NTNU
Norges teknisk-naturvitenskapelige universitet
Institutt for telematikk

EXAM TTM4128 – NETWORK AND SERVICE MANAGEMENT
EKSAM I TTM4128 – NETT OG TJENESTEADMINISTRASJON

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Date / **dato**:   04.06.2011

Time / **tid**:   09:00-12:00

Remedies /   **D**: No printed or handwritten remedies allowed.
Tillatte hjelpemidler: **D**: Ingen trykte eller håndskrevne hjelpemidler tillatt.

Language / **Språkform**:   English / Norsk (Bokmål)
(Den engelske oppgaveteksten er den originale og gyldige teksten.)

Results / Sensurdato: 28.06.2011

English

Question 1.   **(5%)**
What are the basic concepts used to define the structure of Tables in SNMPv1?
Basic concepts are: Table, Entry, Columnar Objects, Rows and Index

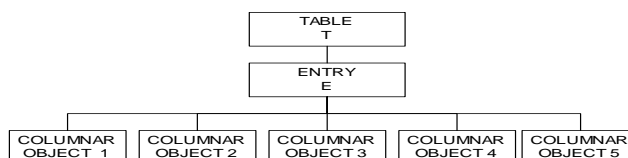**Tabular Representation of Aggregate Objects**

Figure 4.22(a) Multiple Instance Managed Object

- The objects *TABLE T* and *ENTRY E* are logical objects.
  - ❖ They define the grouping and are not accessible
- Columnar objects are objects that represent the attributes and hence are accessible
- Each instance of *E* is a row of columnar objects 1 through 5
- Multiple instances of *E* are represented by multiple rows

Example:

Question 2.   **(25%)**
Assume the following table has an OID of *1.3.6.1.2.1.65.3.8:*

rsIndex	rsAddress	rsType	rsAccess
4	168.192.20.4	Types.1	readWrite
2	168.192.20.2	Types.2	readOnly
1	168.192.20.1	Types.3	readWrite
3	168.192.20.3	Types.4	readOnly

    a) Define the table entry using ASN.1 notation and using the first two columns as indexes.
    b) Give the OID of the last two columns.

c) Give the OID and the value of the entry in the 1st row and 3rd column

a)
tableEntry OBJECT-TYPE
SYNTAX TableEntry
ACCESS not-accessible
STATUS mandatory
DESCRIPTION "Entry of this table"
INDEX { *rsIndex*, *rsAddress* }
::= { 1.3.6.1.2.1.65.3.8 1 }

TableEntry ::= SEQUENCE {
rsIndex   INTEGER,
rsAddress   IpAddress,
rsType   RSType,
rsAccess   RSAccess}

b)
rsType ::= { 1.3.6.1.2.1.65.3.8.tableEntry 3 }
rsAccess ::= { 1.3.6.1.2.1.65.3.8.tableEntry 4 }

c)

rsIndex	rsAddress	rsType	rsAccess
1	168.192.20.1	Types.3	readWrite
2	168.192.20.2	Types.2	readOnly
3	168.192.20.3	Types.4	readOnly
4	168.192.20.4	Types.1	readWrite

1.3.6.1.2.1.65.3.8.tableEntry.1.168.192.1 and its value is Types.3

Question 3.   (5%)
Describe shortly the models that constitute the OSI Network Management.
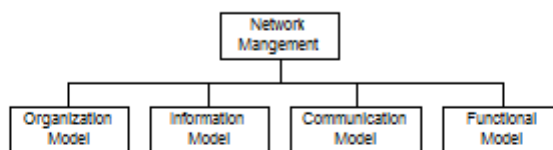

Figure 3.1 OSI Network Management Model

- **Communication Model**
  - Management application layer processes
  - Layer management
  - Layer operations
- **Functional Model**
  - FCAPS *(See Section 3.9)*
  - Service management
  - Business management

Service and Business management functionality is layered on top of FCAPS. In this context "service" is an administrative telecom services.
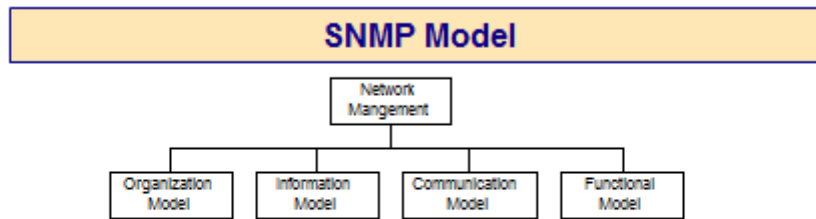
Figure 3.1 SNMP Network Management Model

