University of Nottingham
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COMPUTER NETWORKS

AY2022-2023 Spring Semester

COMP1047 Systems & Architecture

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Computer Networks. Revision

Final Exam

- 40 marks
- Single Choice Questions. Identify exactly one correct answer.
- Multiple Choice Questions. Identify one or more correct answers. Each incorrect answer causes mark deduction.
- Calculations.
- Answer Questions.

Networks Classification

Communication networks are classified according to the distance over which they operate.

The networks are sources of directly generated data:

[1] *Wide Area Networks (**WAN**s)*

[2] *Metropolitan Area Networks (**MAN**s)*

[3] *Local Area Networks (**LAN**s)*

[4] *Campus Area Networks (**CAN**s)*

[5] *Home Area Networks (**HAN**s)*

[6] *Personal Area Networks (**PAN**s)*

Protocol

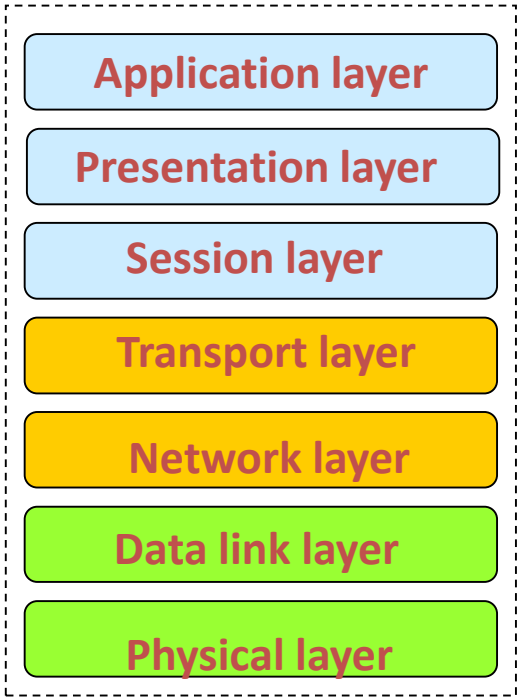
- The operation of modern communication systems is based on the concept of the *"protocol"*
- A format definition of the term "*protocol*" for *communications*

Standardisation

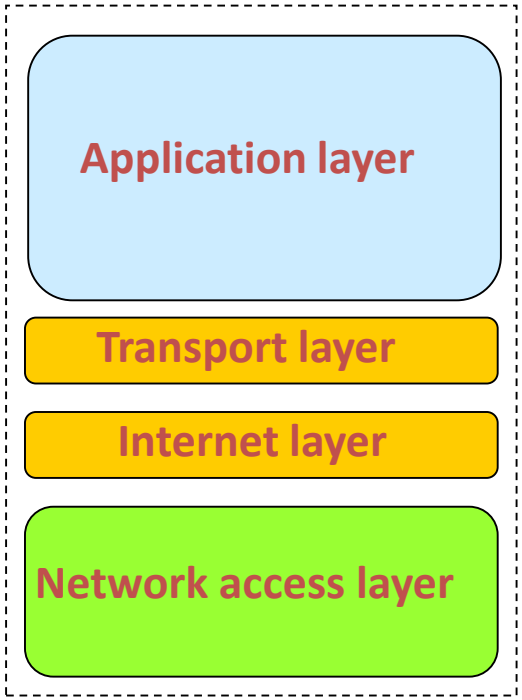
In order to operate across national boundaries and equipment suppliers, the standardisation of procedures is a MUST. Standardisation bodies include:

ISO (International Standard Organization)
ITU-T (International Telecommunication Union)
IEEE (Institution of Electrical and Electronic Engineers)
others…

