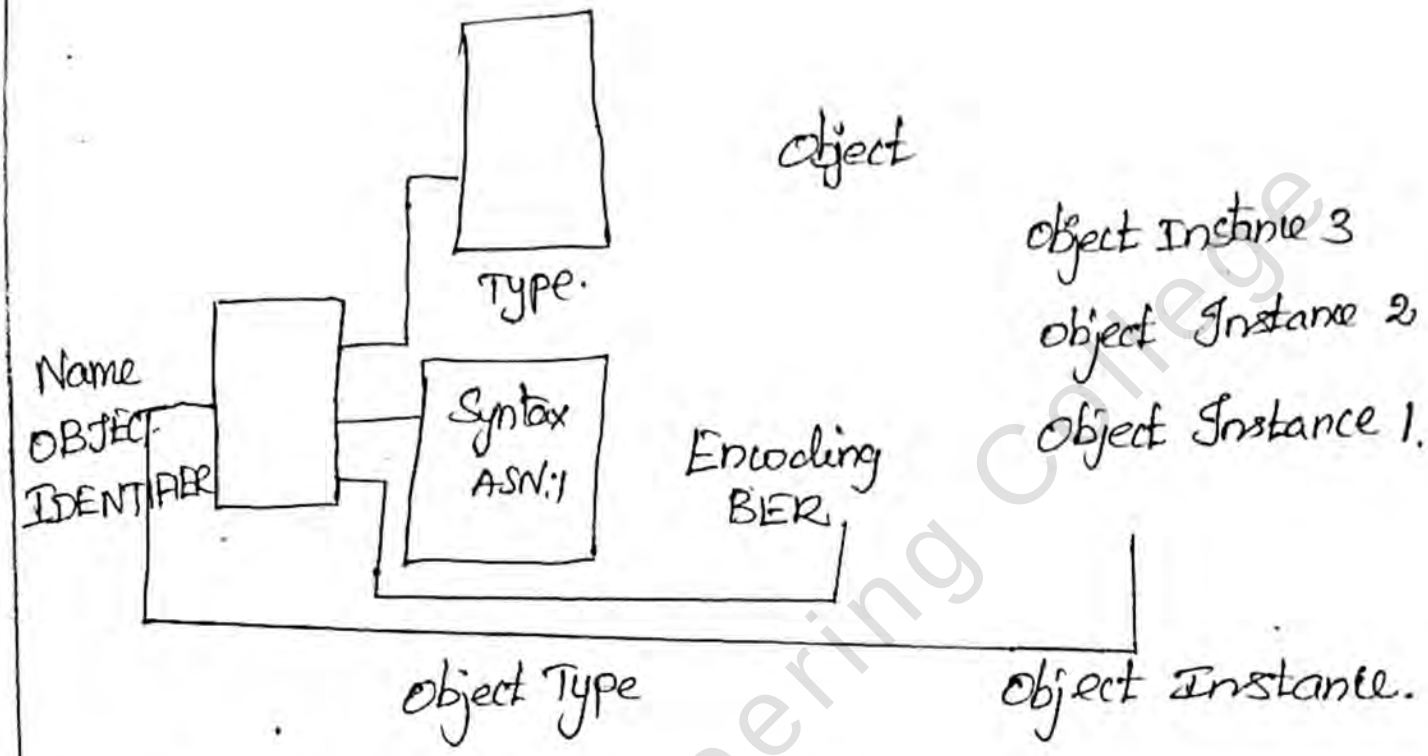
Managed object has 2 types.

* scalar object (A managed object has always single instance)
* Tabular object (Multiple Instance).

Managed object with single Instance.



Managed object: Multiple Instance.



Structure of Managed objects:

* Managed object has 5 parameters. They are textual name, syntax, definition, access and status

*For eg SysDescr is a data type in the MIB that describes a s/m.

Textual Name:

* Textual Name for an obj type is mnemonic and is defined as OBJECT ~~IDENTIF~~ DESCRIPTOR.

* It is unique and is made up of a printable string beginning with a lowercase letter, sysDescr.

* OBJECT DESCRIPTOR does not specify instances of a managed object. It describes what type of object it is and not the occurrence or instantiation of it

Syntax:

↳ It is the ASN.1 definition of the object type. The Syntax of sysDescr is OCTET STRING.

Definition.

* A definition is an accepted textual description of the obj type.

* It is a basis for the common language or semantics to be used by all vendors.

Access:

* Access is the specification for the privilege associated with accessing the information.

* It is one of read-only, read-write, write-only or not-accessible.

* The first two choices are obvious and the third choice, not accessible, is applicable, for eg, in specifying a table.

Status

* Status specifies whether the managed object is current or obsolete. A managed object, once defined can only be made obsolete and not removed or deleted.

* The implementation of it is specified as either mandatory or optional. The status for sysDescr is mandatory.

Macro for Managed objects:

* In order to encode the above information on a managed object to be processed by machines, it has to be defined in a formalized manner. This is done using macros.

Scalar OBJECT-TYPE Macro and example.

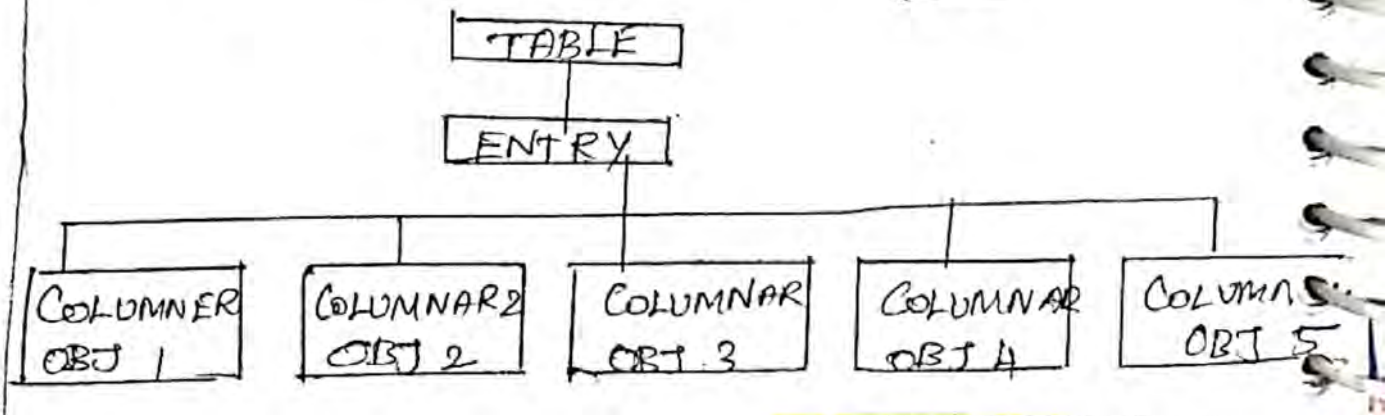
```
OBJECT-TYPE MACRO ::=
BEGIN
    TYPE NOTATION ::= "SYNTAX" TYPE (TypeObjectSyntax)
        "ACCESS" Access
        "STATUS" Status
        VALUE NOTATION ::= value (Value ObjectName)
    Access ::= "read-only" | "read-write" | "write-only"
                "not-accessible"
    Status ::= "mandatory" | "optional" | "obsolete"
```

Aggregate object:

* An aggregate object is a group of related objects
* object 1 through 5 represent simple data type that makes up an entry in a table.
* object 1 with the OBJECT DESCRIPTOR, ipAdEntAddr is the first element of the entry, ipAddrEntry and is given the unique OBJECT IDENTIFICATION.
* object 2 is ipAdEntIfIndex and is the second subordinate object type of ipAddrEntry.
* object 3, 4 and 5, ipAdEntNetMask, ipAdEntBcastAddr and ipAdEntReasmMaxSize resp...

Aggregate object as columnar object:

* This means that a single scalar value is retrived or edited on a managed obj with any one operation. Multiple Instance Managed object.



(3) What is Management Information Base and (MIB II) in SNMP V1. explain it.

Definition:

* Both MIB-I and MIB-II can be implemented in SNMP V1. MIB is organized such that implementation can be done on an as-needed basis.

* The entire MIB does not have to be implemented in either the manager or the agent process. The definition consists of 3 components; name, syntax and encoding.

* MIB-II has an additional attribute to the status of a managed objects. The new term is deprecated. This term mandates the implementation of the object in the current version of MIB-II.

eg: atTable is deprecated in MIB-II.

OBJECT GROUPS:

⇒ objects that are related are grouped into object groups.

⇒ object groups facilitate logical assignment of object identifiers. One of the criteria for choosing objects to be included in stds is that it is essential for either fault or configuration mgmt.

⇒ For eg, if the External Gateway Protocol (EGP) is implemented in a s/m, then all EGP group objects are mandatory for be present.

⇒ There are 11 groups defined in MIB-II.

MIB Module Structure.

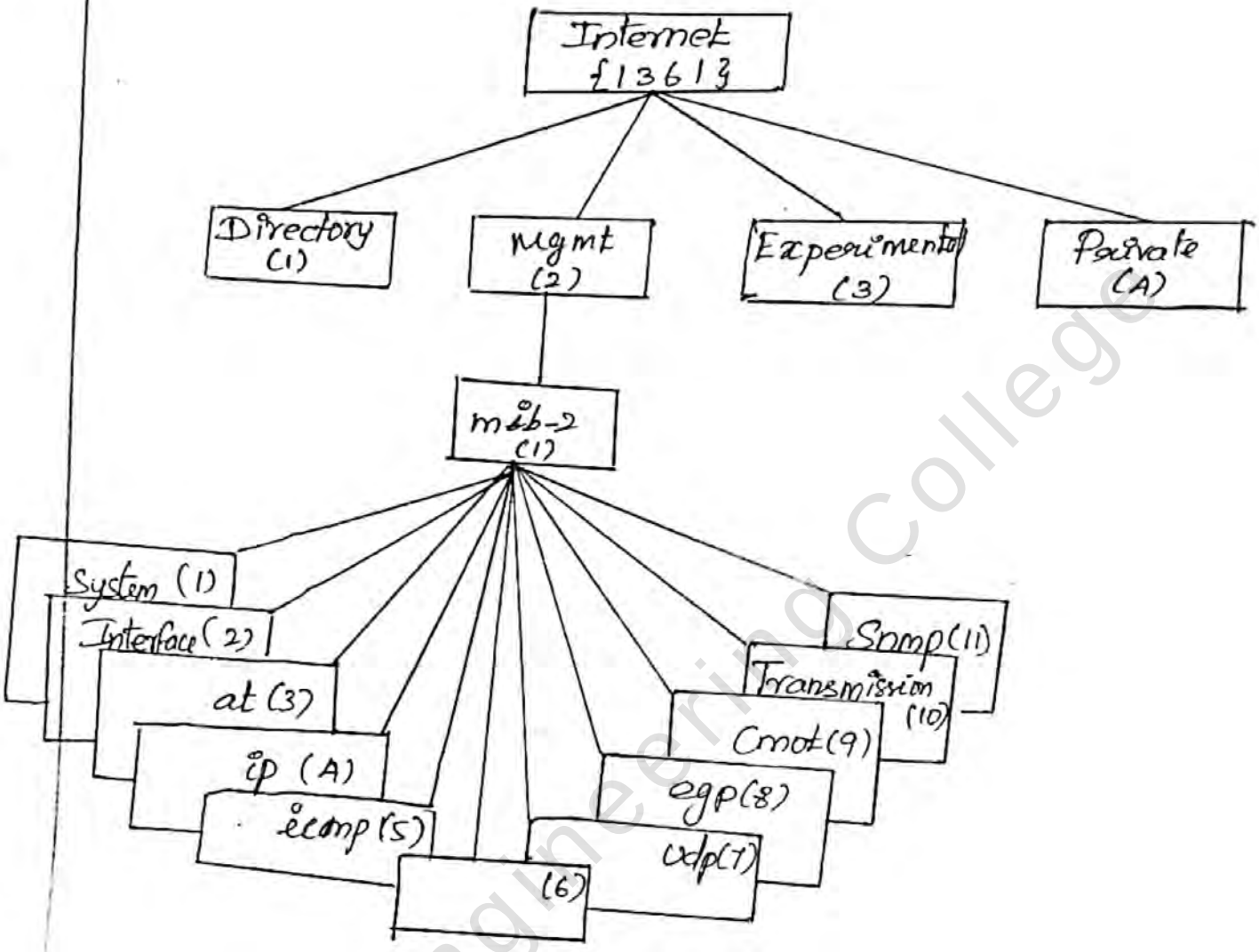
<Module name> DEFINITIONS ::= BEGIN
<imports>
<definitions>
END.

SYSTEM GROUP

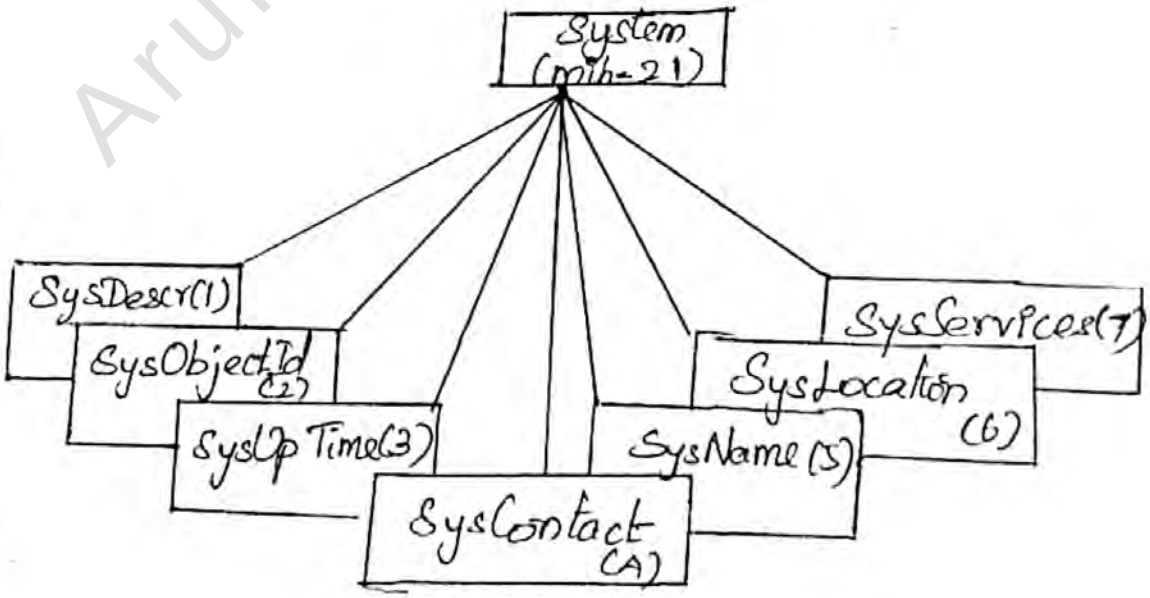
* The s/m group is the basic group in the Internet std MIB. Its elements are probably the most accessed managed objects.