- **Organization Model**
  - Same as for OSI management model
- **Information Model**
  - Same as for OSI management model, but *scalar*
- **Communication Model**
  - Messages less complex than OSI and unidirectional
- **Functional Model**
  - Application functions
    - → Operations and notifications of the SNMP protocol
    - → Administrative model
    - → Security model

Question 4. (10%)

Answer the following statements by indicating TRUE or FALSE:

1) SNMPv1 protocol uses only UDP as transport protocol
2) SNMP access policy is the pairing of the SNMP MIB view with the SNMP access mode
3) RowStatus is an enumerated Integer used by the manager when creating and deleting rows
4) Trap and get-request messages have the same message format in SNMPv1
5) Abstract service interface is used to provide access control

(There will be minus points for wrong answers)

TRUE
FALSE
TRUE
FALSE
FALSE

Question 5. (25%)

a) What is HTML? What is XML?
b) What are the differences between XML and HMTL?
c) Explain why XML is the fundament of the semantic Web?
d) How can Web service be used in network management? Sketch and explain one solution.

a) What is HTML?
HTML is a language for describing web pages.
- HTML stands for Hyper Text Markup Language

- HTML is not a programming language, it is a markup language
- A markup language is a set of markup tags
- HTML uses markup tags to describe web pages
- Hyper Text is used for navigation. By clicking on hyperlinks users can move to another page.

What is XML?
XML is a language designed to carry data, not to display data
- XML stands for eXtensible Markup Language
- XML is a markup language much like HTML
- XML tags are not predefined. The users must define your own tags
- XML is designed to be self-descriptive
- XML is a W3C Recommendation

b) The differences between HTML an XML are as follows:

- HTML was designed to display data and to focus on how data looks .XML was designed to describe data and to focus on what data is.

- The tags used to mark up HTML documents and the structures of HTML documents are predefined. The author of HTML documents can only use tags that are defined in the HTML standard. XML tags are not predefined. XML allows the author to define his own tags and his own document structure

- HTML is not case-sensitive while XML is case-sensitive

c) The semantic Web is the Web that carries semantics or meanings enabling users to search not only for documents that contain data, but also for the desired data itself, through "semantic" identification and location techniques.

XML does not by itself impose any semantic constraints on the meaning of the documents. However, it provides a surface syntax for addition of arbitrary structures and paves the way for extension like RDF, RDF Schema, Oil, OWL, etc. which bring meaning or semantic to the Web.

d) In Network management, the model Manager- Agent is broadly used. A Manager manages several Managed object via Agents. In the OSI systems management (OSI-SM) using the Common Management Information Service/ Protocol (CMIS/P) the Managed object supports full inheritance, provide interface for both Get, Set, Action, Create, Delete and advanced event system. The Web service concept is quite suitable to implement the Managed-object exposing interface containing methods for Get, Set, Action, Create, Delete.

One solution is to add embedded web-service based agents to network components. Data is pushed by the management agents in managed objects to the manager applications. WS are used to utilize the network management applications and their remote interfaces, e.g. remotely apply maintenance, provisioning, monitoring, configuration, etc. activities via a SOAP interface.
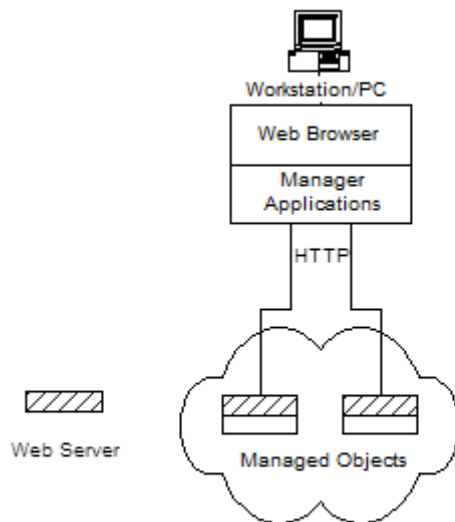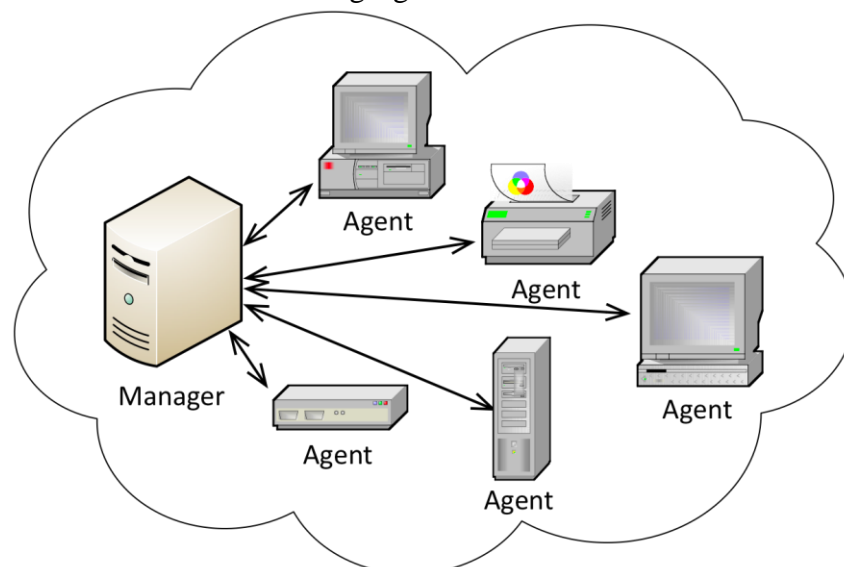
Figure 14.3 Embedded WBM Configuration