OSI Reference Model vs. TCP/IP Reference Model



OSI reference model



TCP/IP reference model

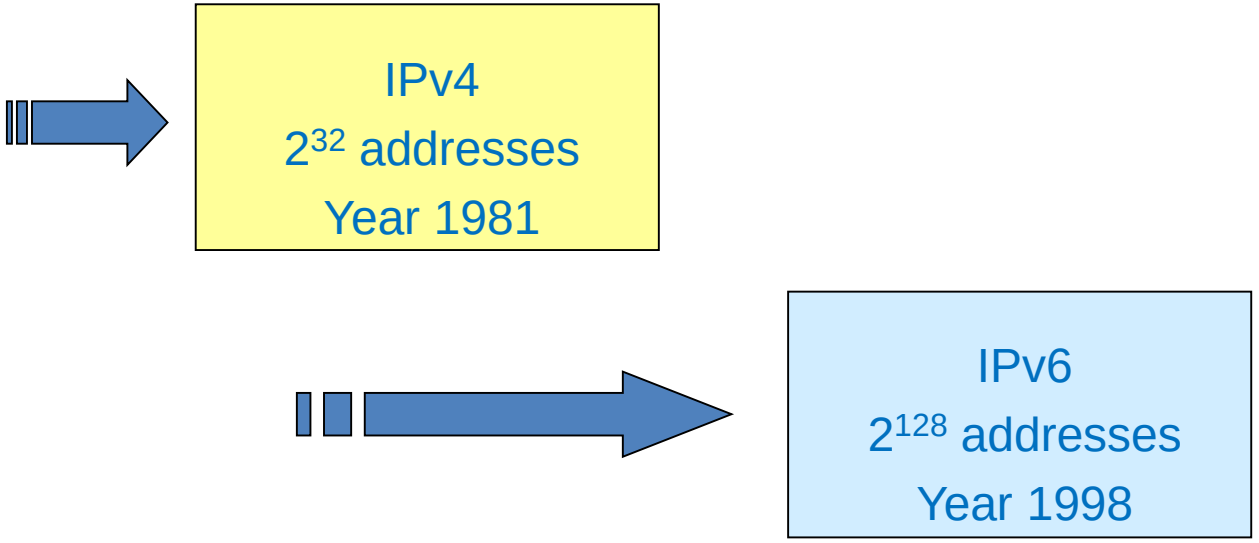
IPv4 Address

- **32 bit binary number** is usually represented as 4 decimal values, **each representing 8 bits**, in the range 0 to 255 (known as octets) separated by decimal points
- known as "dotted decimal" notation

xxxxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx

IPv6

- IPv4 with 2^{32} addresses
- IPv6 with 2^{128} addresses



The growth of the address space in the Internet

IPv6

- *IPv6 includes the following features*

[1] Better and more compact header format
[2] Larger address space
[3] Support for resource allocation (flow labelling and control options)
[4] Built-in security
[5] Better support for quality of service (QoS)
[6] New protocol for neighbouring node interaction
[7] Extensibility

TCP/IP Protocol Suite

[1] *HTTP* (Hypertext Transfer Protocol)

[2] *Telnet*

[3] *FTP* (File Transfer Protocol)

[4] *SMTP* (Simple Mail Transfer Protocol)

[5] *DNS* (Domain Name Server)

[6] *RIP* (Routing Information Protocol)

[7] *SNMP* (Simple Network Management Protocol)

Routing

- All devices need to know what IP addresses are on directly attached networks
  - If the destination is on a local network, send it directly there
  - If the destination address isn't local
    - Most non-router devices just send everything to a single local router
    - Routers need to know which network corresponds to each possible IP address

Physical Topologies

- **Physical topologies**
- The mapping of the nodes of a network
- The physical connections between them

- Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies

Transmission Media

Channel

- **In order to communicate, a number of channels are employed to deliver services to the users**
- **In terms of the physics underlining propagation channels are divided into two categories**

Unguided wave channels

audio channel
atmospheric channel
free space channel

} *Propagation through wave diffraction*

Guided wave channels

twisted wire pairs
coaxial cables
optical fibre cables

} *Propagation through wave guidance*

Fibre To The x - FTTx

- The industry today has earmarked the penetration of fibre into the access network as "*FTTx*" (Fibre To The x)
- The most common architectures are
  - ***FTTHome*** **(*FTTH*)**
  - ***FTTBuilding*** ***(FTTB)***
  - ***FTTCurb*** ***(FTTC)***
  - ***FTTNode*** ***(FTTN)***

Fibre To The x - FTTx

❑ *Features of optical fibre*

- *Enormous information carrying capacity*
- *Easily upgradeable*
- *Ease of installation*
- *Allows fully symmetric services*
- *Reduced operations and maintenance costs*

❑ Benefits of optical fibre

- Very long distance
- Very less signal attenuation
- Strong, flexible, reliable
- Allows small diameter and light weight cables
- Secure
- Immune to EMI (electromagnetic interference)