* Implementation of the system group is mandatory for all s/m in both the agent and the manager.

Internet MIB-II Group.



System Group.



Interfaces Group.

* The interfaces group contains managed objects associated with the interfaces of a sim.

* If there is more than one interface in the system, the group describes the parameters associated with each interface.

⇒ for eg, if an Ethernet bridge has several n/w interfaces cards, the group would cover inform associated with each interface.

* The Interfaces MIB contains only generic parameters. The i/f group specifies the no. of interfaces in a n/w component and managed objects associated with each interface.

* Implementation for this group is mandatory for all systems.

2 nodes ⇒ ① ifEntry
② ifTable.

Ex. ifEntry OBJECT-TYPE
SYNTAX ifEntry
ACCESS not-accessible
STATUS mandatory
DESCRIPTION.
"An i/f entry containing objs at the subn layer and below for a particular

INDEX {ifIndex}
::={ifTable 1}

Interface Sublayers :

* One of the strengths of an Ip layer protocol is that it is designed to run over any n/w i/f.

*The interface group provides the means for additional managed objects specific to particular types of n/w interface.

eg) a Specific medium such as Ethernet or Time Division Multiplex channal.

Address Translation Group:

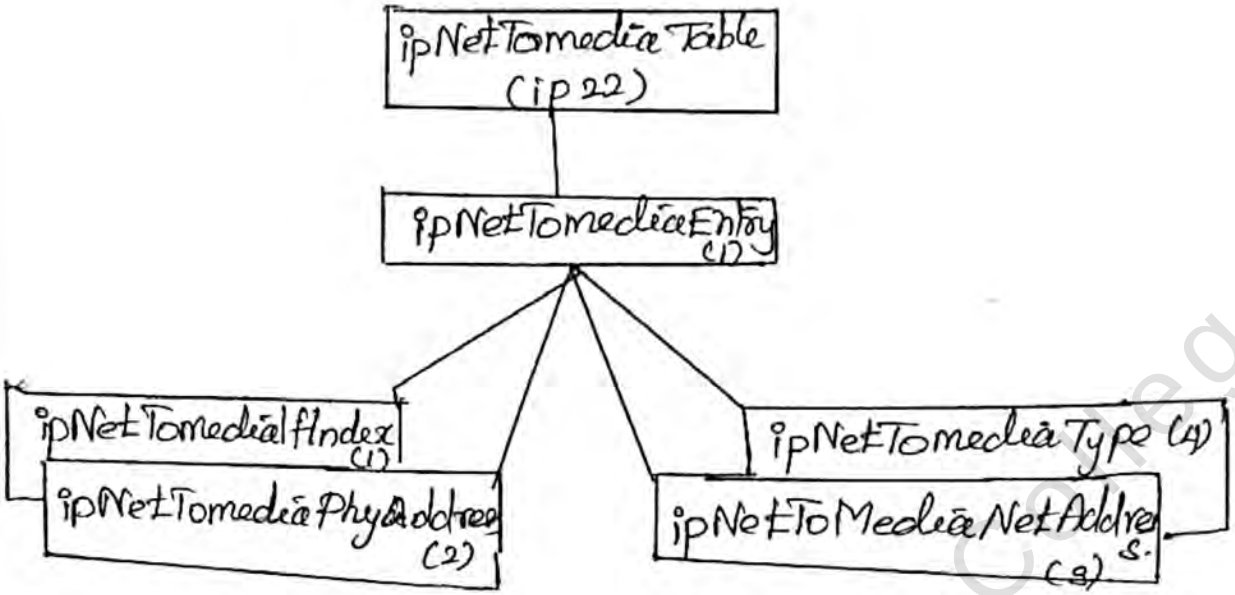
* The address Translation group consists of a table that converts Network address to physical or subnetwork address for all interfaces of the s/m

IP Group:

*The Internet is based on Ip protocol as the networking protocol. This group has information on various parameters of the protocol.

*It also has a table tht replaces the Address Translation Table.

IP Address Translation Table.



ICMP Group

* The ICMP group contains statistics on ICMP protocol control messages of ICMP
* The syntax of all entities is read-only counter. for eg, statistics on the no. of ping requests sent might be obtained from the counter reading of icmpOutEchoes.

TCP Group and UDP group.

* The transport layer of the Internet defines Transmission Control protocol (TCP) for a connection oriented circuit and User Datagram Protocol (UDP) for a connectionless circuit.

(4) Illustrate communication model in SNMPV1 in detail. (or) State the working of communicat. model defined in SNMP V1 in detail.

SNMP Communication Model.

* The SNMPV1 Communication model defines specifications of 4 aspects of SNMP communication.

1. Architecture
2. Administrative model (That defines data access policy).
3. SNMP protocol
4. SNMP MIB.

SNMP Architecture

⇒ The SNMP architectural model consists of a collection of n/w mgmt stations and n/w elements or objects.

⇒ N/w elements have mgmt agent built in them, if they are managed elements. The SNMP comm protocol is used to communicate information b/w n/w mgmt stations and mgmt agents in the elements.

⇒ There are 3 goals of the architecture in the original specifications of SNMP.

1. It should minimize the number and complexity of

mgmt functions realized by the mgmt.

② It should be flexible for future expansion

③ The architecture should be independent of architecture and mechanisms of particular hosts and gateways.

⇒ Only non-aggregate objects are communicated using SNMP. The aggregate objects are communicated as instances of the object.

* They comprise three basic messages: set, get and trap. The get request and get next-request msgs are generated by the manager to retrieve data from network elements using associalid mgmt agent
* The set request is used to initialize and edit n/w element parameters.
* The get response-req is the response from the agent to get and set msgs from the manager

⇒ There are 3 types of traps.

* Generic trap
* Specific trap.
* time stamp.

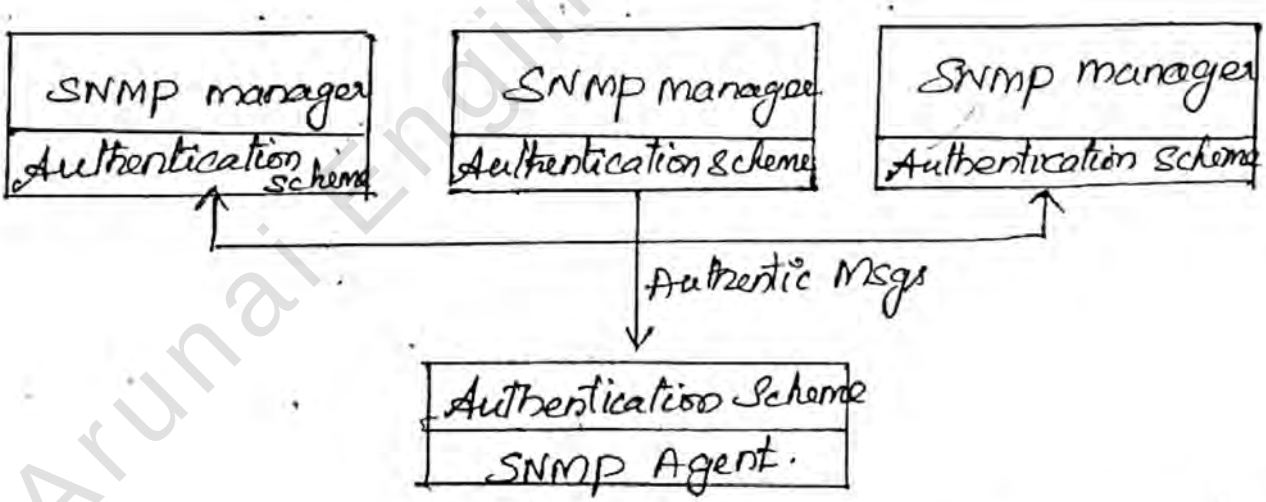
Administrative Model.

* It helps to understand the administrative relationship among entities that participate in the communication protocol in SNMP.

* The entities residing in mgmt stations and n/w elements are called SNMP application entities.

* The appln entities residing in the mgmt station as the SNMP manager and the appln entity in the element as the SNMP agent. The pairing of the 2 entities is called an SNMP community.

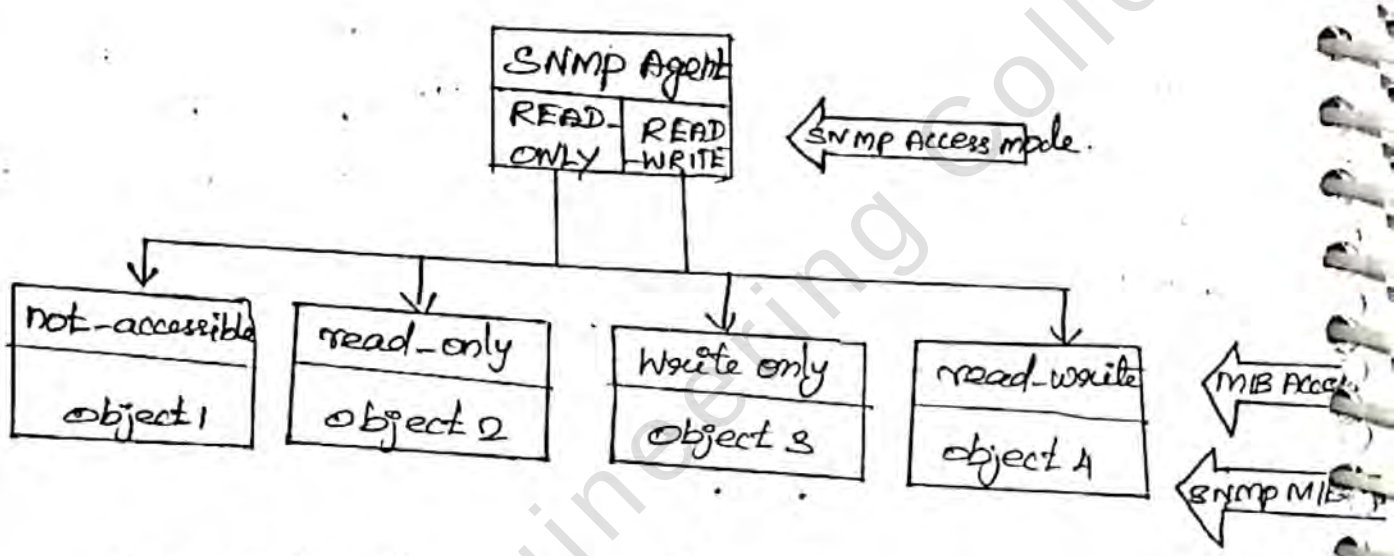
SNMP Community.



* A n/w element comprises many managed objects both std and private. However, a mgmt agent may be permitted to view only a subset of the n/w elements. This is called the community MIB View.

* In addition to the MIB view, each community name is also assigned an SNMP access mode, either READ ONLY or READ-WRITE. A pairing of SNMP MIB views with an SNMP access mode is called a community profile.

SNMP Community Profile

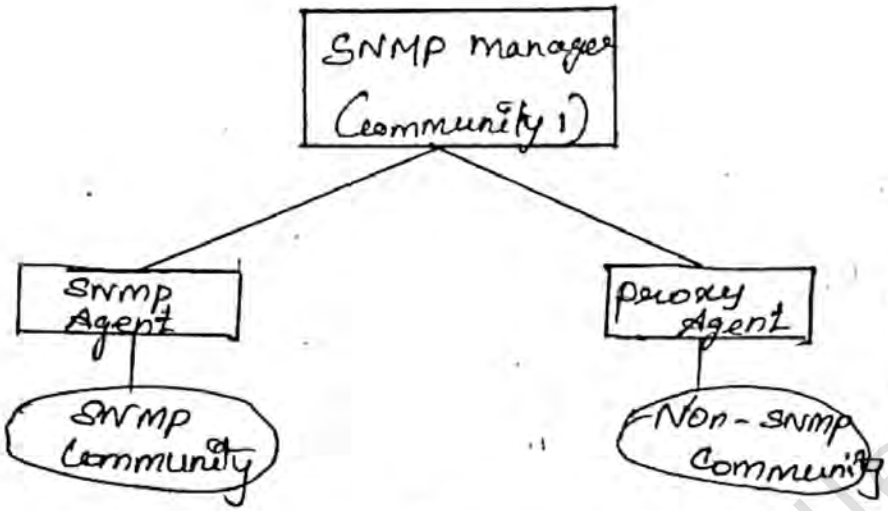


Access modes → (1) Read-only
(2) Write-only
(3) Read-write
(4) Not-accessible → No operation can be performed

(3) SNMP protocol Specifications :-

* An SNMP msg consists of a version identifier, an SNMP community name and a protocol data unit (PDU).
* The version and community names are added to the data PDU and along with the appln header

SNMP proxy Access policy.



⇒ A managed object is a scalar variable and value is called variable. Associated with the variable its value. The pairing of the variable and value is called variable binding or VarBind.

Get and Set Type PDUs.

PDU Type	Request ID	Error Status	Error Index	VarBind 1 Name	VarBind 1 Value	...	VarBind n Name	VarBind n value.

Trap PDU.