Figure.

Question 6.   **(15%)**
As a network manager one of your jobs is to manage a network that consists of some components as illustrated in the following figure.

In order to help detecting network congestion problem, every agent informs the manager the total number of IP packets it received and sent every five minutes. The manager logs the information that thereafter can be utilized further, for example, to create a chart displaying real-time network traffic.

Hence, you need to develop a small application that enables the agents to send the values. Moreover, the manager should be able to log the information (the chart creation is not part of your task). You use *net-snmp* tool-suite and SNMP v2 for this.

    a.   In which MIB module you can find the total number of IP packets received and sent?

    b.   Which part of *net-snmp* you use in the manager and the agents? What do you need to configure/define on those components? Describe briefly how your application should work! (Note: you are not asked to write a code in your answer sheet!)

a) IP- MIB module

b) On the manager side, we need to run an application that can receive SNMP notification/trap. *net-snmp* contains `snmptrapd`, a daemon that can do this task.
On the agent side, we use `snmpd` (an SNMP agent daemon) and utilize `snmpget` and `snmptrap` commands from *net-snmp*.
We need to configure the agent to response to get requests containing a certain community name. On the manager side, we configure that notifications with a certain community name are logged. Moreover, we need to define a notification type on the MIB tree. This OID will be used to uniquely identify our notifications.
The application is run on the agent part. Every five minutes it executes `snmpget` command that will get the number of IP packets received and sent from `snmpd` application. Then, the application executes `snmptrap` command to send a notification to the manager containing the specified community name, the specified OID and the values.

Question 7.   **(15%)**
In the semester assignment part 2 you have created a semantic web application that can receive an alias of an MIB object name and return the value of the corresponding MIB object instance of a certain agent. Moreover, you have deployed this application as a web service. The following figure summarizes the assignment.

Using a web browser on the Host, a user provides an alias and invokes your web service to obtain the value of the corresponding object instance of the Agent.
Explain briefly how your application works from the moment a user provides *hostuptime* as the alias until obtains the result (the value of *hrSystemUptime* of the Agent)! What are the messages exchanged during the process?

When the user provides *hostuptime* and invokes the service from a web browser, a SOAP-request placed as a payload of an HTTP GET message is created and sent to the service provider part of the web service. Then the semantic web application on the manager side will look the MIB object names of *hostuptime* up and should give *hrSystemUptime* as the result. Thereafter, an `snmpget` command that sends an SNMP get-request message to the Agent is executed. The Agent retrieves the value of *hrSystemUptime* object instance and sends the result back to the manager using an SNMP get-response message. The result is further forwarded to the Host, encapsulated as a SOAP response in an HTTP response message.

NORSK

Oppgave 1.   **(5%)**
Hva er de grunnleggende begreper som brukes til å definere strukturen av tabeller i SNMPv1?

Oppgave 2.   **(25%)**
Anta at følgende tabellen har en OID av 1.3.6.1.2.1.65.3.8*:*

rsIndex	rsAddress	rsType	rsAccess
4	168.192.20.4	Types.1	readWrite
2	168.192.20.2	Types.2	readOnly
1	168.192.20.1	Types.3	readWrite
3	168.192.20.3	Types.4	readOnly

a) Definer tabellen's oppføringen i ASN.1 notasjon og bruk de to første kolonnene som indekser.
b) Gi OID av de to siste kolonnene.
c) Gi OID og verdien av oppføringen i første rad og tredje kolonne

Oppgave 3.   **(5%)**
Beskriv kort de modellene som utgjør OSI Network Management.

