CINQUIEME SEMESTRE
Spécialité Avionique et Systèmes de Contrôle du Trafic Aérien

SB508
Ground based Safety Nets

Nov 2016

Teacher : Eric FAURE - ENAC

Outline

- Personal presentation
- Lesson 1 : Context
- Lesson 2 : Safety nets in general
- Lesson 3 : MSAW & APM
- Lesson 4 : APW + Conclusions
- Lesson 5 : STCA

Outline

- Personal presentation
- Lesson 1 : Context
- Lesson 2 : Safety nets in general
- Lesson 3 : MSAW & APM
- Lesson 4 : APW + Conclusions
- Lesson 5 : STCA

- OBJECTIVE
- At the end of the course the students will be able to :
  - ❑ Be aware of ANS services provide by ANS Providers
  - ❑ Understand the general view of ATM systems / services
  - ❑ Speak about the needs of ATCO in terms of ATM services
  - ❑ Describe the différents kinds of ATM services
  - ❑ Describe the différents types of ATM systems used by ATCO

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1) Context and base concepts of ANS Systems
2) ATM systems
3) Surveillance Data Processing systems
4) Flight plan Data Processing System
5) Others systems

5

1) Context and base concepts of ANS Systems
2) ATM systems
3) Surveillance Data Processing systems
4) Flight plan Data Processing System
5) Others systems

6

Air Navigation Service Providers

dgac DSNA

DFS Deutsche Flugsicherung

EUROCONTROL

skyguide

Belgocontrol

.....

In CHINA

Air Traffic Management Bureau

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Air Navigation Service Providers