PDU Type	Enterprise	Agent Address	Generic Trap type	Specific Trap Type	Time-Stamp	VarBind 1 Name	VarBind 1 Value	...	VarBind n Name	VarBind n value

SNMP operation

* SNMP operations comprise get and set msgs from the manager to agent and get & trap msgs from the agent to the manager.

(5) Explain the data structure of protocol operation in SNMPv2.

Data Structure of SNMPv2 PDUs.

* The PDU data structure in SNMPv2 has been standardized to a common format for all messages.

* This improves the efficiency and performance of msg exchange b/w SNMs.

* The PDU type is indicated by an integer. The error_status and error_index fields are either set to zero or ignored in the get request, get-next-req, and set msgs.

* There is a difference in usage of the error_status and error_index fields between SNMP V1 and SNMP V2.

* In version 1, any error encountered by the agent in responding to requests from the manager generates a non-zero value in either the error_status field or in both the error_status and error_index fields.

* In SNMP V2, if only the error_status field of the Response PDU is non-zero, the value fields of the variable binding in the variable-binding list are ignored.

* It can be seen that the format of the structure is the same in both cases, except that in the get-bulk-req msg, the third & fourth fields are different.

⇒ 3rd error status field, is replaced by non-repeat
⇒ 4th error index field, is replaced by max-repetitio

SNMP V2 PDU (all but bulk)

PDU Type	Req ID	Error Status	Error Index	VarBind1 name	VarBind1 Value	....	VarBind n name	VarBind n value.

SNMP V2 GetBulkRequest PDU.

PDU Type	Req ID	Non Repeaters	Non-repetition	VarBind1 Name	VarBind1 Value	....	VarBind n name	VarBind n value

SNMP V2 protocol operations

⇒ The messages get request, get-next-request, set request, and get response are in both SNMPV1 and SNMP V2.

⇒ The 2 additional msgs that are in SNMPV2, which are not in Version 1, are the GetBulkRequest and InformRequest.

GetBulkRequest

⇒ It is used to retrive bulk data from a remote entity. Its greatest benefit is in retrieving multiple rows of data from a table.

⇒ The basic operation of get-bulk-request is the same as get-next-request.

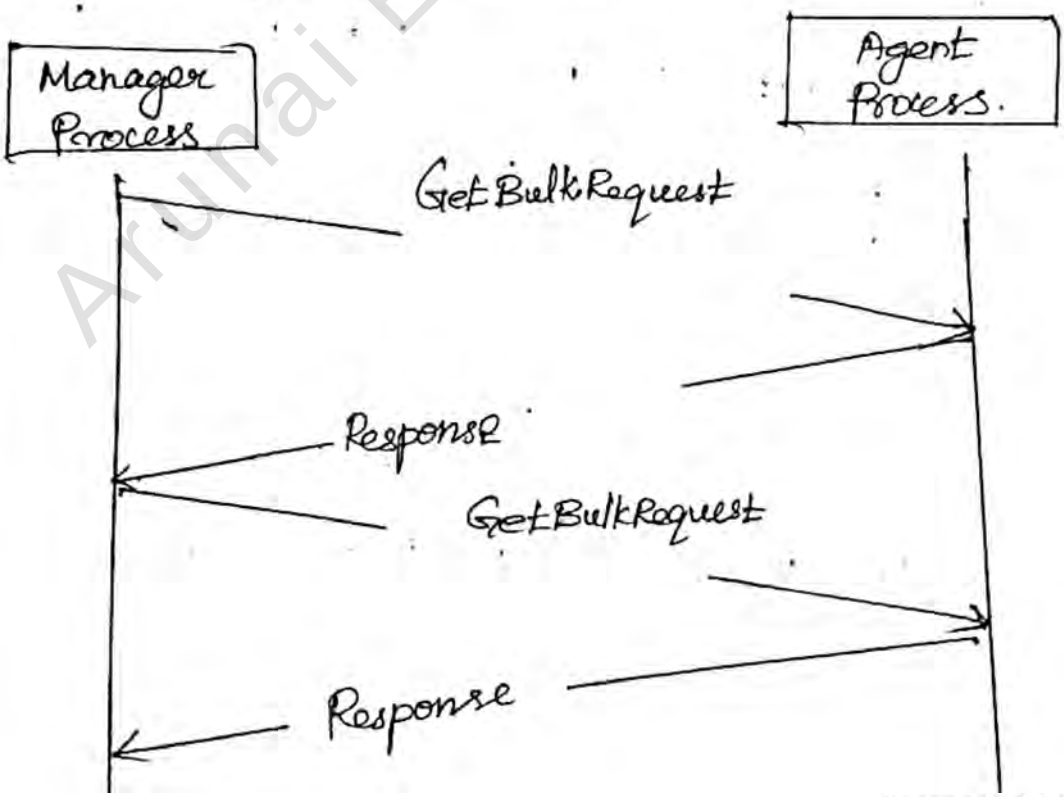
⇒ The datastructure of the response for the get-bulk response operation differs from other get & set operations

⇒ Successful processing of the get bulk-req produces variable bindings. in the response PDU, which is larger than that contained in the corresponding req.

SNMP v2 - Trap and InformRequest PDU operations

* A trap is defined by using a NOTIFICATION-TYPE macro. If the macro contains an OBJECTS clause, then the objects defined by the clause are in the variable binding in the order defined in the clause.

Get Bulk-Request Example.



SNMP V2 Trap PDU

PDU Type	Req ID	Error Status	Error Index	VarBind1 sysUpTime	VarBind1 Value	VarBind2 snmpTrapOID	VarBind2 Value	...

(6) Explain in detail about SNMP Architecture with necessary diagram.

* The SNMP document architecture addresses how existing documents and new documents could be designed to be autonomous and at the same time, be integrated to describe the diff SNMP frameworks.

Architecture:

* An SNMP mgmt nlw consists of several nodes, each with an SNMP entity. They interact with each other to monitor and manage the nlw & resources.

* The architecture of an SNMP entity is defined of the architecture elements of an entity and the names associated with an SNMP entity.

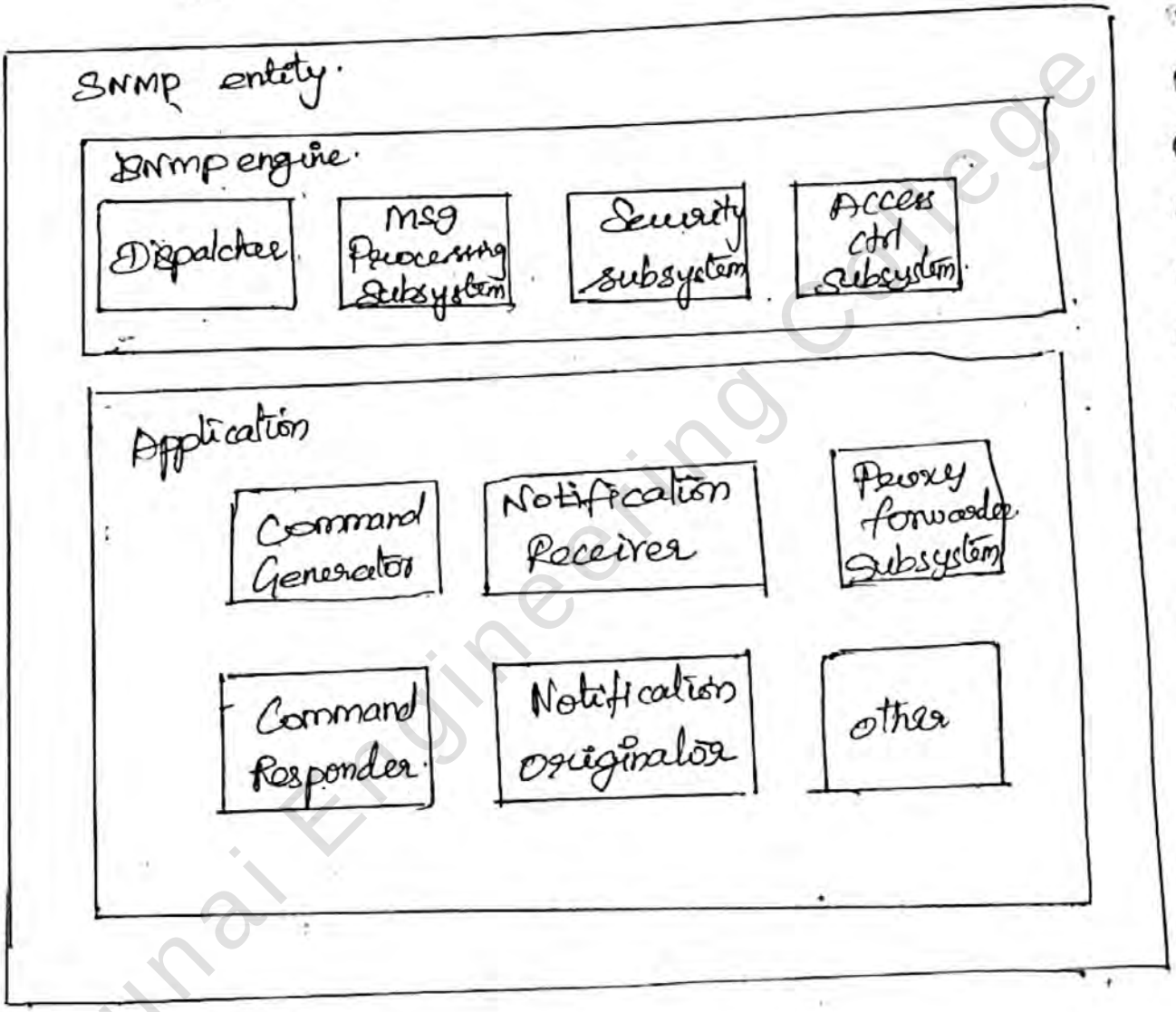
* The SNMP engine, named snmpEngineID, comprises a dispatcher, msg processing subsystem, security subsystem and an access ctrl subsystem.

SNMP Engine

⇒ SNMP Entity has one SNMP engine, which is uniquely identified by an snmpEngineID.

⇒ The SNMP engine ID is made up of octet strings. The length of the ID is 12 octets for SNMPV1 and SNMPV2 and is variable for SNMPV3.

SNMP V3 Architecture



SNMP Engine ID.

	1st Bit			
SNMPV1 SNMPV2	0	Enterprise ID (1-4 octets)	Enterprise Method (5th octet)	Function of the method (6-12 octets)
SNMPV3	1	Enterprise ID (1-4 octets)	Format indicator (5th octet)	Format (Variable No. of octets)

Dispatch Subsystem:

* There is only one dispalcher in an SNMP engine and it can handle multiple versions of SNMP msgs.

⇒ Functions of SNMP V3.

(1) It sends msg to and receives msgs from the n/w.

(2) It determines the version of the msg and interacts with the corresponding MPM.

(3) It provides an abstract interface to SNMP appln to deliver an incoming PDU to the local appln and to sent a PDU from the appln to a remote entity.

Msg processing subsystem:

⇒ The SNMP msg processing subsystem of an SNMP engine interacts with the dispalcher to handle version specific SNMP msgs.

Security and access control subsystems

⇒ It provides security services at the msg level in terms of authentication and privacy protection.

Appln module:

⇒ The appln module is made up of one or more applns, which compress cmd generator, notification receiver, proxy forder, cmd responder.

Names:

* Naming of entities, identities and mgmt infon is part of SNMPV3 specifications

* Two names are associated with identities / principal and security name.

Abstract Service Interfaces:

* If the interface is defined such that it is generic and independent of specific information, it becomes a conceptual i/f, termed abstract service interface.

(7) List the various application of SNMPV3 and explain in detail.

⇒ * SNMP V3 formally defines five types of applications.

⇒ These are not the same as the functional model that the OSI model addresses.

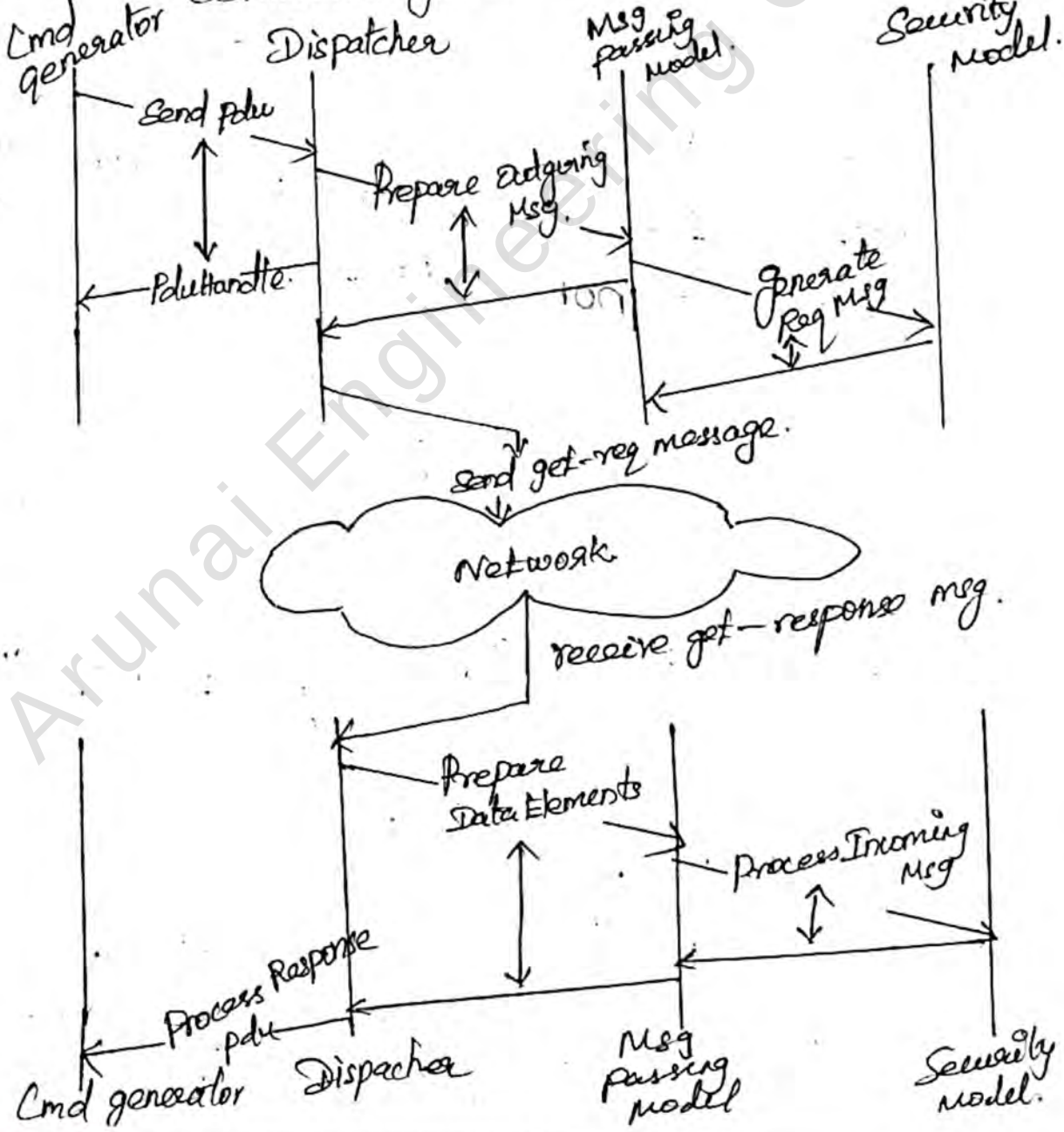
⇒ They are Command generator, Command responder notification originator, notification receiver and proxy forwarder.

