

# NANSC SUMMER TRAINING

AIR\_NAVIGATION\_REPORT

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## **TRAINING CONTENT:**

1. Basic Network
2. OSI Reference model
3. Aviation Network & AIS
4. Phonetic Alphabet
5. Air Traffic Control & External interfaces  
(Data sources)
6. Data processing

# **Basic Network:**

## **Definition of LAN:**

- It usually refers to the collection of computers, printers, modems or other equipment that can be interconnected through some medium within several kilometers.

## **Design Objective of LAN:**

- Run in a limited geographical area
- To connect PCs or workstations in local area
- High bandwidth and low delay
- Provide local service



HUB



Switch



Router



ATM Switch

## **WAN:**

- Provide data communication service in a wide area.

## **Classification of WAN:**

- PSTN: Public Switched Telephone Network
- ISDN: Integrated Services Digital Network

- DDN: Digital Data Network
- X.25: Public Packet Switched Network
- Frame Relay
- ATM: Asynchronous Transfer Mode

## **WAN Switching Mode Circuit switch:**

circuit switch based on the telephone network

- Advantage: low delay and transparent transmission
- Disadvantage: low ratio of network resources utilization

Packet switch: store and forward with packet as the unit

- Advantage: multiplex
- Disadvantage: Low real-time performance

Standardization Organization International Organization for Standardization (ISO)

- Institute of Electrical & Electronic Engineers (IEEE)
- America National Standard Institute (ANSI)
- Electronic Industries Association/Telecom
- Industries Association (EIA/TIA)
- International Telecom Union (ITU)
- INTERNET Action Board (IAB)

## **Definition of bandwidth:**

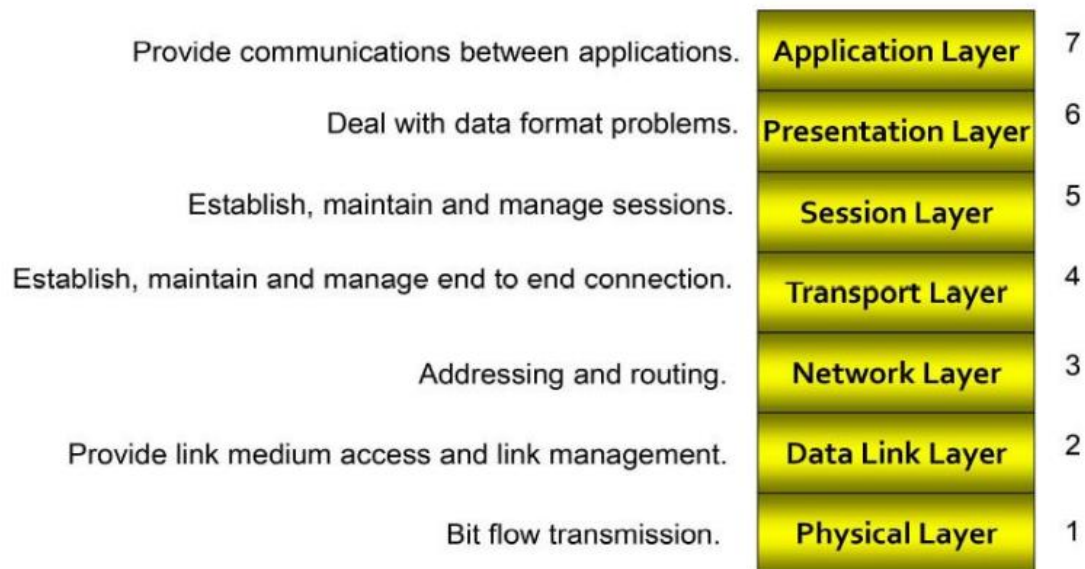
describes the information volume of the network data transmitted from one node to any other



- Node at a fixed time.
- Bandwidth of the Ethernet: 10M, 100M and 1000M etc.
- Various types of service bandwidth of WAN
- Delay: time of inter-node data transmission

## OSI Reference model

- Stands for open system interconnection.
- It is a reference framework that explains the process of transmitting data between computers.
- It is divided into seven layers that work together to carry out specialized network functions, allowing for a more systematic approach to networking.



High layers oversee data transmission between hosts, while low layers oversee data transmission in network. Every layer communicates with its peer through services provided by the lower layer. Data encapsulation and decapsulation processes are carried out. **At the transmitter**, within going from the upper layers to the lower one data is encapsulated. **At the receiver**, data is de-capsulated while going from the low layers to the higher one.