dgac DSNA

DFS Deutsche Flugsicherung

EUROCONTROL

skyguide

Belgocontrol

Air Navigation Services

Airlines

AIRFRANCE

American Airlines

BRITISH AIRWAYS

easyJet

Lufthansa

In CHINA

Air Traffic Management Bureau

8

In CHINA

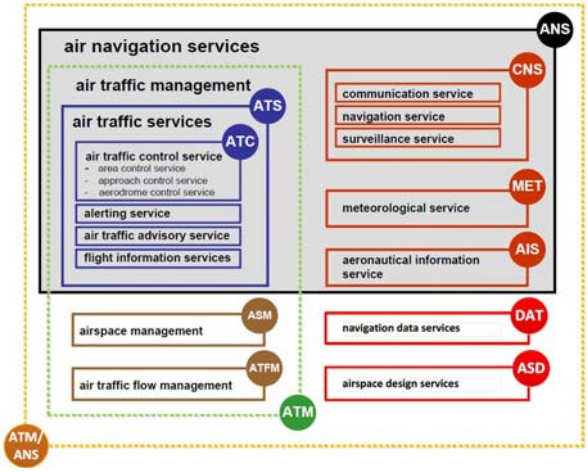
Civil Aviation Administration of China

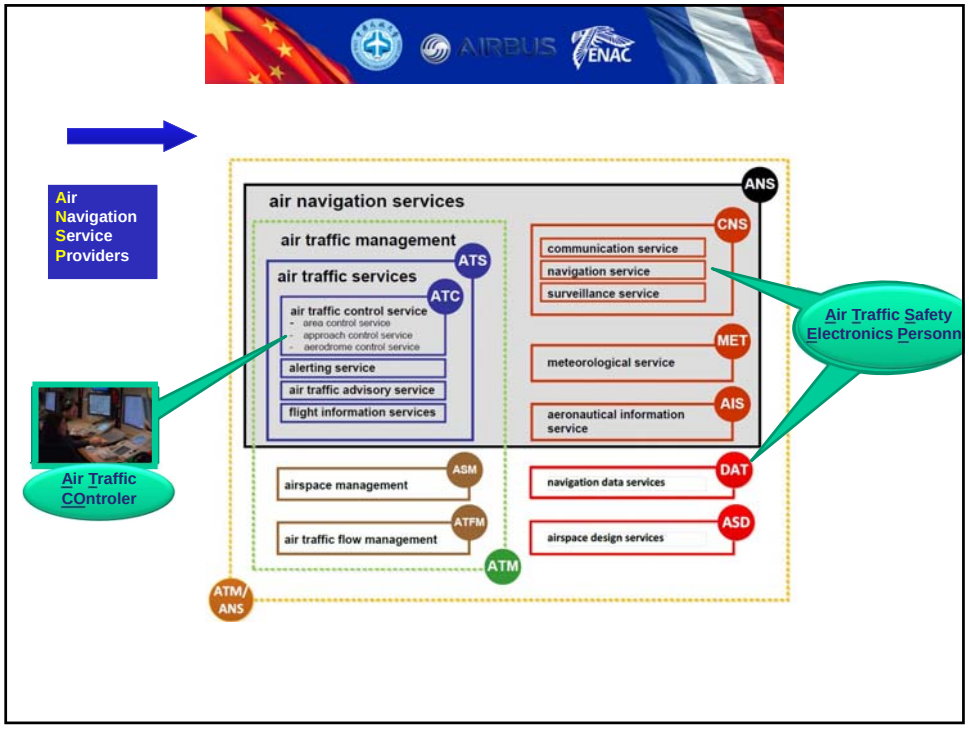
Air Navigation Service Providers

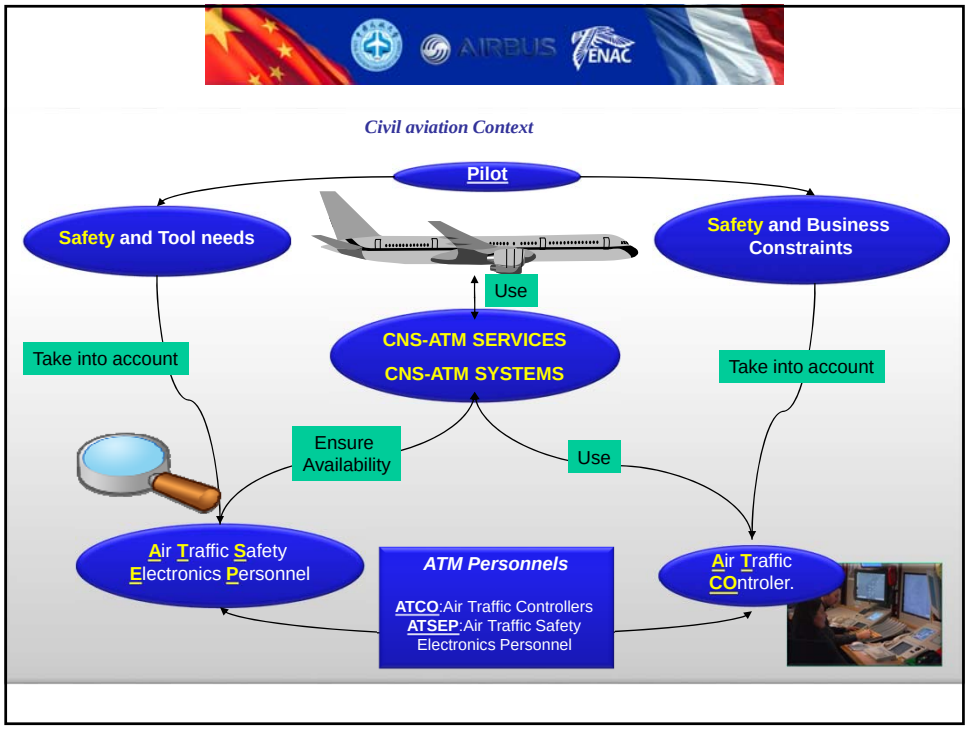
Air Traffic Management Bureau

7 regional ATMB

Air Navigation Service Providers




Air Navigation Service Providers
air navigation services
ANS
air traffic management
ATS
air traffic services
ATC
air traffic control service
- area control service
- approach control service
- aerodrome control service
alerting service
air traffic advisory service
flight information services
CNS
communication service
navigation service
surveillance service
MET
meteorological service
AIS
aeronautical information service
Air Traffic Safety Electronics Personn
Air Traffic COntroler
ASM
airspace management
ATFM
air traffic flow management
ATM
DAT
navigation data services
ASD
airspace design services
ATM/ ANS


Civil aviation Context
Pilot
Safety and Tool needs
Safety and Business Constraints
Use
CNS-ATM SERVICES
CNS-ATM SYSTEMS
Take into account
Take into account
Ensure Availability
Use
Air Traffic Safety Electronics Personnel
ATM Personnels
ATCO:Air Traffic Controllers
ATSEP:Air Traffic Safety Electronics Personnel
Air Traffic COntroler.

1) Context and base concepts of ANS Systems

2) ATM systems ?