Command Generator

*A Command generator appln is used to generate get-request, get-next-req, get bulk and set request messages.

* The command generator also processes the response received for the command sent. Cmd generator application is associated with the n/w manager process.

Command generator Application



* The use of the cmd generator appln using the get-req. The cmd generator sends the sendpdu primitive to the dispatcher, which requests the MPM to prepare an outgoing msg.

* The dispatcher also sends a SendPduHandle to the command generator to track the req.

* The SM is used to generate the outgoing msg including authentication and privacy parameter.

Command Responder.

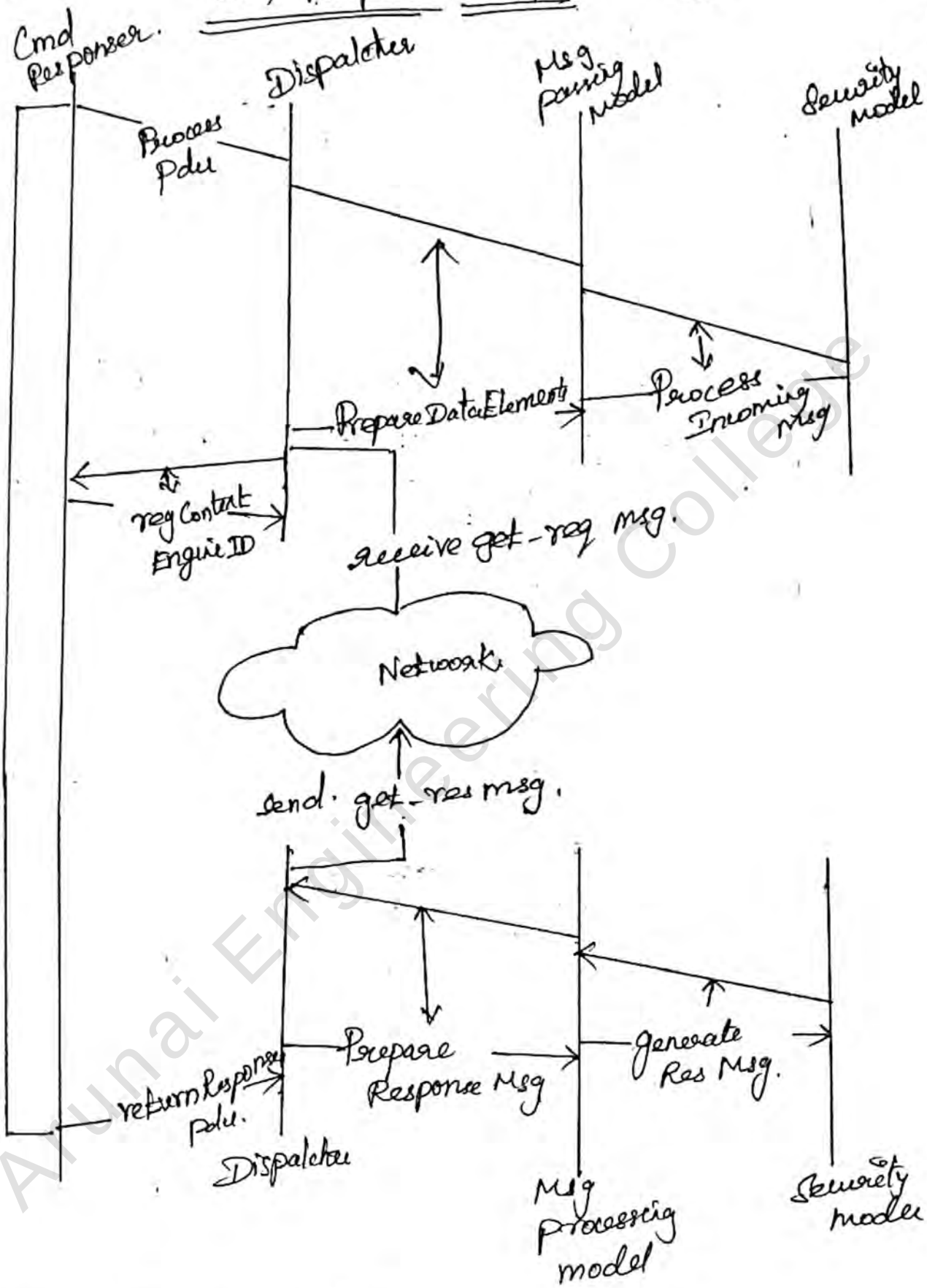
⇒ A cmd Responder processes the get and set requests destined for it and is received from a legitimate non-authoritative remote entity.

⇒ It performs the appropriate action of get or set on the mib element, prepares a get-response msg and sends it to the remote entity that made the request.

⇒ The msg is passed to the Dispatcher via the returnResponsePdu.

⇒ The MPM prepares the response message, the SM performs the security functions and the Dispatcher eventually transmits the get-res msg on the n/w

Cmd Responder Appln.



Notification Originator:

* The notification originator appln generates either a trap or an inform msg.

* Its function is somewhat similar to cmd responder except that it needs to find out where to send the msg and what SNMP version and security parameters to use.

Notification Receiver

* This appln receives SNMP notification msgs. It reg with the SNMP engine to receive these msgs, just as the cmd responder does to receive get and set msgs.

Proxy forwarder:

* This application performs a function similar to what in proxy server
* The proxy definition has been clearly defined and restricted in SNMP V3 specifications
* The term proxy is used to refer to a proxy forwarder appln that forwards SNMP requests, notifications, and responses without regard for what managed obj are contained in those msgs.

UNIT - V

PART - A

(1) List the groups contains information to manage the ATM sublayer entities?

① Traffic descriptors
② DS3 physical - layer convergence parameters (PLCP).
③ Transmission Convergence (TC) sublayer parameters
④ Virtual path link / virtual channel link
⑤ Performance parameters for AAL5. (ATM adaptation layer).

(2) Mention the AtmForum Group?

* atmForum Group classified into 5 subgroup

1. atmForumAdmin } defined in the Integrated local
2. atmForumUni } Mgmt i/f (ILMI) specification.
3. atmUniOxi → Used in the Data Exchange Interface
4. atmLanEmulation — It is i/f between DTE and DCE
5. atmForum Network } — MIB for MH Interface.
   Management.

(3) what is the use of M1 Interface?

* M1 Interface is an Interface b/w an SNMP mgmt s/m and an SNMP agent in an ATM device.

* It is a mgmt of ATM Network Element and it has four entities ① ifInNUcastPkts, ifOutNUcastPkts, ifOut@Lan, ifSpecific.

(4) what is the use of M2 Interface?

* M2 Interfaces comprises the n/w of two ATM devices. The NMS manages the n/w with an interface to device A.

* The mgmt information on ATM Links b/w devices is gathered from ILMI MIB. It is a mgmt of private N/w.

(5) what is the role of M3 Interface.

* M3 Interface is the mgmt i/f b/w the private NMS and the public service provider NMS.

* It allows the customer to monitor and Configure their portion of the public ATM n/w

* N/w show the typical config, how a customer would interact with the public service provider n/w via the carrier mgmt s/m.

(6) What is the necessary to use Digital Exchange Interface?

* The Digital Exchange Interface (DXI) is an Ilf b/w Digital Termined Equipment (DTE) and a Digital Circuit Equipment (DCE) that connects to a public data n/w.

* A DTE will be a hub or the router and the DCE is a Digital Service Unit (DSU), which interfaces to an ATM switch.

(7) List the groups in M3 call class II Mgmt functions.

~~(1) ATM key~~

They are classified into 3 subgroups

(1) ATM level subgroup

(2) VPC / VCC - level subgroup

(3) Traffic subgroup.

(8) Mention the Services provided by the class I requirements.

(a) Retrieving performance & config infon for a UNI link.

(b) public service NMS reporting an alarm or trap msg to the use NMS on a UNI-link failure.

(9) List the states Monitoring Tool.

* Ifconfig. — Obtains & configures n/w intf parameters & states
* Ping — checks the status of node/host
* nslookup — Looks up DNS for name-IP addr translation
* dig — Queries DNS server.
* host — displays infon on Internet host/domains.

(10) List out the Network Traffic Monitoring Tools

* Ping — Used for measuring round trip pkt loss
* bing — Measures pt to pt bandwidth of a link.
* tcpdump
* gethethers
* iptrace
* ethereal, wireshark.

(11) Mention the Network Routing Tools.

* netStat – Displays the contents of various nlw related data structures

* arp – Displays & modifies the Internet to ethernet addr translation tables

* traceroute / tracert } – Trace the route to a destination with routing delays.

(12) What are the SNMP tools.

* SNMP MIB tools are of three types,

(1) SNMP MIB browser uses a graphical I/f.

(2) A set of SNMP command-like tools.

(3) Linux / FreeBSD-based tool, snmpsniff, which is useful to read SNMP PDUs.

(13) Define Protocol Analyzer.

* The protocol analyzer is a powerful and versatile nlw mgmt tool.

* It is a tool that analyzes data pkts on any transmission line.

* Measurements using the protocol analyzer can be made either locally or remotely.

14) Draw the Architecture of Digital Exchange Interface Mgmt.

DTE – Digital Terminal Equipment
DCE – Digital circuit Equipment.

(15) Write the functions of performance monitoring for an ATM network.

* Performance Monitoring
* Traffic mgmt
* UPC (User Parameter Ctrl) / NPC (Nlw parameter Ctrl) discagreement monitoring
* Performance mgmt ctrl
* N/w data collection

(16) Define ATM Forum.

* ATM forum defines the ATM link-specific view of config and fault parameter across a UNI.

(17) Define ASDL.

* Asymmetric digital subscriber line (AD.

* ADSL is a type of digital subscriber line (DSL) technology that enables faster data transmission over copper telephone lines tha a conventional voiceband modem.

(18) How you can differ UNI and NNI?

* A UNI (User N/w interface) connects a user access device to a switch inside the ATM N/w, while an NNI (network to network Interface) (connects two switches or two ATM & networks.

* In telecommunications, a user nlw Interface is a demarcation point b/w the responsibility of the service provider and the responsibility of the subscriber.

* This is distinct from a NNI that defines a similar i/f b/w provider n/ws

(19) Define DSL

* DSL stands for Digitial subscriber Line.

* User gets a high speed bandwidth connection from a phone wall jack on an existing telephone n/w.

* DSL works within the frequencies that the telephone doesn't so you can use the internet while making phone calls.

PART-B

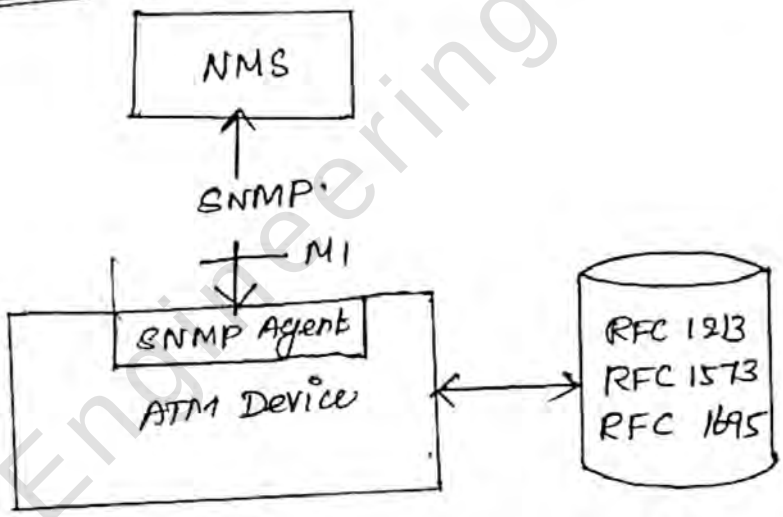
① Explain in detail about M_1, M_2 ~~[illegible]~~ Interface

M_1 Interface : Management of ATM Network Element

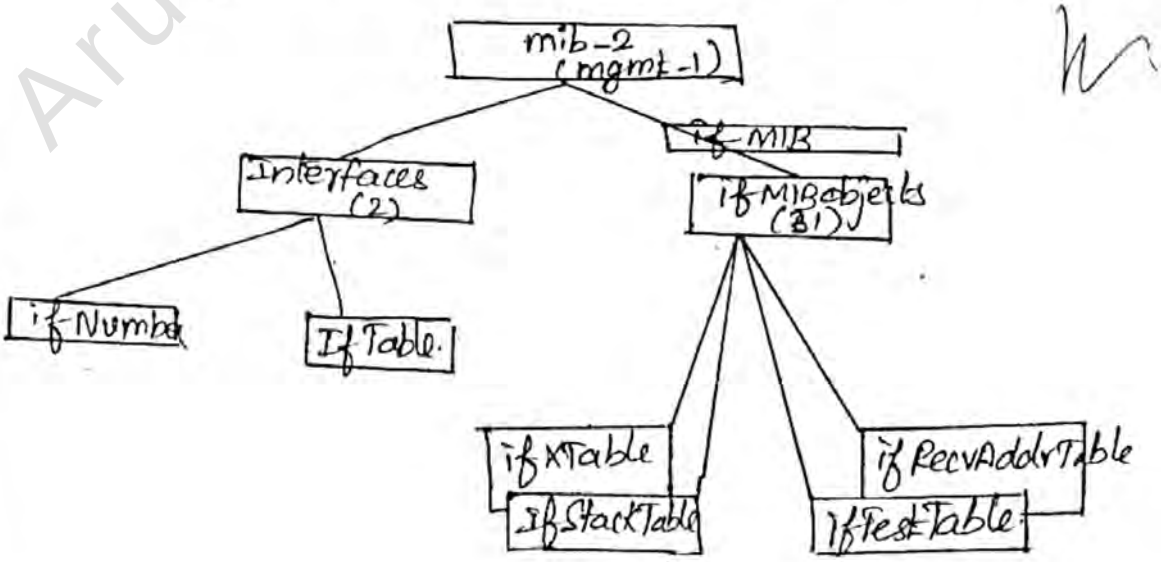
* M_1 Interface is interface between an SNMP mgmt s/m and SNMP agent in an ATM device.

