NTNU
Norges teknisk-naturvitenskapelige universitet
Institutt for telematikk

SOLUTION PROPOSAL for EXAM TTM4128 – SERVICE AND RESOURCE MANAGEMENT

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Date / **dato**: 26. mai 2006

Time / **tid**: 09:00-13:00

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

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

Results / Sensurdato: Week 25 / Uke 25, 2006

English

Question 1. Network Management Systems (25%)

a) List the main functions of Network Management (functional groupings). Explain the content of at least two of these functions.

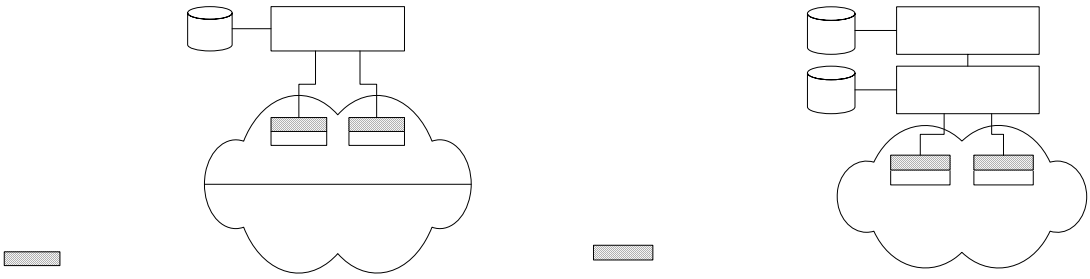
Book section 1.8 & Lecture 2b

- Network provisioning
  - i. Network planning and design
  - ii. Responsibility of the engineering group
- Network operations
  - i. Responsibility of the Network Operations Center (NOC)
  - ii. The daily operations of the network: Fault, Configuration, Accounting, Performance, Security (FCAPS)
  - iii. Fault management: managing the occurrence of faulty events such as disconnections at virtual connections, links, and interfaces
  - iv. Configuration management: setting and tuning various network devices
  - v. Accounting management: charging and billing the use of resources in an enterprise
  - vi. Performance management: measurements of performance metrics
  - vii. Security management: preventing unauthorized access, attacks, and protecting data
- Network maintenance
  - i. Installation and maintenance of equipment
  - ii. Responsibility of I&M group

b) What is meant by two-tier and three-tier network management systems? Draw the organization model of these systems (including the main components), and explain the differences between these systems.

Book section 3.3 & Lecture 2b

Two-tier: Agent built into network element, example: managed hub, managed router. An agent can manage multiple elements, example: switched hub, ATM switch. MDB is a physical database. Unmanaged objects are network elements that are not managed - both physical (unmanaged hub) and logical (passive elements)
Three-tier: Middle layer plays the dual role. Agent to the top-level manager. Manager to the managed objects. Example of middle level: Remote monitoring agent (RMON)



The main difference is that in three-tier model the intermediate layer acts as both manager and agent.

c) What is autonomic communication? What are adaptable service systems? Give examples of autonomic and adaptive systems.

Lectures 13, 14

Autonomic communication is a research initiative addressing network-level autonomic and self-organising communication paradigms. The main purpose is to define a self-organising communication network concept and technology that can be situated in multiple and dynamic contexts, ranging from sensor networks to virtual networks of humans.
Adaptable Service Systems are service systems that adapt dynamically to changes in both time and position related to users, nodes, capabilities, status and changed service requirements
Examples of autonomic and adaptive systems: routing protocols in ad-hoc networks, service discovery protocols, Bluetooth, UPnP, etc.

Question 2. SNMP (25%)

a) What are SMI and MIB? Explain the contents of them and what are they used for.

Book section 4.7 & Lecture 5

SMI is Structure of Management Information and MIB is Management Information Base. SMI contains the object type specifications (syntax and semantic rules), which includes the name, syntax, and encoding scheme, of the managed objects. SMI is used to confirm that MIB content and structure are in line with the standardized specifications.
MIB contains the managed objects (databases of variables) that represent the resources of a system and which may be monitored and modified by a (remote) manager to control the behaviour of that system.

b) Explain the differences between the SMI in SNMPv1 and the SMI in SNMPv2.

Book section 3.3 & Lecture b

SMI in SNMPv2 has been improved with the following:

- New data types (e.g. snmpDomains, snmpProxys)
- Notification introduced (have similar structure as other PDUs)
- Textual conventions
- Table expansion / Augmentation of tables
- Creation and deletion of rows

c) Consider the following Table:

index	**destination**	**next**
3	20.0.0.1	10.0.0.1
4	20.0.0.2	10.0.0.2
5	20.0.0.3	10.0.0.3
2	20.0.0.4	10.0.0.4
1	20.0.0.5	10.0.0.5

Assume the table Object ID is **1.3**. Assume the Object ID for the columns *index*, *destination*, and *next* is 1, 2, and 3 respectively (i.e. **1.3.1**, **1.3.2**, and **1.3.3**). Assume that you know the number of rows in the table when you make requests.