Oppgave 4.   **(10%)**
Svar følgende ved å skrive TRUE eller FALSE:

1) SNMPv1 protokollen bruker kun UDP som transport protokoll
2) "SNMP access policy" er kombinasjon av "SNMP MIB view" med "SNMP access mode"
3) RowStatus er en "enumerated Integer" som brukes av manageren ved oppretting og fjerning av rader
4) Trap og get-request meldinger har samme melding format i SNMPv1
5) "Abstract service interface" er brukt for å oppnå access control

(feil svar gir minus poeng)

Oppgave 5.   **(25%)**

a) Hva er HTML? Hva er XML?
b) Hva er forskjeller mellom XML og HTML?
c) Forklar hvorfor XML er fundament av Semantisk Web?
d) Hvordan kan webtjenesten brukes i nettverksadministrasjon? Skisser og forklar én løsning

Oppgave 6. **(15%)**
Som en nettverksleder en av dine oppgaver er å administrere et nettverk som består av noen komponenter som illustrert i figuren nedenfor.
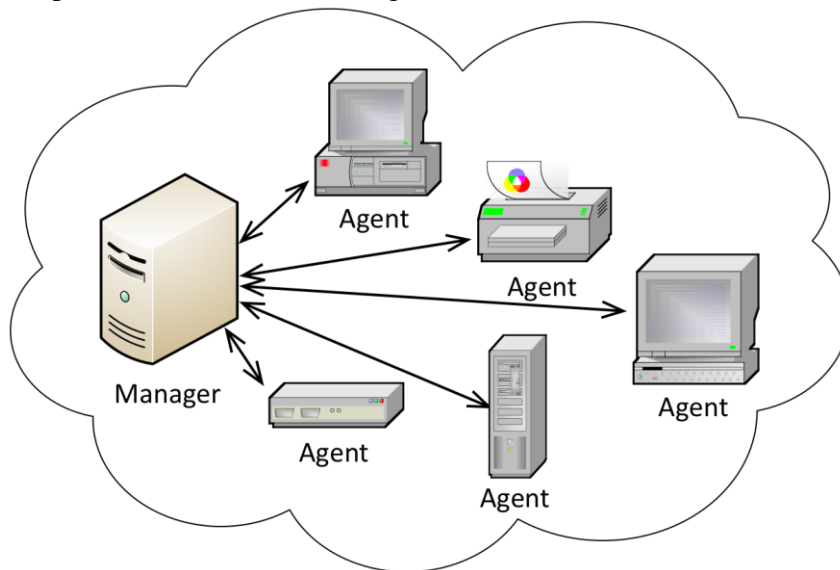

For å hjelpe detektere nettverket's "congestion problem", informerer hver agent manageren det totale antallet IP-pakker den mottok og sendte hvert femte minutt. Manegeren lagrer den informasjonen som deretter kan utnyttes videre, for eksempel, å lage et diagram som viser real-time nettverkstrafikk.
Derfor trenger du å utvikle en liten applikasjon som gjør at agenter sender IP-pakker verdiene. Videre bør manageren være i stand til å lagre informasjonen (diagram etableringen er ikke en del av oppgaven din). Du bruker net-snmp verktøy og SNMP v2 for dette.
a. I hvilken MIB modul du kan finne det totale antallet IP-pakker som mottas og sendes?
b. Hvilken del av net-snmp du bruker i manager og agenter? Hva trenger du for å konfigurere / definere på disse komponentene? Beskriv kort hvordan programmet skal fungere! (Merk: du blir ikke bedt om å skrive en kode i svaret!)

Oppgave 7. **(15%)**

I semesteroppgaven del 2 har du laget en semantisk web-applikasjon som kan motta et alias av et MIB objekt navn og returnere verdien av den tilsvarende MIB objekt forekomst av en viss agent. Videre har du utplassert dette programmet som en webtjeneste. Figuren nedenfor oppsummerer oppdraget.
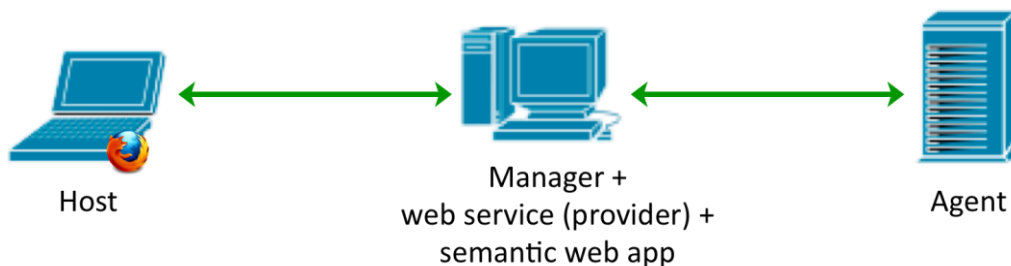
Ved å bruke en nettleser på host maskinen, en bruker kan gi et alias og påkaller din web service for å få verdien av det tilsvarende objektet forekomsten av agenten.
Forklar kort hvordan programmet fungerer fra det øyeblikket en bruker gir hostuptime som

alias til får resultatet (verdien av hrSystemUptime av agenten)! Hva er meldingene som blir utvekslet under prosessen?