



# Network Management

## What is Network Management?

- Work to ensure the productivity of the network
- Becoming more and more difficult, due to heterogeneity of networks
- More than hacking...
- The FCAPS model (OSI)
  - **F**ault management
    - Analyse and find faults, analyse, and fix
    - Error logs, diagnostics, filtering of error messages
  - **C**onfiguration management
    - Configuration of new devices, managing hardware and software updates
  - **A**ccounting
    - Collect data for billing purposes, mediation

## FCAPS (contd...)

- Performance
  - Follow the usage and load of the network in order to plan upgrading equipment, reconfiguration for performance optimisation, forecasting future network usage
- Security
  - Protecting the network and its elements from attacks, protecting clients from attacks
- Investment planning, reliability,...
- Many viewpoints, an **operator policy** dependent thing

## Network Management Systems

- Network Elements – routers, hosts, etc.
- Data Communications Network – a network that connects the network elements to the network management system (either dedicated or the data network)
- Network Management System – (or Operations System) – the equipment controlling network elements
- In order for the network management system to control the network elements, a [Network Management Protocol](#) is needed.

## Network Management Protocols

- Proprietary
- Common Management Information Protocol (CMIP) -  
(a TMN protocol (ITU-T))
- Simple Network Management Protocol (SNMP) – IETF
  - For background, ASN.1 and BER

## ASN.1 (ISO 8824)

- Abstract Syntax Notation One
- See: <http://www.isi.salford.ac.uk/books/osi/chap8.html>
- An **abstract** type definition: **not for presentation**
- Example:
  - integer, values from 1 to 27. Infinite size types possible
  - Mutual recursion, loop breaking using CHOICE
- Basic types: INTEGER, REAL, BOOLEAN, ENUMERATED, BIT STRING, OCTET STRING, NULL, OBJECT IDENTIFIER, several character string types
- Construction mechanisms: SEQUENCE OF, SET OF, CHOICE, OPTIONAL, DEFAULT

## **Example (Salford)**

<http://www.isi.salford.ac.uk/books/osi/fig8p1.gif>

## ASN.1 (contd.)

- The definitions can be used to define new data type definitions
- Definitions can be grouped to **modules**
- Modules have unique numeric Object Identifiers
- In addition Object descriptors that are human readable and ambiguous
- OID:s have a *tree structure*

## Basic Encoding Rules (BER) (ISO8825)

- Encoding rules define how the abstract ASN.1 data types are presented in the real world – either within hosts or as transfer encoding
- Encoding is a difficult task due to the flexibility of ASN.1
- There are many encoding rule sets, BER is the one used in SNMP
- TLV code: Type-Length-Value
- For compound types, Value can contain other TLV triples (recursion)

## Management Information Base (MIB)

- The data structure in the Network Element, containing configuration, counters etc.
  - System: general parameters, location, uptime, system name etc.
  - Interfaces: physical addresses, counters
  - Address translation: ARP configuration and info
  - IP: routing table, counters, statistics
  - TCP: number of opens, timeouts, etc.
  - UDP: counters
  - ICMP, EGP, SNMP, etc
- Forms a tree
- Depends on the type, make, version of the network element
- New network elements require updates to the network management system

## SNMP

- A simple protocol for reading the values of the MIB variables, and setting them (GET/SET)
- A binary protocol (ASN.1 + BER) over UDP
- NE contains a *SNMP agent*
- Network management software can poll
- NE can send traps