## Application Layer

- Applications create data.
- Word processing, mail and electronic table.
- It ensures an application can effectively communicate with other applications on different computer systems and networks.

## Presentation Layer

- Data is formatted and encrypted.
- It is responsible for the delivery and formatting of information to the application layer for further processing or display.
- ASCII, MPEG, JPEG.

## Session Layer

- Allow users on different machines to establish active communication sessions.
- Responsible for establishing, maintaining, synchronizing and terminating sessions between end-user applications.
- SQL, NFS, RPC.

## **Transport Layer**

- It segments upper layer data, where data is broken into segments for reliable delivery.
- Ensure the reliability of the data transmission.
- Set up end to end connection.
- From the protocols:
  - TCP, UDP for TCP/IP stack.
  - SPX for IPX/SPX stack.

## **Network Layer**

- Enable different networks to be interconnected.
- It is responsible for assigning unique addresses to different nodes in a network.
- The network layer address (IP address) is composed of two parts:
  - the network address
  - the host address, which is globally unique.
- Segments are packaged into packets and routed.

- Routed protocols: IP, IPX.
- Routing protocols: RIP, OSPF, IS-IS, BGP.

## Data Link Layer

- The data link layer is the protocol layer in a program that handles how data moves in and out of a physical link in a network.
- This layer encodes, decodes and organizes data bits in the data link layer before it transports the data bits as frames between two adjacent nodes on the same local area network (LAN) or wide area network (WAN).
- Within this layer packets are framed and sent to the next device.
- This layer determines how devices recover from collisions that might occur when nodes attempt to send frames at the same time. In addition to error verification.
- It is responsible for Physical address definition (MAC address), which is composed of 48 bits.
- The data link layer has two sublayers:
  - The logical link control (LLC) sublayer.
  - The media access control (MAC) sublayer.
- IEEE802 Standard is the most popular LAN standard nowadays.
- WAN data link layer equipment:



- Modem and ISDN terminal adaptor.
- CSU/DSU and WAN switch.
- WAN data link layer standard: HDLC, PPP, ASDN and Frame Relay.

## **Physical Layer**

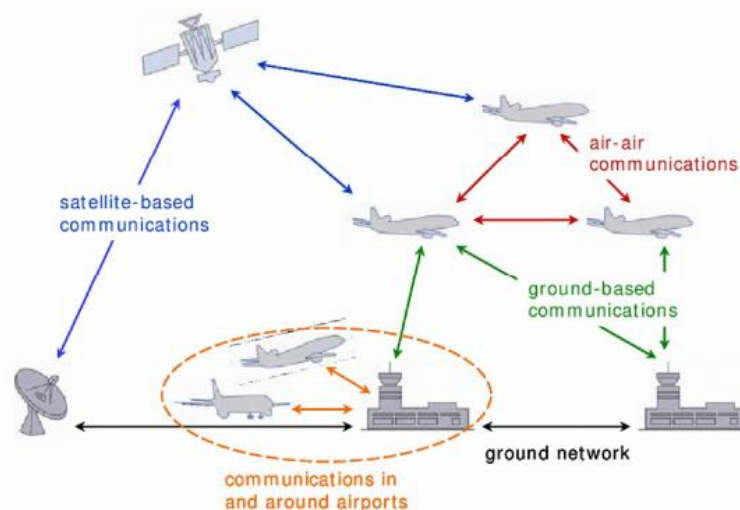
- Frames are converted into bits and transmitted physically, by different voltage levels through standard cables.
- Types of physical layer cables:
  - Twisted pair: UTP and STP.
  - Coaxial cable: thin and thick.
  - Fiber.
  - Wireless radio: WLAN.
- LAN physical layer:
  - Cable standard: 10 Base-T, 100 Base-T, 1000 Base-SX.
  - Network Equipment: repeater and hub.
- WAN physical layer:
  - Common interface: RS-232, V.24, V.35.
  - DTE equipment: router and terminal host.
  - DCE equipment: WAN switch and Modem

# Aviation Network & AIS

## Types Of Aviation Specific Networks: -

1. Air-ground communication
2. Ground-ground communication

### Aviation networks



## Air ground communication Protocol:

ACARS: “**A**ircraft **C**ommunications **A**ddressing And **R**eporting **S**ystem”.

ex: VDL/HFDL - SATCOM

Service providers: SITA - ARINC

**VDL**: used in sending information between aircraft and ground station.

## Ground-ground communication Protocol:

Communication Protocol: IP - X.25

Service Providers: SITA - ARINC - national Carriers.

Applications: AMHS, AIDC, new PINS.