* Four entities ifInNUcastPkt, IfOutNUcastf ifOutQLen, and ifSpecific. have been deprecated

SNMP ATM MANAGEMENT (M_1 Interface)



Interfaces Group Tables for Sublayers.

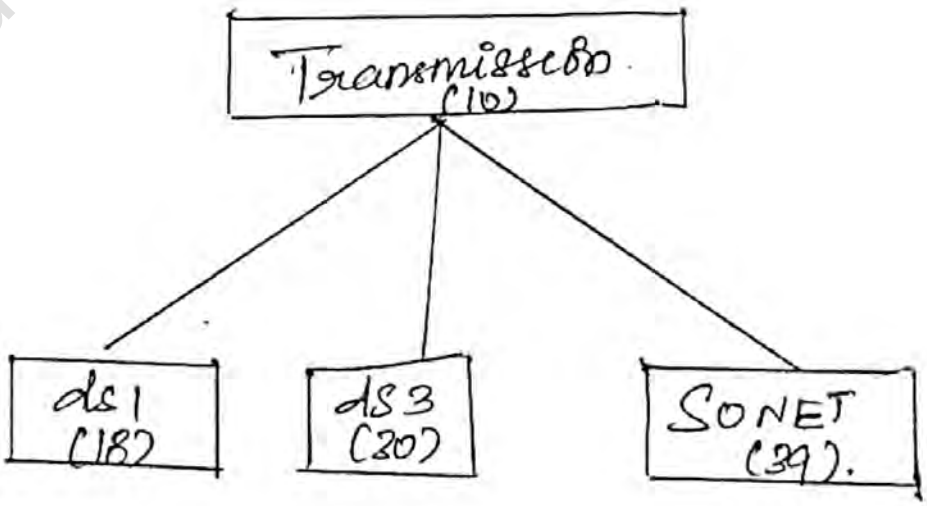


ENTITY	OID	DESCRIPTION
ifXTable	ifMIBObject1	Additional objects for the i/f table
ifStackTable	ifMIBObject2	Information on relationship b/w sublayers.
ifTestTable	ifMIBObject3	Tests that NMS instructs the agent to perform.
ifRcvAddressTable	ifMIBObject4	Information on type of pkts/frames accepted on an interface.

* The below fig shows the 3 transmission modes that are used for the ATM.

* ① DS1 {1.544 - Mbps twisted-pair cable}
② DS3 {44.736 Mbps coaxial cable}
③ SONET {n x 155.52 - Mbps optical fiber}

Transmission Groups for ATM.



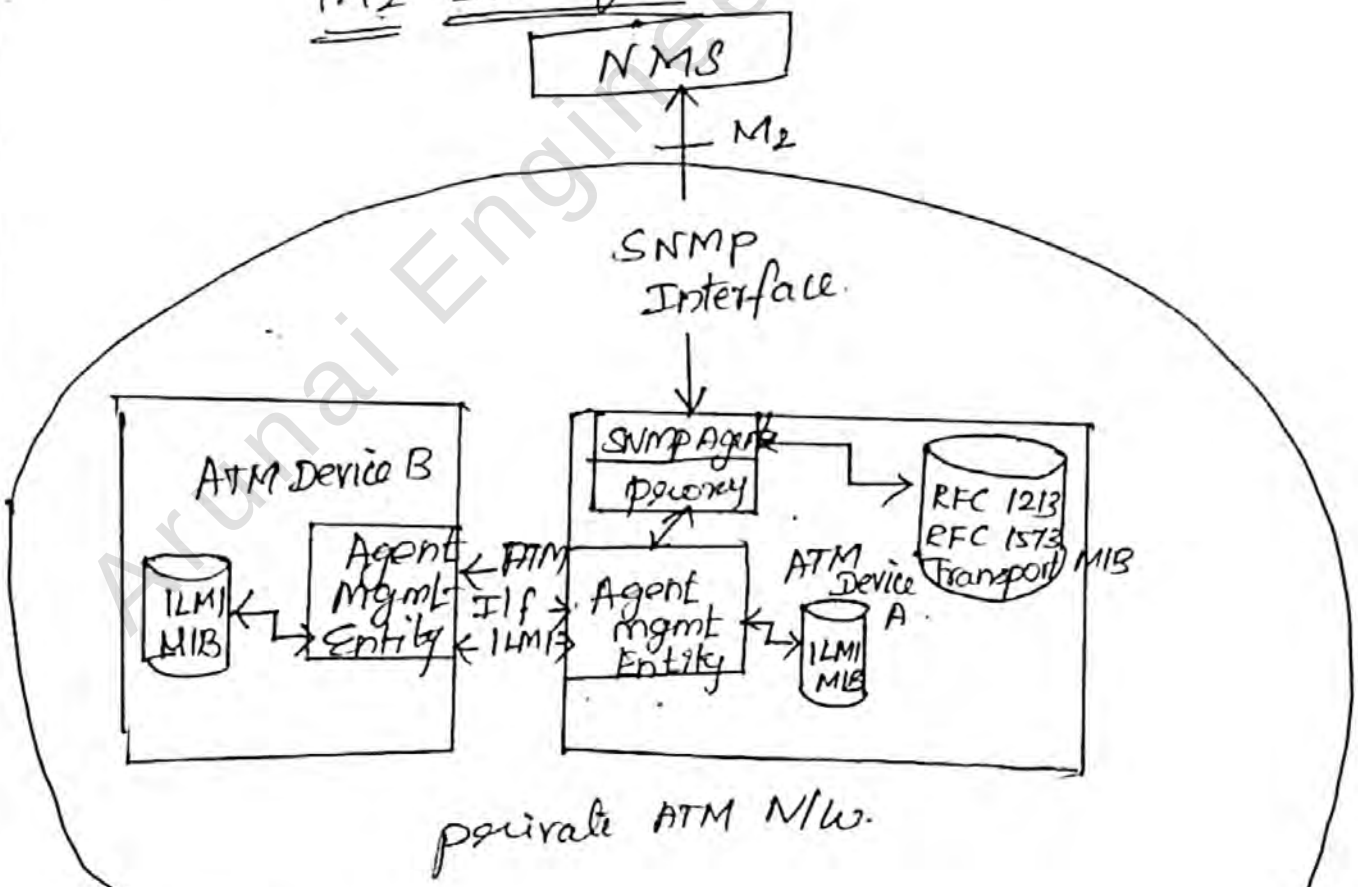
M_2 Interface : Management of a private Network

* M_2 interface, comprises the n/w of two ATM devices. The NMS manages the n/w with an interface to device A.

* The ILMI protocol is used for communication b/w the agent mgmt entity (AME) in device A and the AME in device B.

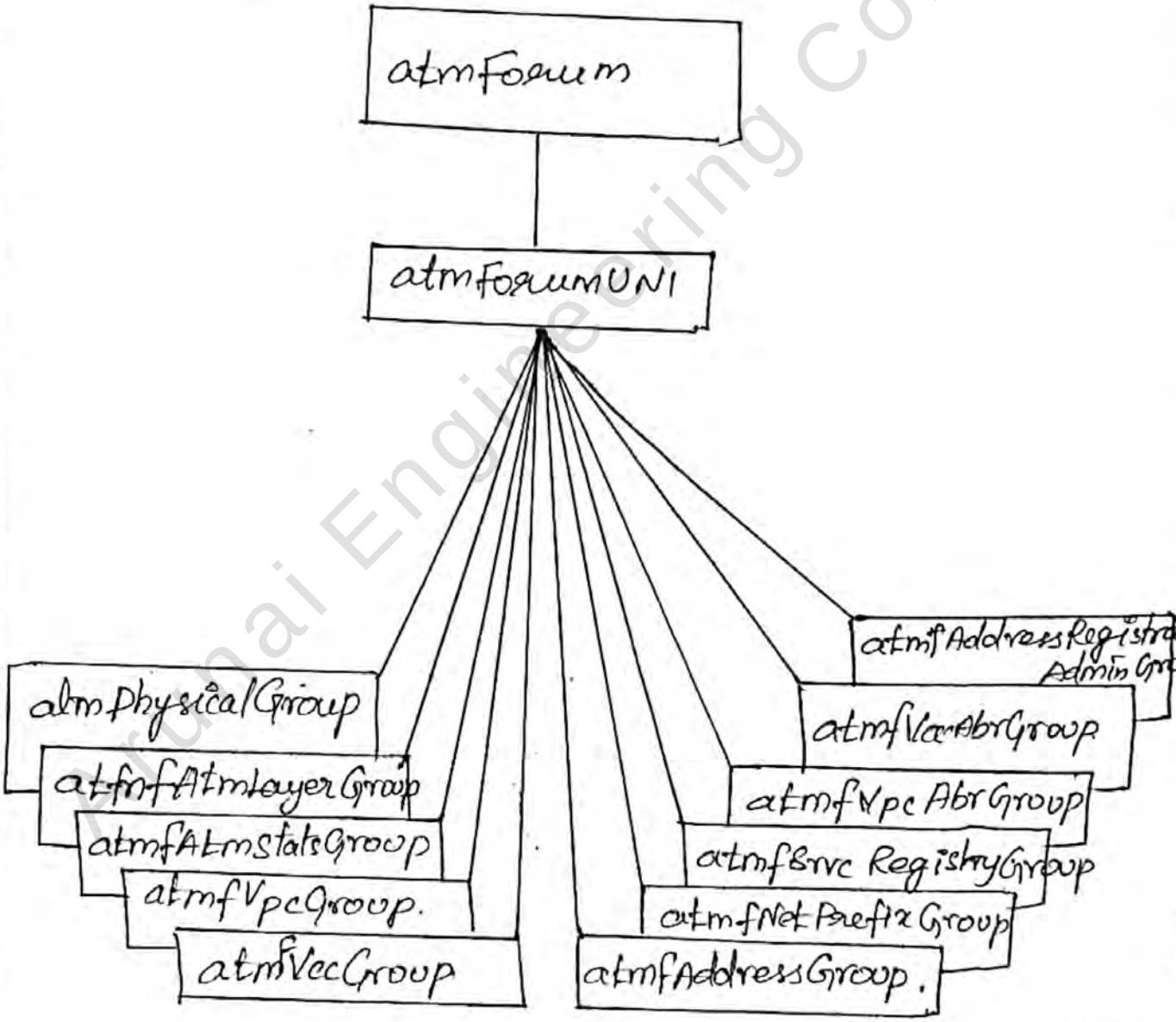
* A proxy agent that resides in device A does the translation b/w ILMI MIB and SNMP MIB

M_2 Interface



* The ILMI specifications define the administrative and UNI groups of the ATM Forum MIB. The administrative group defines a general-purpose registry for locating ATM N/w services such as the ATM name answer server.

ATM UNI MIB object Group.



* Write the table for ATM managed objects Group. refer book.

(2) Explain in detail about M3 Interface.

M3 Interface : Customer Network Mgmt of a public Nlw.

* M3 is the mgmt interface blw the private NMS and the public servider provider NMS.

* It allows the customer to monitor and Configure their portion of the public ATM nlw.

* Nlw show the typical configuration, how a customer would interact with a public seavice provider nlw via the carrier mgmt system.

* There are two classes of M3 requirements in the figure below. They are status and configuration monitoring (class I) and vitual configuration Control (class II).

Class I

* class I requirements are those which a public nlw seavice provider offers to the customer

* These include the customer peaforming monitoring and mgmt of configuration, fault & performance mgmt of a spesific customer's portion of a public ATM nlw.

* Example of this service are
(a) Retrieving performance and configuration information for a UNI link.
(b) public service NMS reporting an alarm or trap msg to the user NMS or a UNI-link failure.

Class II

* It provide greater capability to the user. The user can request the service provider to add, delete, or change virtual connections b/w a pair of customer's UNIs.

* eg:
→ The customer wanting to establish a new virtual path or increase the no. of Virtual circuits in a given virtual path.