3) Surveillance Data Processing systems

4) Flight plan Data Processing System

5) Others systems

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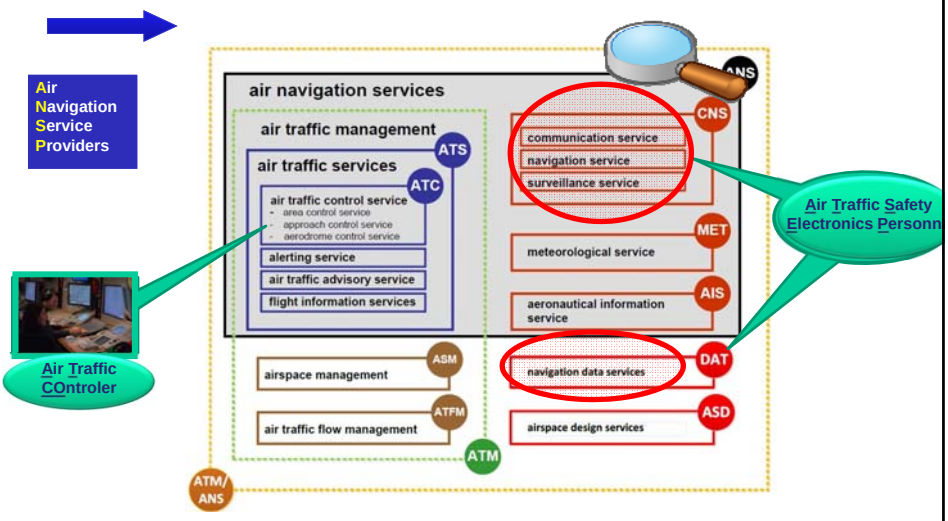
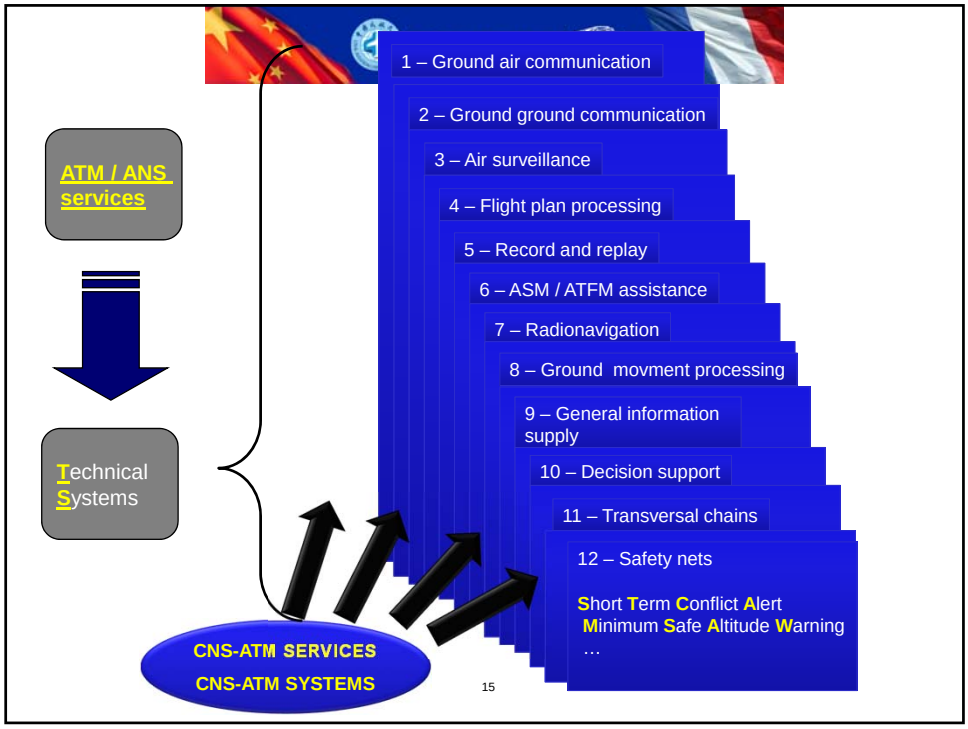
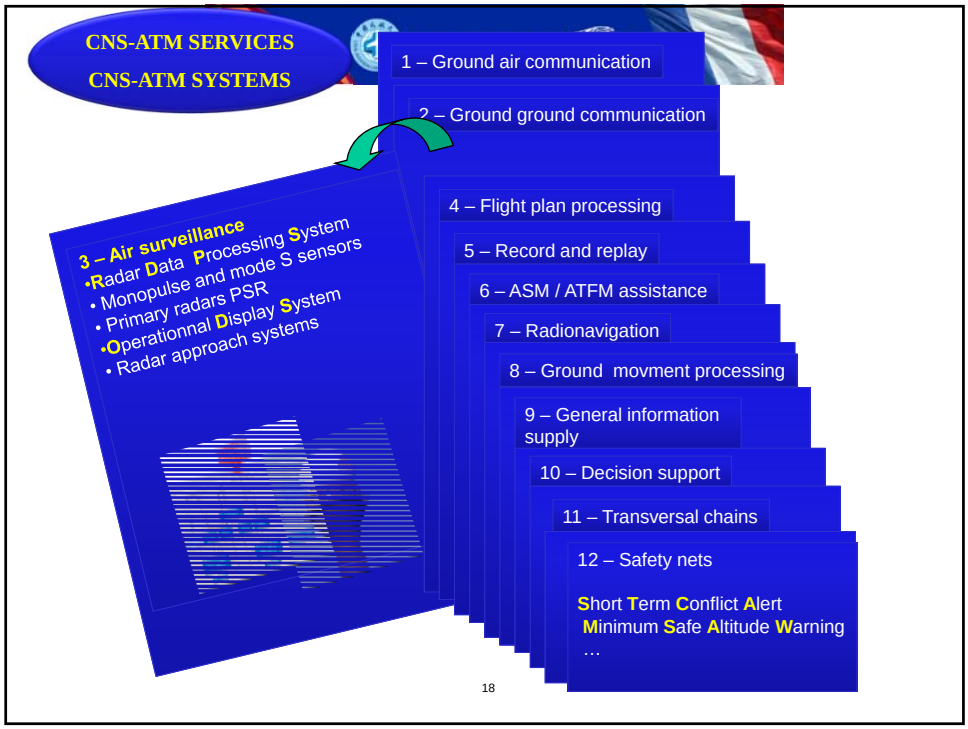
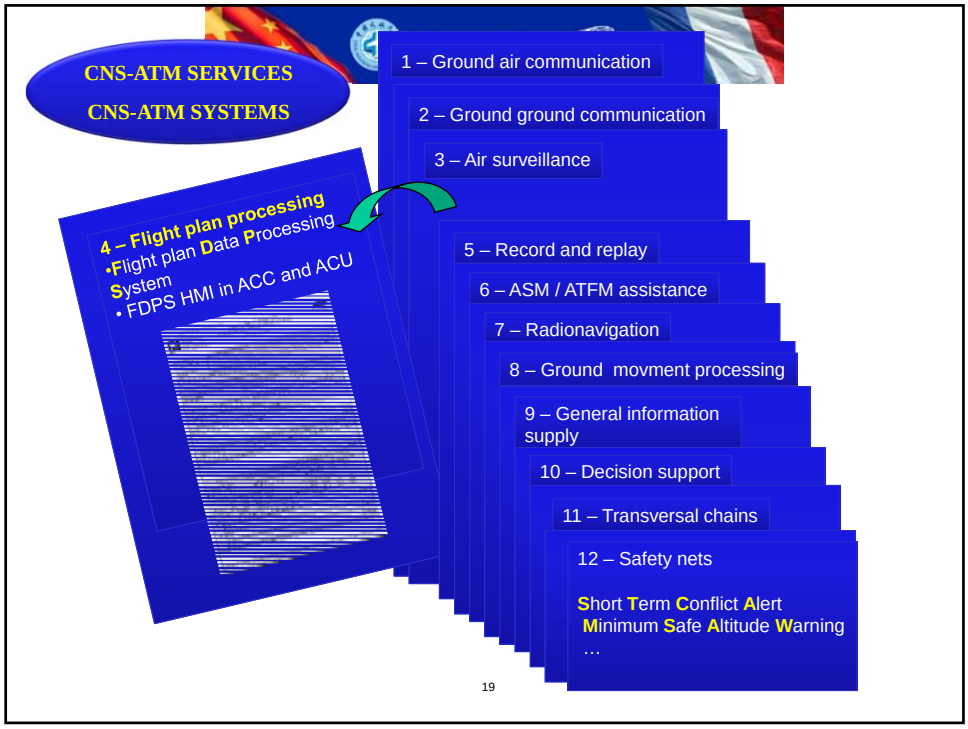