## Flight Plans: -

Detailed Information About Flight: aircraft type, departure, destination, route of flight, altitude.

### ⦿ ATS message format

```
(FPL -ACF402 IN  
-EA30/H-S/C  
-EHAM0940  
-K0830F290 LEK28 LEK UA6 XMM/M078 F330  
UA6 PON URION CHV UAS NTS DCT 4611N00412W  
DCT STG UAS FTM FATIMIA  
-LPPT0230 LPPR  
-REG/FBVGA SEL/EJFL EET/LPPC0158 DOF/140908)
```



## Aeronautical Charting Products:-

### Maps & Procedure Charts

- Geographic information systems (GIS) allow you to store, digitalize, analyze, map and visualize data in different ways.

## Types Of Charts: -

1. Standard Instrument Departure.
2. Standard Terminal Arrival Rounds.
3. En Route Charts.
4. Instrument Approach Charts.

## Phonetic Alphabet:

<b>A</b> ALFA AL-FAH	<b>B</b> BRAVO BRAH-VOH	<b>C</b> CHARLIE CHAR-LEE	<b>D</b> DELTA DELL-TAH	<b>E</b> ECHO ECK-OH	<b>F</b> FOXTROT FOKS-TROT
<b>G</b> GOLF GOLF	<b>H</b> HOTEL HOH-TEL	<b>I</b> INDIA INI-DEE-AH	<b>J</b> JULIET JEW-LEE-ETT	<b>K</b> KILO KEY-LOH	<b>L</b> LIMA LEE-MAH
<b>M</b> MIKE MIKE	<b>N</b> NOVEMBER NO-VEH-BER	<b>O</b> OSCAR OSS-CAH	<b>P</b> PAPA PAH-PAH	<b>Q</b> QUEBEC KEH-BECK	<b>R</b> ROMEO ROW-ME-OH
<b>S</b> SIERRA SEE-AIR-RAH	<b>T</b> TANGO TANG-GO	<b>U</b> UNIFORM YOU-NEE-FORM	<b>V</b> VICTOR VIK-TAH	<b>W</b> WHISKEY WISS-KEY	<b>X</b> X-RAY ECKS-RAY
<b>Y</b> YANKEE YANG-KEY	<b>Z</b> ZULU ZOO-LOO	<b>1</b> ONE WUN	<b>2</b> TWO TOO	<b>3</b> THREE TREE	<b>4</b> FOUR FOW-ER
<b>5</b> FIVE FIFE	<b>6</b> SIX SIX	<b>7</b> SEVEN SEV-EN	<b>8</b> EIGHT AIT	<b>9</b> NINE NIN-ER	<b>0</b> ZERO ZEE-RO

# Air Traffic Control (ATC):

- Data received from the external interfaces used in data processing and then sent this data to air controller to control the air navigations; preventing accidents and dangerous air situations.
- The air controller uses some equipment to help him:



- Voice communication control systems
- Flight data information display
- Air situation display



To be able to call the airplane and communicate with it when it enters the (FIR), there is a call sign the air controller send to the pilot



## ATC types:

1. ATC tower
2. ATC approach
3. En-route ATC



## In the cap of the tower:

Air traffic controllers help in the arrangement of airplane and give it the directions to put it on its route until it reaches the Runway to take off or help it during landing

Air traffic controllers help the plane until it's out of his vision

## **In the approach of the tower:**

Air traffic controllers help the plane to set its directions and control its route in the airport and the areas near it

## **In En route ATC:**

Air traffic controllers help the plane to set its directions and control its route in the country where the plane flies and inside FIR

Ex: CANC

## **External interfaces (Data sources) :**

- Some devices help in data processing:
- Basic principle of Radar:: send a signals of radio energy (traveling at the speed of light) are transmitted, reflected off a target and then returned as an echo.
  - **Primary Radar:** this system used in aviation to detect and track aircraft
  - **Secondary Radar (long distances and wide range):** this system used to deliver enhanced aircraft identification and improved situational awareness by its direct connection with the plane

- ADSP
- WAN



## Data processing

After gathering the data from data sources, Data fusion in (SDP & FDP)

**SDP: Sensor Data Processing & FDP: Flight Data Processing**

Data comes from the radar sent to SDP

- Track initiation
- Track validation
- Track update
- Track cancellation

Flight plane sent to FDP

- Track/Flight Plan Correlation
- SSR Code Allocation
- 4D Trajectory Prediction

## **Reference slides:**

- Eng. Mohamed Sultan
- Eng. Osama Salah Elden
- Eng. Amr Medhat
- Eng. Ahmed Taha