CNM

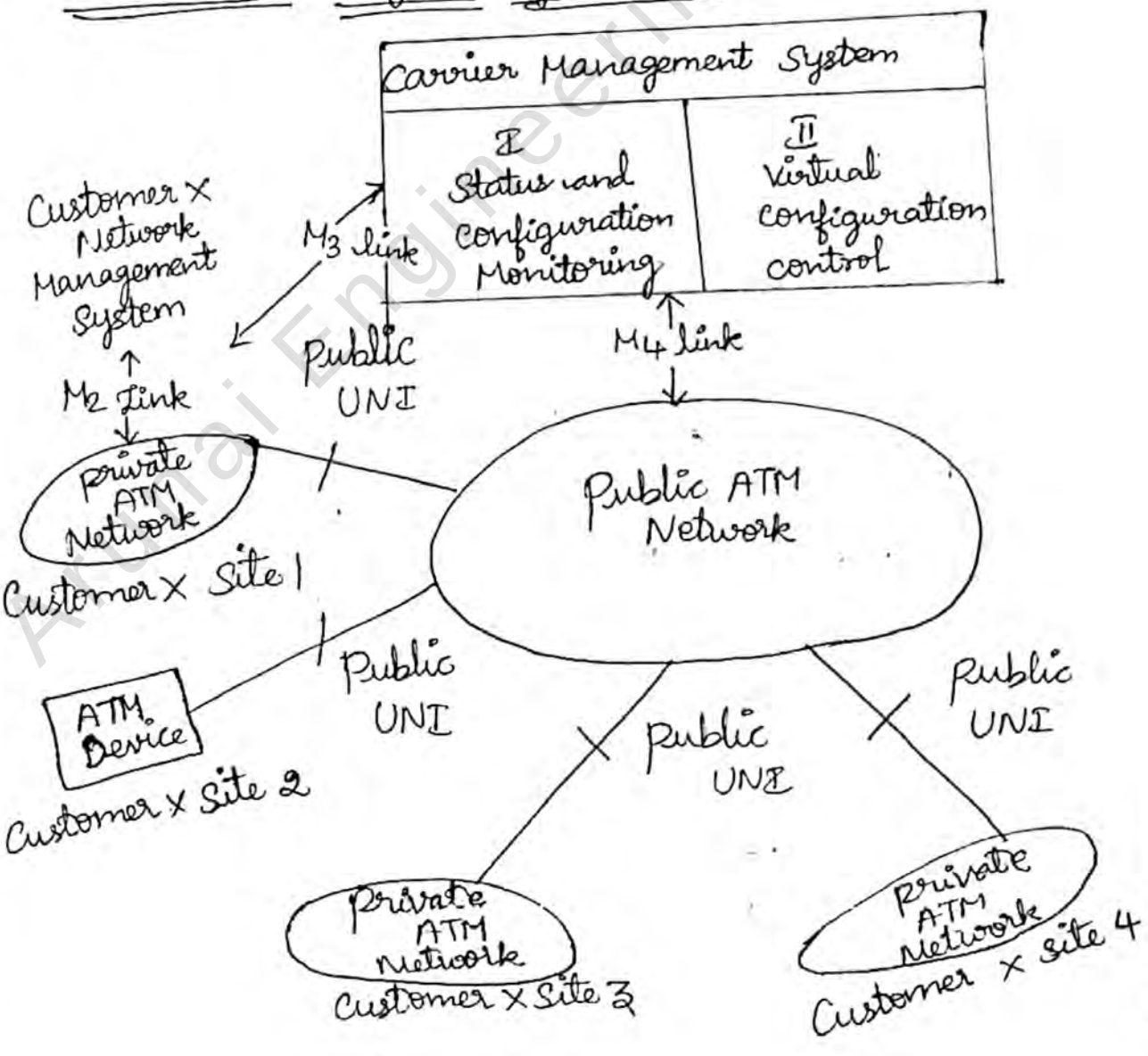
* A customer Nlw mgmt (CNM) agent resides in the private service provider is NMS provides the M3 service.

* The CNM sends requests to the carrier mgmt sim, which acts as an agent to the CNM.

* The carrier management s/m then invokes the request on the n/w elements (NE) or other NMS and returns the responses to CNM.

* The requirements for M3 & M4 are specified as mandatory or required, conditionally required and optional. Class I requirements are mandatory and class II requirements are optional.

Customer Mgmt of Private & Public N/w



Class I Interface Mgmt functions:

* The request's has SNMP "read-only" capability. The public nlw service provider should give the CNM customer the ability to retriere all the information.

Class II Interface Mgmt functions:

* M3 class II functionality is divided into 3 groups.

1. ATM-level subgroup
2. Vpc/vcc-level subgroup
3. Traffic subgroup.

* ATM-level subgroup should provide the CNM the ability to modify the ATM level infor configuration Infor.

* The vpc/vcc-level subgroup provides the CNM ability to modify.
  1. Virtual path link config. & status infor
  2. Virtual Channel link config & status in
  3. Virtual path connection config & status in
  4. Virtual channel connection Config & Status in

* The traffic subgroup shall provide the CNM the ability to modify.

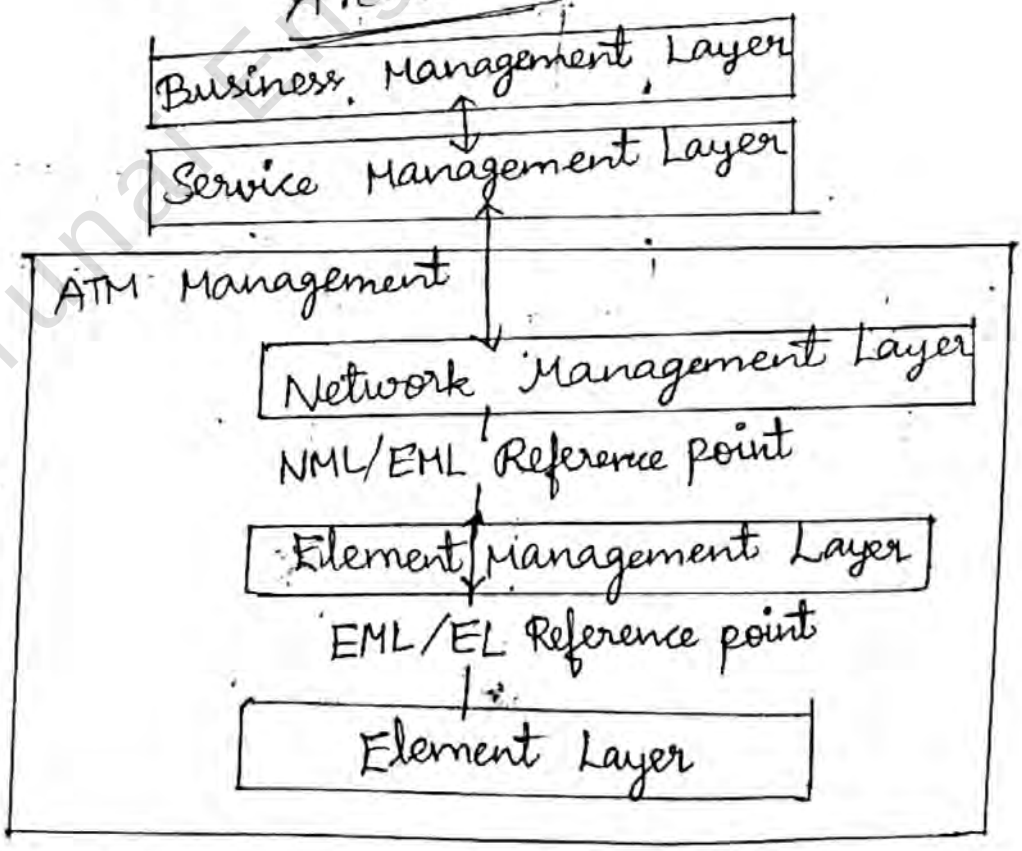
1. Traffic descriptors and infon objs for Vcc.
2. Traffic descriptors and infon objs for VPC.

(3) Explain in detail about M4 Interface.

* The mgmt of public ATM n/w is primarily the responsibility of n/w service providers such as PTT (Telephone and Telegraph) companies & postal Telephone and Telegraph (PTT) companies

* They have the challenge of not only managing the public n/w, but also keeping up with new technology.

ATM Relationship to TMN layered Architecture

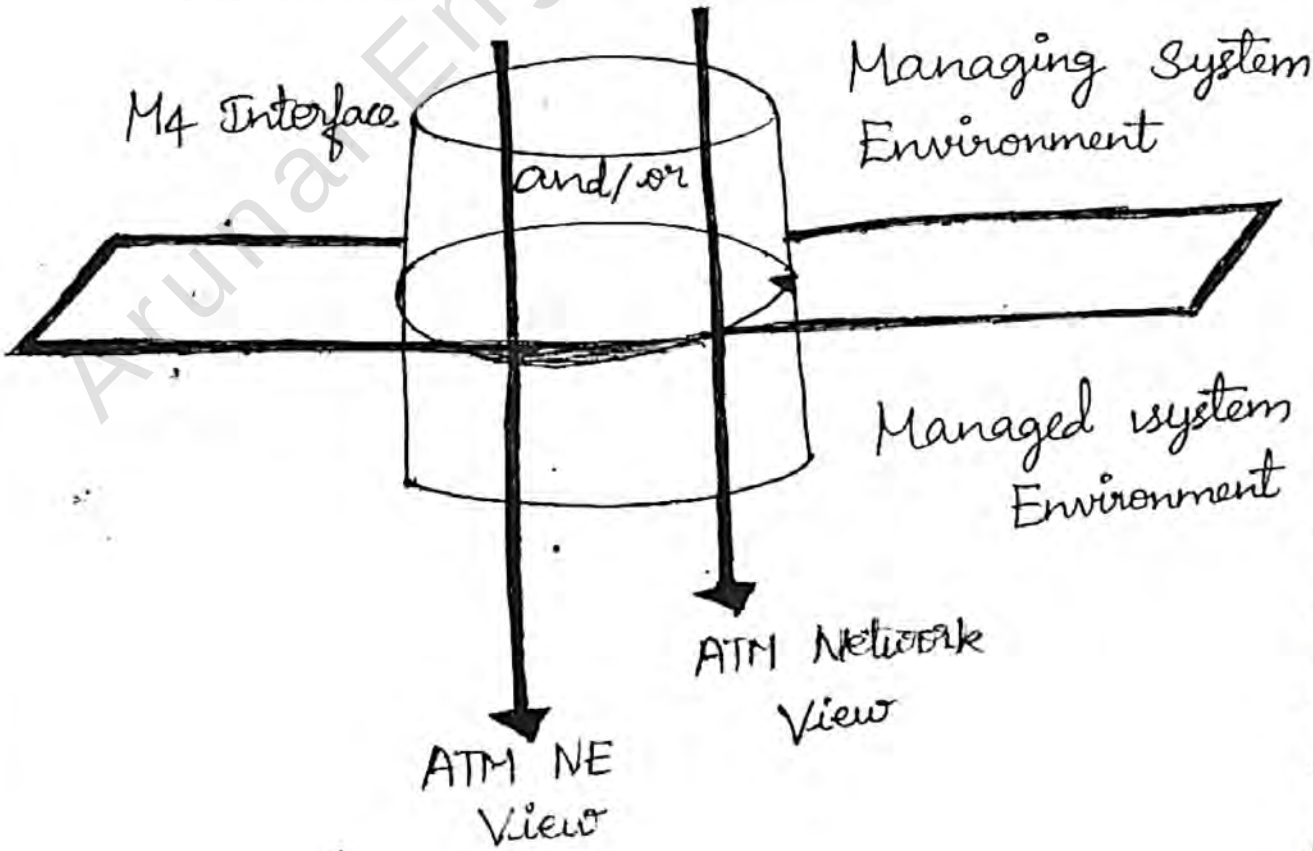


* The top two layers, the business mgmt layer and the service mgmt layer, deal with the business and service aspects of TMN and are not addressed by the ATM Forum.

* The element layer (EL) contains NEs. The NEs specific to ATM technology are components such as ATM workstation, ATM switches, ATM transport devices etc.

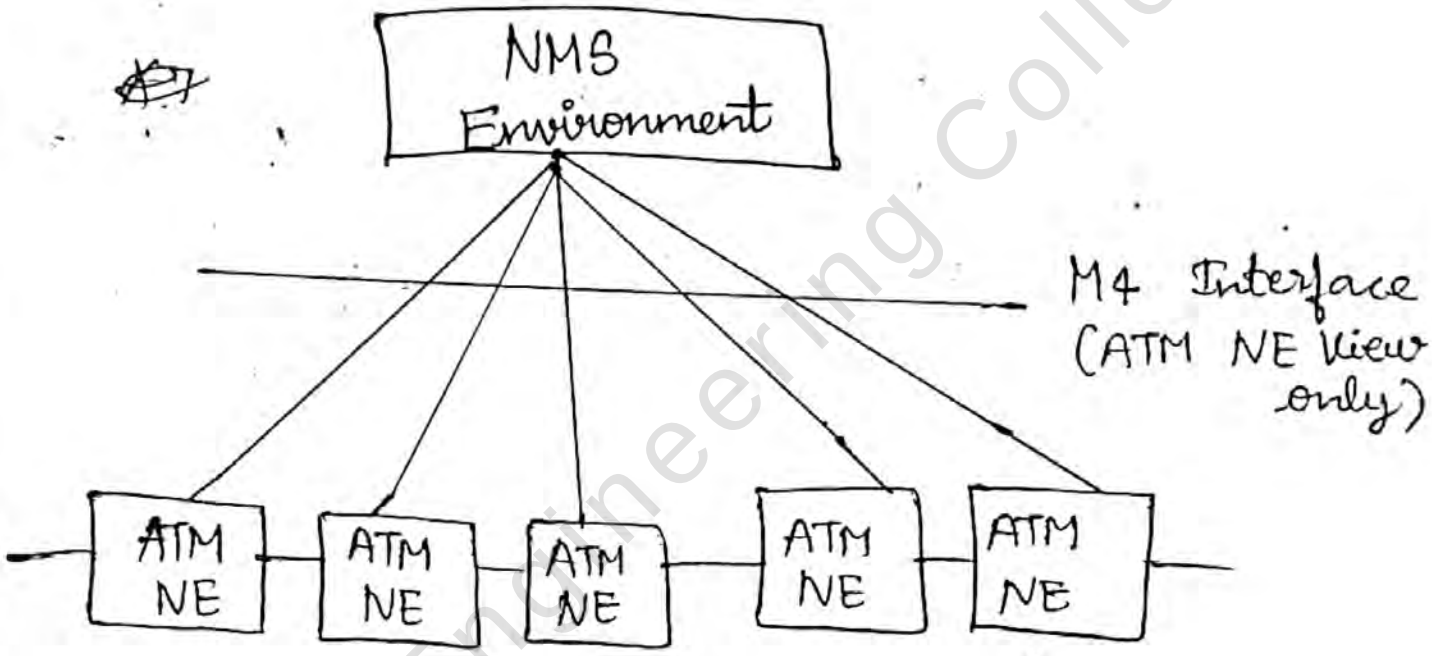
* The element mgmt layer (EML) manages NEs. The n/w mgmt layer (NML) has the responsibility to manage the n/w either directly or via the EML.