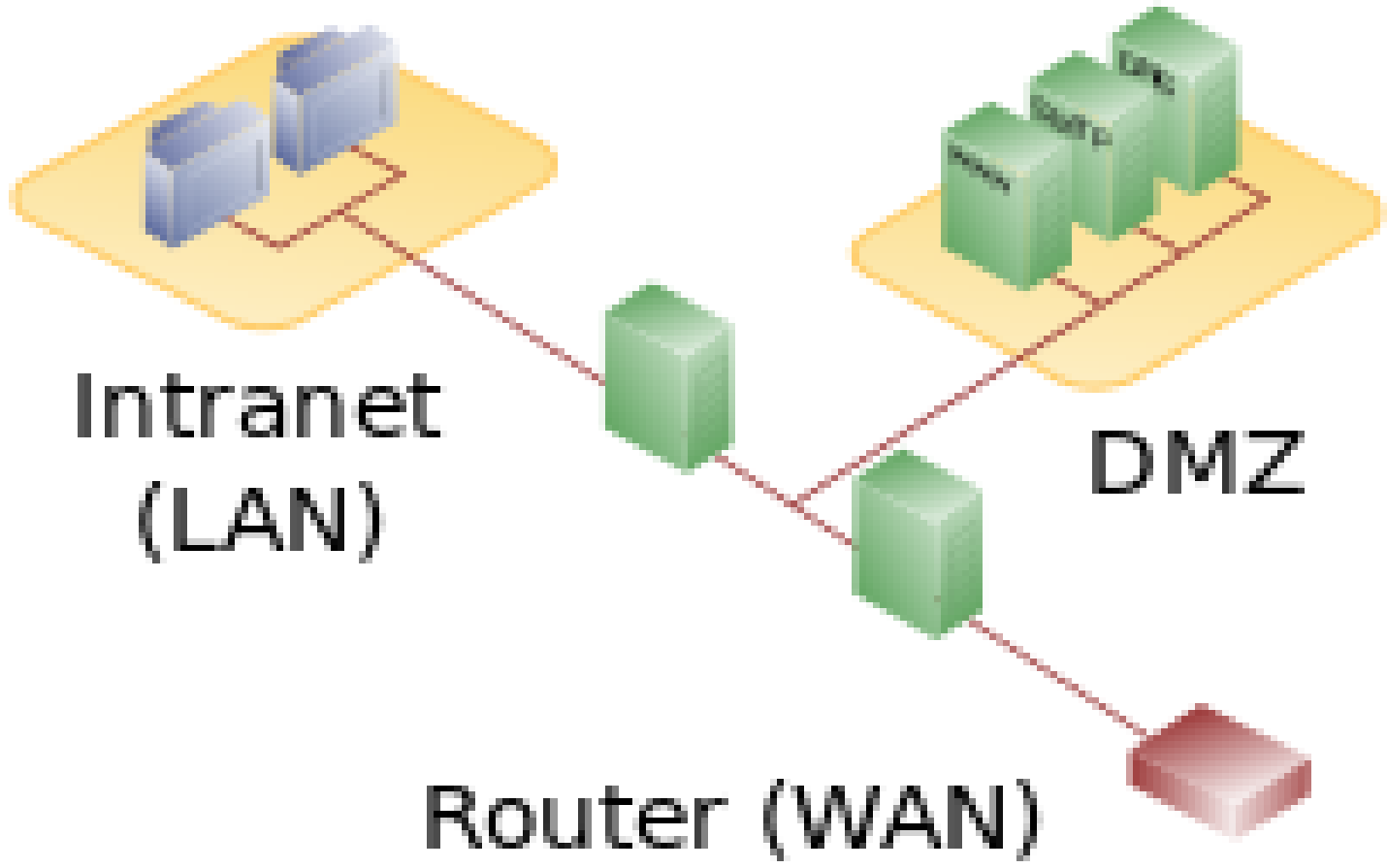
The 3 “A”s of Network Security

- AAA (or Triple A): an acronym
- Stands for:
  - Authentication
  - Authorisation
  - Auditing (or Accounting)

The 3 “A”s of Network Security

- Authentication
  - i.e. use of passwords
  - Biometrics
- Authorisation
  - After verifying the user’s identity we still need to check their level of access
  - Which computers are they allowed to access?
  - Which actions are they allowed to perform?
- Auditing
  - We should record a user’s access to data – this can be an effective deterrent to mischievous behaviour

Dual Firewall Architecture




Thank you