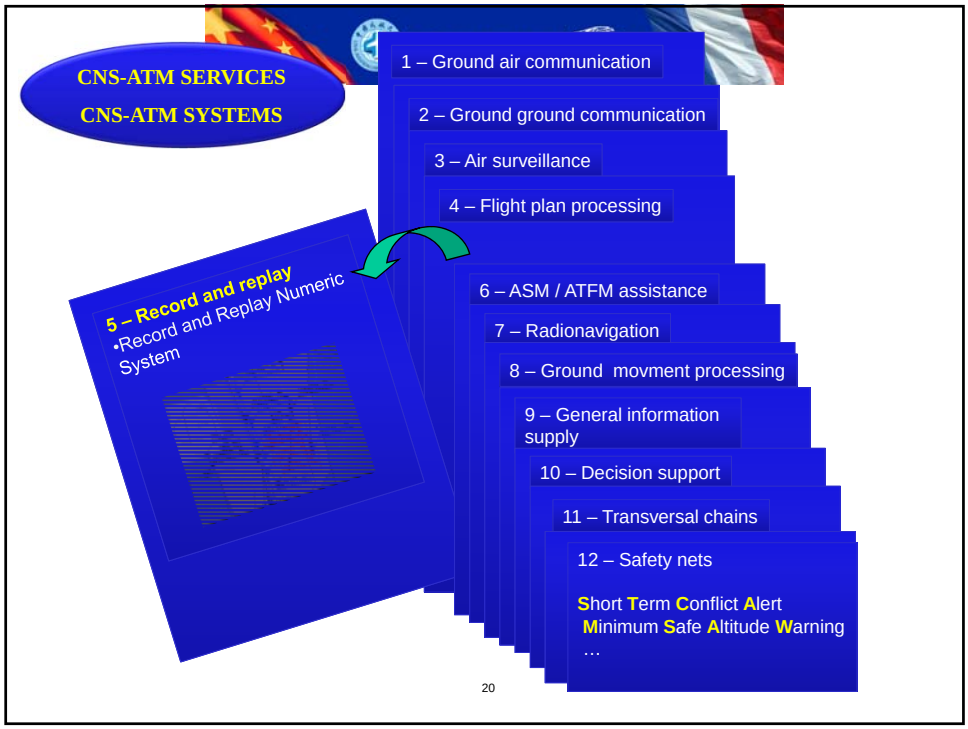

ATM / ANS services
Technical Systems
CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
15

CNS-ATM SERVICES
CNS-ATM SYSTEMS
AIRBUS
ENAC
1 – Ground Air communication
• radio chain
• Emitter recepter station
• Specialised link
• Frequency interference
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
16

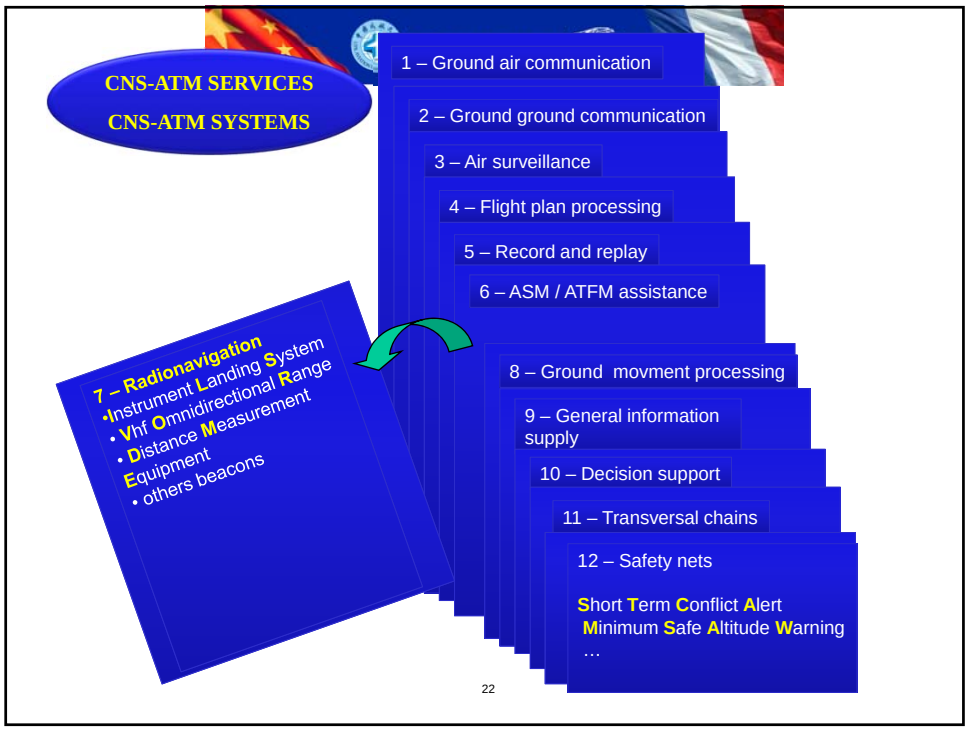
CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
• Phone chain
• Spécialised link phone
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
17


CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
•Radar Data Processing System
• Monopulse and mode S sensors
• Primary radars PSR
•Operationnal Display System
• Radar approach systems
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
18

