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)
  - Fault management
    - Analyse and find faults, analyse, and fix
    - Error logs, diagnostics, filtering of error messages
  - Configuration management
    - Configuration of new devices, managing hardware and software updates
  - Accounting
    - 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
Abstract Syntax Notation One

See: http://www.isi.salford.ac.uk/books/osi/chap8.html

An **abstract** type definition: not for presentation
  - An example: 12.7 and 13·10⁻³ have the same data type but different presentation

Example data types:
  - Integer with 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 additional Object descriptors that are human readable and ambiguous
- OID:s have a *tree structure*
Basic Encoding Rules (BER) (ISO 8825)

- 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
- BER uses TLV coding: 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