1. Show how to use a very simple *get-request* to get the **next** value of the row that has **index** value 5 in the following two cases:
    - Using the first column as index.
    - Using the first two columns as indices.

Book sections 5.1.4, 6.3 & Lectures 5, 6

By using the following format get-request (OID table, Column number, index1, index2):
get-request (1.3.3.5)
get-request (1.3.3.5.20.0.0.3)

2. Draw request-response messages between the manager and the agent using *get-next-request* and *response* messages to retrieve the values of the table (using the first two columns as indices)

First we reorganize the table in lexicographical order

index	**destination**	**next**
1	20.0.0.5	10.0.0.5

2	20.0.0.4	10.0.0.4
3	20.0.0.1	10.0.0.1
4	20.0.0.2	10.0.0.2
5	20.0.0.3	10.0.0.3

We use the following requests and reply messages:

--------- get-next-request (1.3.1, 1.3.2, 1.3.3) ---------->
<------- response (1.3.1.1.20.0.0.5 = 1, 1.3.2.1.20.0.0.5 = 20.0.0.5, 1.3.3.1.20.0.0.5 = 10.0.0.5) -------

--------- get-next-request (1.3.1.1.20.0.0.5, 1.3.2.1.20.0.0.5, 1.3.3.1.20.0.0.5) ---------->
<------- response (1.3.1.2.20.0.0.4 = 2, 1.3.2.2.20.0.0.4 = 20.0.0.4, 1.3.3.2.20.0.0.4 = 10.0.0.4) -------

--------- get-next-request (1.3.1.2.20.0.0.4, 1.3.2.2.20.0.0.4, 1.3.3.2.20.0.0.4) ---------->
<------- response (1.3.1.3.20.0.0.1 = 3, 1.3.2.3.20.0.0.1 = 20.0.0.1, 1.3.3.3.20.0.0.1 = 10.0.0.1) -------

--------- get-next-request (1.3.1.3.20.0.0.1, 1.3.2.3.20.0.0.1, 1.3.3.3.20.0.0.1) ---------->
<------- response (1.3.1.4.20.0.0.2 = 4, 1.3.2.4.20.0.0.2 = 20.0.0.2, 1.3.3.4.20.0.0.2 = 10.0.0.2) -------

--------- get-next-request (1.3.1.4.20.0.0.2, 1.3.2.4.20.0.0.2, 1.3.3.4.20.0.0.2) ---------->
<------- response (1.3.1.5.20.0.0.3 = 5, 1.3.2.5.20.0.0.3 = 20.0.0.3, 1.3.3.5.20.0.0.3 = 10.0.0.3) -------

3. Draw request-response messages between the manager and the agent using *get-bulk-request* and *response* messages to retrieve the values of the table (using the first two columns as indices)

We use the following requests and reply messages:

--------- get-bulk-request (0, 5, 1.3.1, 1.3.2, 1.3.3) ---------->
<------- response (1, 20.0.0.5, 10.0.0.5, 2, 20.0.0.4, 10.0.0.4, 3, 20.0.0.1, 10.0.0.1, 4, 20.0.0.2, 10.0.0.2, 5, 20.0.0.3, 10.0.0.3) -------

d) Give a brief description of the following SNMP concepts: *community*, *MIB view*, *community profile*, and *access policy*.

Book section 5.1.2 & Lecture 6

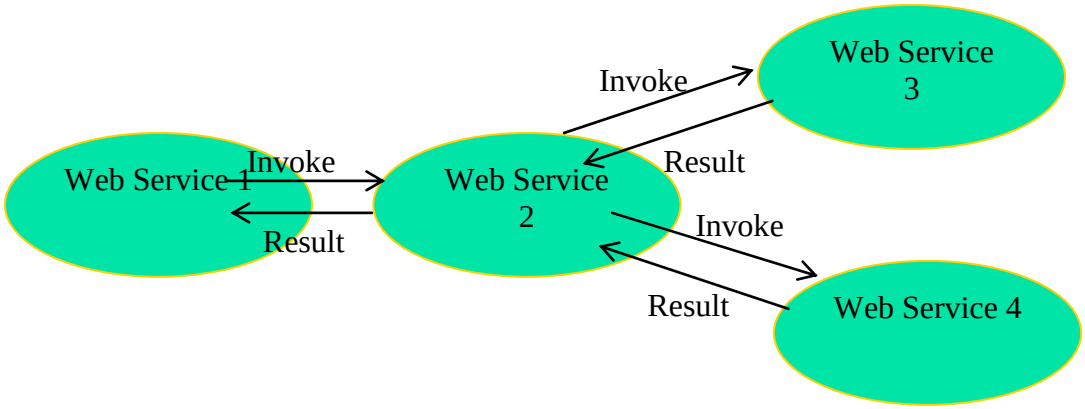
Community in SNMP is a pairing of an application entity residing in the management station (SNMP manager) and an application entity in the element (SNMP agent).
MIB view is the authorization information that controls the viewing permission of the network element's managed objects. (Simplified definition: the "MIB View" defines which SNMP parameters can be accessed by the SNMP manager)
Community profile is a pairing of an SNMP MIB view with an SNMP access mode (SNMP access mode can be NOT-ACCESSABLE, READ-ONLY, WRITE-ONLY, or READ-WRITE)
Access policy is a pairing between an SNMP community with an SNMP community profile.

