Networking 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
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 additional 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