Dual View of the M4 Interface:



* Both views are present in the architecture across the M4 I/f plane. It should be noted that this is a conceptual view, and the physical connections can be the same for both views.

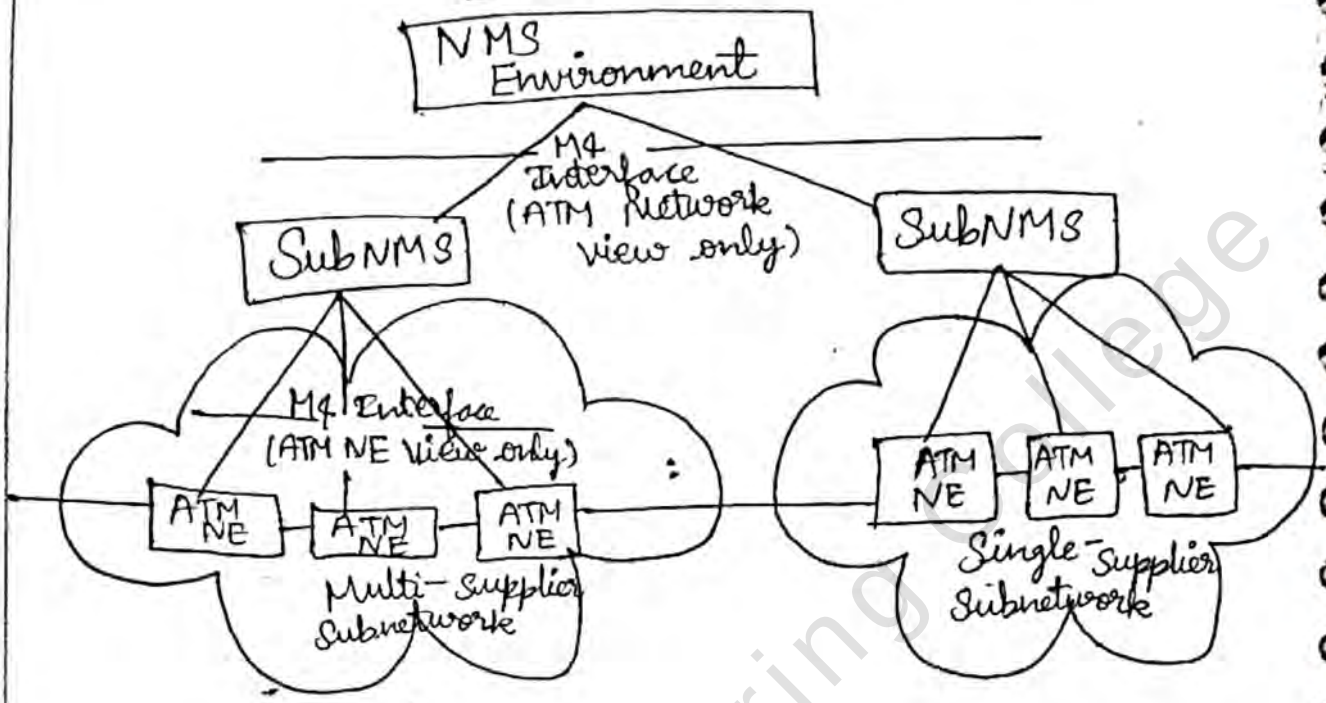
NE-View Mgmt Architecture



* The NMS environment, consisting of one or more NMSs, directly interfaces with the ATM NE and manages them.

* There is a single M4 i/f b/w ATM NE and the NMS environment.

Example of N/w View mgmt physical Configuration



* It consists of 2 ATM s/n/ws, one a single-supplier subnetwork and the other a multi-supplier subnetwork.

* In the single-supplier subnetwork shown on the right side, the subNMS has only an ATM NE view.

* In the multi-supplier subn/w environment shown on the left side, the subNMS is presented only an ATM NE view, although it may actually be communicating to lower-level NMS of each supplier.

(A) Explain in detail about N/w statistics Measurement Systems?

* One key aspect of n/w mgmt is traffic mgm. Networking tools, SNMP tools are used to gather n/w statistics in the n/w at various node and segments.

* One of the best ways to gather n/w statistics is to capture packets traversing n/w segments or across node interfaces in a promiscuous mode.

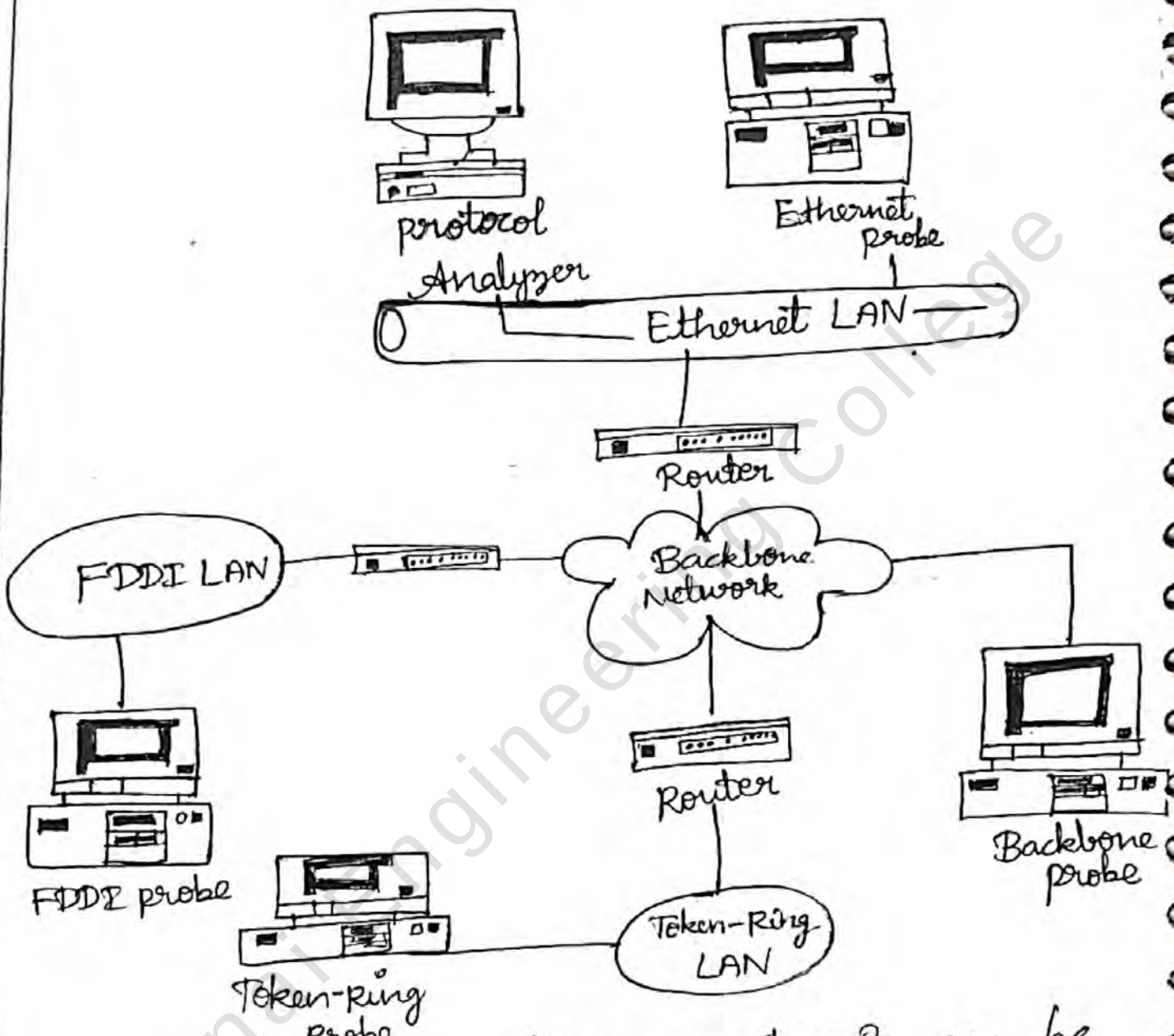
* Another way to gather n/w statistics is to develop a simple appln using a function similar to tcp dump, using a high-performance n/w interface card & processor and analyse the data for the required statistics.

1. Traffic Load Monitoring:

* Traffic load monitoring can be done based on the source, the destination and the source, destination pair.

* To balance the traffic load among the various LAN segments, in which case we need to measure the total traffic in each n/w segment or domain.

Monitoring of Total Nw with individual RMON probes.



* Data for traffic monitoring can be sampled at the data link layer using the RMON MIB history group.

* Traffic relevant to a host, either as source or as a destination, is available in the host group.

* Hosts can be ranked on the traffic load that they carry using the HostTopN group.

* Load statics in an IP n/w can be obtained measuring IP packets at the n/w layer level.

* Traffic is measured as the no. of. octets.

eg:

* news-ext.gatech.edu transmitted 3k octets/sec of outgoing traffic to and received 60k octets of incoming traffic from howland.erols.net.

Load statistics : Monitoring of conversation pairs

HP NetMetrix/UX: Load Monitor view - Agent: Cocacola

File Help

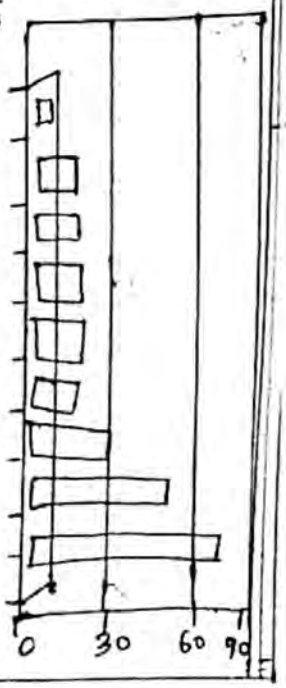
Data: Live
Zoom: conversation

10 Selected of 1089

NetHost1 ⟷ NetHost2	octlor2	Oct2or1
news-ext.gatech.edu ⟷ cliffy.rs.itd.umich	1K	6K
LOW-CONTRIB ⟷ santanni.cc.gatech.e	2K	6K
epk-news-hub1.bbnplan ⟷ news-ext2.gatech.edu	7K	1K
news-ext.gatech.edu ⟷ ucp-pacifier.com	9K	818
LOW-CONTRIB ⟷ LOW-CONTRIB	7K	3K
Usenet.news.psi.net ⟷ news-ext.gatech.edu	657	10K
news-ext.gatech.edu ⟷ news-[illegible]b.bis.com	17K	603
LOW-CONTRIB ⟷ LOW-CONTRIB	4K	24K
feta-fddi.gatech.edu ⟷ atlanta3.mbone2.bbnp	20	43K
news-ext.gatech.edu ⟷ howland.erols.net	30K	60K

K octets/Sec

Average total octs 20.636K.



2. Protocol Statistics

* Packets can be captured by data capture devices based on the filter set for the desired criteria.

* From the captured data, we can derive protocol statistics of various protocols at each layer of the OSI Reference model.

* This is very useful at the application layer level.

* We can obtain the traffic load for different applns such as file transfer (FTP), web data (HTTP) & news group (NNTP).

* This infon can be used for bandwidth mgmt of real-time & non-real-time.

3. Data and Error statistics

* Data and error statistics can be gathered directly from managed objects using the specified defined in various MIB groups.

Eg * Statistics on Ethernet can be derived fro.
- the Ethernet-like statistics group in Ethernet
- like -i/f types MIB [RFC 1284], Token-ring
- Statistics from IEEE 802.5 MIB [RFC 1748]

(5) Explain in detail about Network Mgmt S/m.

Network Management:

* A n/w consists of routers, switches and hubs connected by n/w links. Servers, workstations and PCs are connected to LANs in the n/w.

* The first task involved in n/w mgmt is the configuration of the above n/w elements, their agents and the NMS itself. This includes discovery of n/w elements and the topology of the n/w.

* The fault mgmt capability of the NMS must support monitoring of the health of the NEs and links.

* The NMS reports faults to the operator in a variety of ways depending on the nature, severity, and importance of the fault.

* The NMS must support performance mgmt especially of the expensive WAN links. Report in this category include n/w availability systems availability, pbm reports, servic response to problem reports and customer satisfaction.

* Performance mgmt provides traffic trend reports to enable the n/w administrator to identify bottlenecks.

* Account Mgmt

* It is probably the least developed function of network mgmt applications. It include individual host use, administrative segments and external traffic.

* The cost of operations for the Information mgmt services department is based on the service that it provides to the rest of the org.

Security Mgmt:

* It is both technical and an administrative issue in infon mgmt. It involves securing access to the n/w and information flowing in the n/w access to data stored in the n/w & manipulation the data that are stored & flowing across the n/w.

2. System And Application Management:

* S/m and n/w mgmt are begining to be considered together as a solution for information mgmt issues and pbms.

* S/m mgmt tools, which used to be custom dereloped, are currently available as commercial S/m and are being integraled with n/w mgmt.

3. Enterpriše Management.

* Two solutions are offered by two vendors, Computer Associates and Tivoli. Both partners with several NMS vendors provide integraled solutions.

Computer Associates Unicenter TNG.

* The CA unicenter TNG framework provides infrastructure having support integraled distributed enterpriše mgmt.