Question 3. Web Services / Semantic Web (25%)

a) Justify why Web services can be useful in Network Management. Hint: Start by explaining shortly what network management is, then explain what a Web service is. Next, try to use the Web services concept in the realization of a Network Management System. Finally, explain the benefits of using the Web services in Network Management.

A Web service

- Describes any computational functionality that can be found and invoked over any network (e.g. the Internet).
- Represents a self-describing, self-contained application.
- Designed to be used by other programs or applications rather than humans.
- Access via transparent Internet protocols like http, ftp etc.
- Can be mixed and matched with other Web Services in a value chain.



The Web service concept is quite suitable to implement Managed-object exposing interface for Get, Set, Action, Create, Delete.

The biggest advantages of using the Web service in network management are as follows:

- It uses XML which is a universal data format
- It is based on HTTP that passes through firewalls
- It is using SOAP that can be easily manipulated by all software programs

b) Explain clearly why there is a need for the Semantic Web. Use examples to illustrate. Explain the benefits that the Semantic Web can bring. How the content of web-documents can be realized.

There is a need for the Semantic Web because the current World Wide Web has the following serious limitations:
1. It focuses on publishing and presenting documents to human beings but one must know where things are located.

Example: The URL: http://www.w3.org/Addressing/. indicates only address of a web page and not what exactly it contains

2. It is quite difficult to find things. People need somehow to get information about what are contained where e.g. from email, from advertisement, etc.

Example: It is not easy to use Google to find supermarket in Alicante. By using the keywords supermarket and Alicante, no correct result is obtained. However, by using the keywords hipermercado and Alicante, all the supermarkets in the Alicante region are listed.

The problem is that with HTML the semantic binding between supermarket and hipermercado, which is the “equivalent” relation, cannot be expressed. With the current World Wide Web, only text-based search and matching processes are carried out and will fail to detect that supermarket and hipermercado mean the same in respectively English and Spanish.

3. It is very difficult or even impossible to write a software program that goes through a list of web pages and extract a specific information item that is working properly.

Example: From a mobile phone distributor web page, a person can extract and compare the prices of 4 phones. But, it is quite difficult to write a program to do so because HTML does not specify the phone types or prices. HTML does simply not have the necessary semantics.

The Semantic Web brings the following benefits:

- It will enable users to search not only for documents that contain data, but also for the desired data itself, through “semantic” identification and location techniques

- It will support software agents that are able not only to locate data, but to perform meaningful tasks with data automatically and on the fly that today must be done manually and episodically by computer users.

The Semantic Web is by using the descriptive technologies RDF (Resource Description Framework) and OWL(Ontology Web Language) and the data-centric, customizable markup language XML to provide descriptions that supplement or replace the content of Web documents.

The content will be given explicit meaning, making it easier for machines to automatically process and integrate information available on the Web.

The content may manifest

- as descriptive data stored in Web-accessible databases
- or as markup within documents (particularly, in XHTML interspersed with XML, or, more often, purely in XML, with layout/rendering cues stored separately).

The machine-readable descriptions allow content managers to add meaning to the content, thereby facilitating automated information gathering and research by computers.

Question 4. eTOM **(25%)**

a) Explain what is meant by the following concepts:
   1. NGOSS[1]
   2. ITIL
   3. ”Architecture Framework”
   4. ”The development circle” (in other context this is called the 4 ”views” of NGOSS)

b) Give brief description for eTOM (ehanced Telecom Operations Map): Purpose and structure.

c) How is SID (Shared Information and Data Model) planned used in the framework for telecom administration (according to TelecomManagement Forums)?

d) Nowadays, SID exists in two ”versions”: One focuses on the analysis of the business process (”business view”), while the other focuses on the implementation. Both of these (GB922 and GB926) employ UML for the description of the ”entities”.
   1. Which of these use the ”methods” field and how?
   2. What is the purpose of ”OSS through Java™ Initiative”?
   3. Could you explain what is ”Core Business Entity” used for?
   4. There exists (with regard to ”OSS through the Java™ Initiative”) 5- five basic concepts that is used in the daily management for each operation environment. What are these concepts? Illustrate in a sketch how they are related.

[1] NGNOSS in some documents