* It is based on a client/seaver architecture having an agent in each host and a centralized workstation.

* Both two-dimensional and three-dimentional presentations are available.

Tivoli Enterprise Manager

* Tivoli Enterprise mgmt framework, originally named the Tivoli TME 10 framework, provides s/m & n/w mgmt and is in the same class as the unicenter TNG framework.

A. Telecommunications Mgmt systems

* A typical telecommunication n/w often includes equipment acquired over several years and a telecommunication NMS must be capable of managing these heterogeneous s/ms from a single point.

* Typical telecom n/w include multivendor multitechnology equipment, supporting diverse protocols.

* Provisioning of bandwidth is a common and important requirement in telecom n/ws.

* A related requirement is the maintenance of the latest inventory in the db so that when there is an incoming bandwidth-provisioning request, reliable & fresh info about the availability of bandwidth can be accessed.

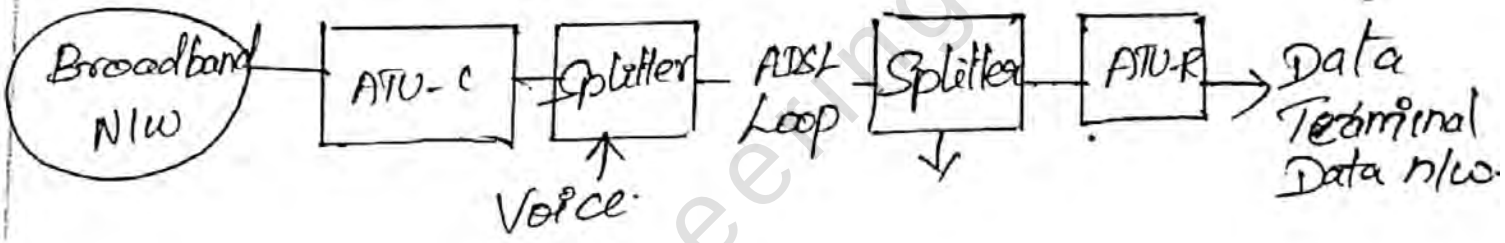
(6) What is ADSL ? Explain it in detail ?

ADSL

* Assymetric digital subscriber Line (ADSL).

* ADSL is a type of DSL technology that enables faster data transmission over copper telephone lines than a Conventional Voiceband modem

ADSL Access Network.



* ATU – ADSL transmission unit and Splitter at each end of the ADSL line.

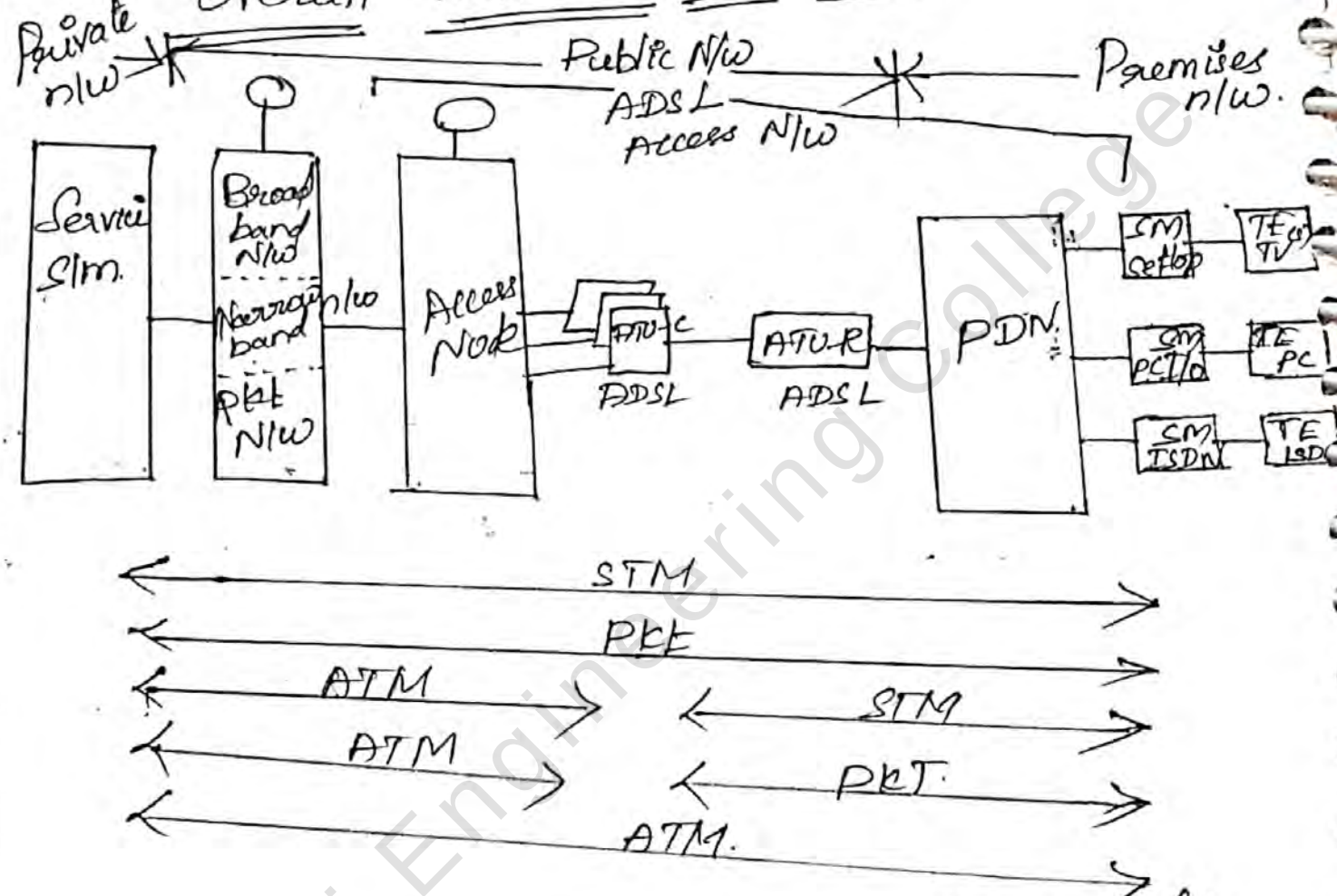
* ~~The ATU terminating unit~~ ..

* The ATU at the central office is ATU-C and the one at the customer residence is ATU-R

* The ATU is also called the ADSL modem. The data and video s/l from the broadband n/w is converted to an analog s/l by the ATU-C and multiplexed and demultiplexed.

* The splitter at the central office combines the plain old telephone service (POTS) voice s/l and the broadband s/l.

Overall Network and ADSL.



ATM – Asynchronous Transfer Mode
STM – Synchronous Transfer mode.
TE – Terminal Equipment
OS – Operating S/m
PDN – premises Distribution N/w
SM – Service Module.

* The service systems are on a private n/w providing on-line services, Internet access, LAN access, interactive video and video conferenc Services.

* The private network interfaces with the public n/w, which is broadband, narrowband or pkt n/w.

* The access node is the concentration point for broadband, narrowband data, and pkt data.

* It is either located in the central office or a remote location such as ONU.

* The access node include ATU-Cs, such as in a digital subscriber loop access multiplexer.

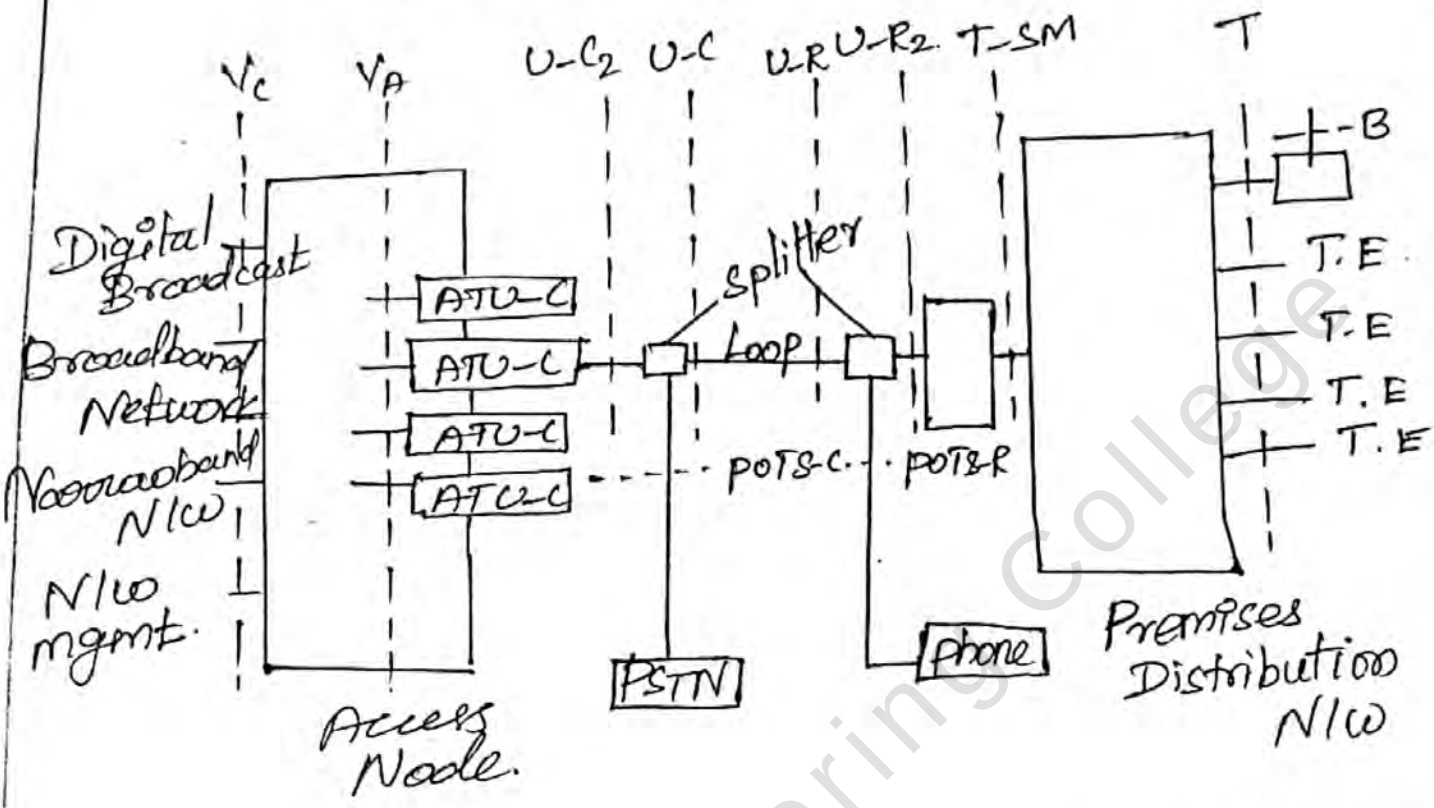
* STM, which is the bit synchronous transmission mode. An eg of this is the bit pipe such as T_1/E_1, ISDN or a simple modem.

* The 2nd transport scheme is the end to end pkt mode such as IP packets.

* The next 2 transport modes are hybrid modes.

ADSL Architecture

ADSL system Reference model.



* Additional components are splitters at the central office and customer premises, which separate low-freq telephony from video and digital data.

* PSTN is the switch connected at the Central office, while telephones are off the Splitter at the customer end.

* Digital broadcast is the typical broad-cast video.

*N/w mgmt could be treated as one of lte OS components.

*There are 5 interfaces : V, U, T, B and Pos

→ Vc is lte i/f b/w lte access node & n/w, it is usually physical I/f.

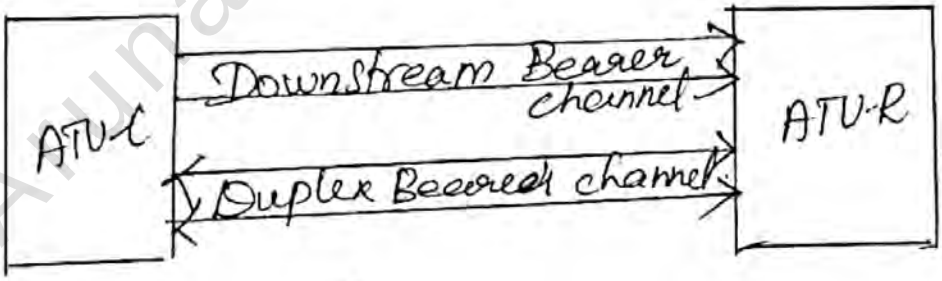
→ VA is lte logical I/f b/w ATU-C & lte access node.

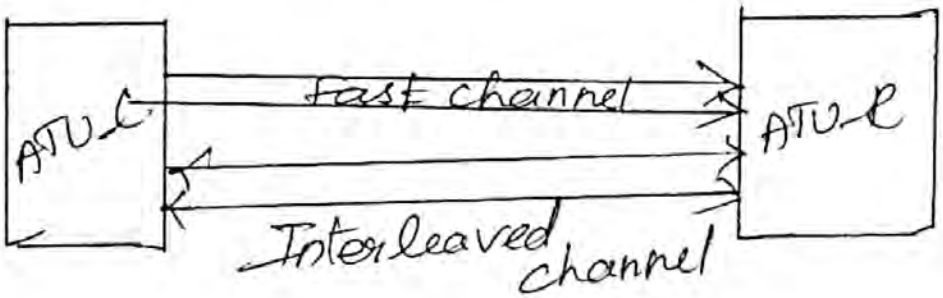
→ U I/f may disappear when ADSL-Lite is implemented.

— B I/f is for auxiliary data i/p.

ADSL - Channeling schemes:

ADSL channeling.





* Real-time signals, such as audio & real-time video use a fast buffering scheme and hence are referred to as the fast channel.

* The digital data channel is referred to as the interleaved channel.

ADSL - Encoding Schemes.

* ADSL mgmt is dependent on the line-encoding scheme used, and hence we will have two type. They are,

① Carrierless amplitude and phase (CAP)

② Discrete multitone (DMT) technology.

* Both are based on the QAM scheme.