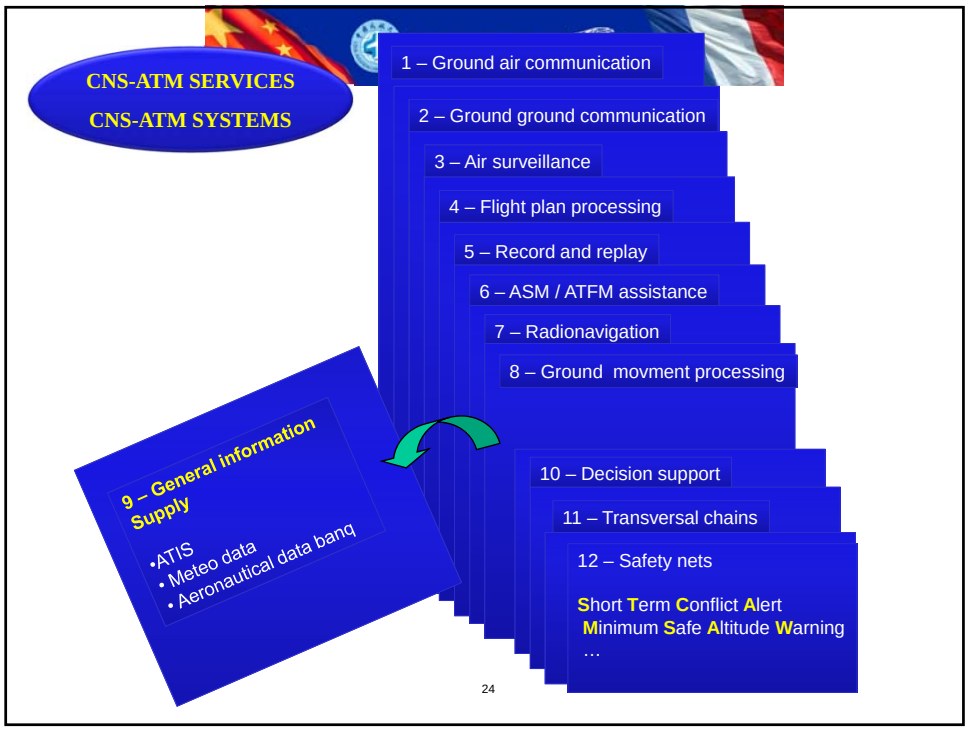

CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
•Flight plan Data Processing System
• FDPS HMI in ACC and ACU
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
19


CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
•Record and Replay Numeric System
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
20

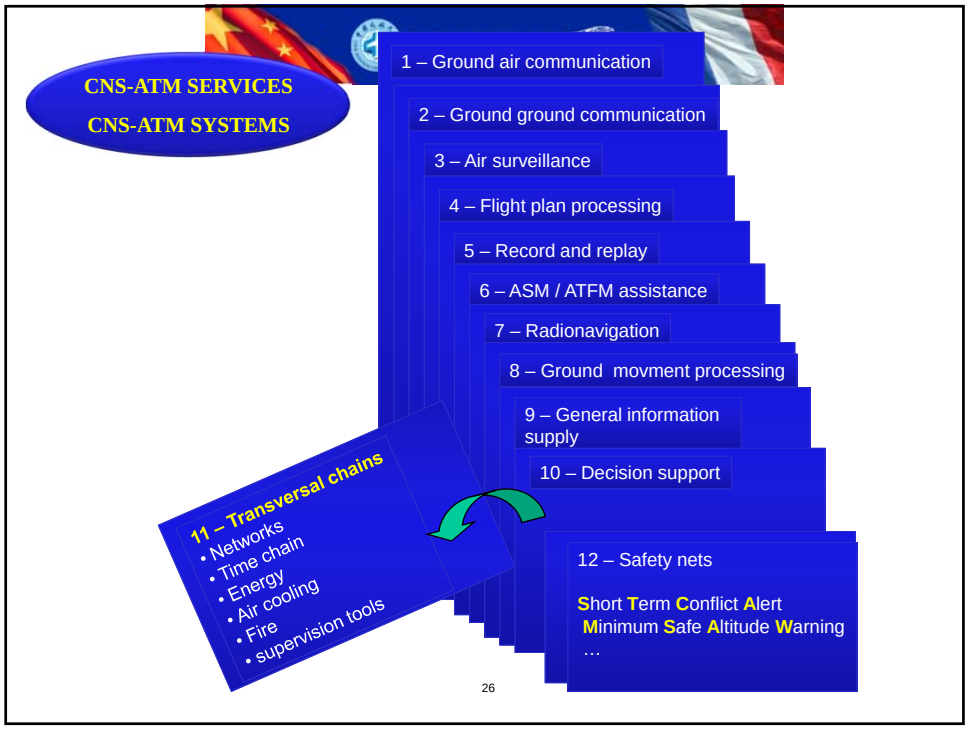
CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFCM assistance
Air Space Management
Air Traffic Flow and Capacity Management
• In Europe :
• Control Flow Management Unit
• Enhanced Traffic Flow Management System
• Integrated Flight Plan System
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
21


CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
•Instrument Landing System
• Vhf Omnidirectional Range
• Distance Measurement Equipment
• others beacons
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
22

CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movement Processing
•Ground surveillance : Ground radars, A-SMGCS
• Markup and stop bars
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
23


CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information Supply
•ATIS
• Meteo data
• Aeronautical data banq
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
24

CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
•Departure MANanger ,
• Arrival MANanager
• En Route Air Traffic Organization
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
25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CNS-ATM SYSTEMS
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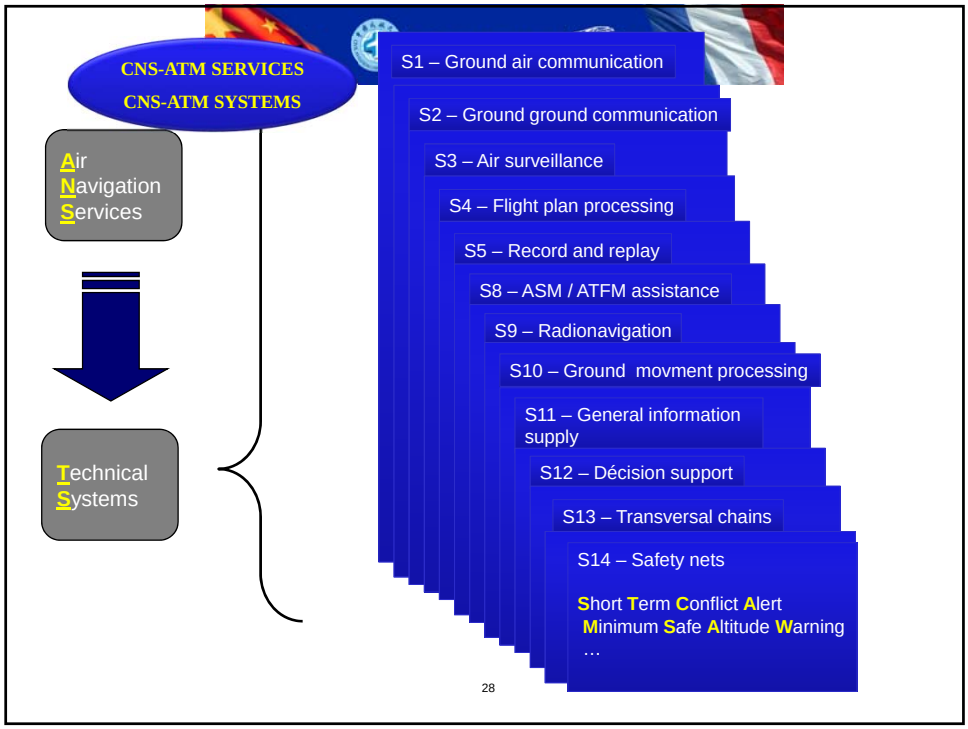
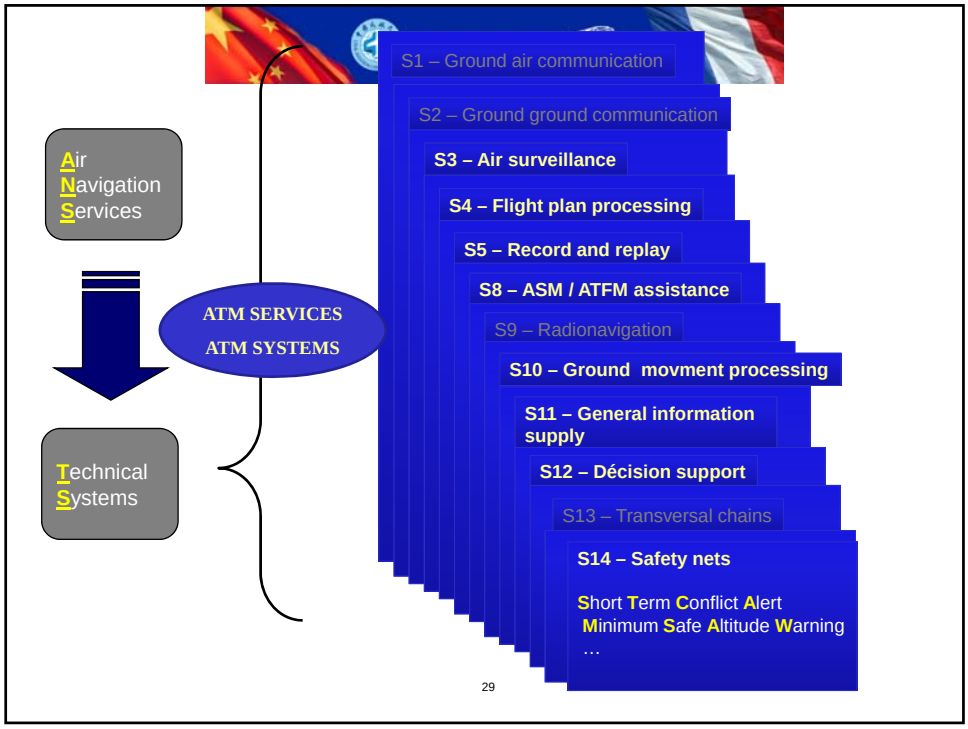
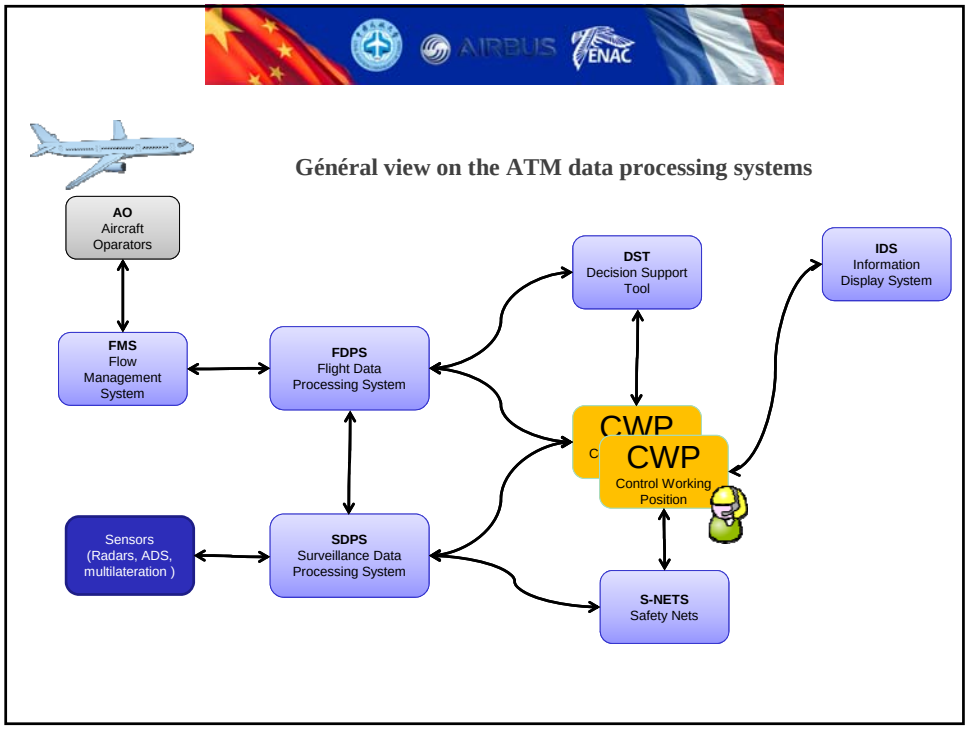
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
• Networks
• Time chain
• Energy
• Air cooling
• Fire
• supervision tools
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
26

CNS-ATM SERVICES
CNS-ATM SYSTEMS
1 – Ground air communication
2 – Ground ground communication
3 – Air surveillance
4 – Flight plan processing
5 – Record and replay
6 – ASM / ATFM assistance
7 – Radionavigation
8 – Ground movment processing
9 – General information supply
10 – Decision support
11 – Transversal chains
12 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
Area Proximity Warning
…
27


CNS-ATM SERVICES
CNS-ATM SYSTEMS
Air Navigation Services
Technical Systems
S1 – Ground air communication
S2 – Ground ground communication
S3 – Air surveillance
S4 – Flight plan processing
S5 – Record and replay
S8 – ASM / ATFM assistance
S9 – Radionavigation
S10 – Ground movment processing
S11 – General information supply
S12 – Décision support
S13 – Transversal chains
S14 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
28


S1 – Ground air communication
S2 – Ground ground communication
S3 – Air surveillance
S4 – Flight plan processing
S5 – Record and replay
S8 – ASM / ATFM assistance
S9 – Radionavigation
S10 – Ground movment processing
S11 – General information supply
S12 – Décision support
S13 – Transversal chains
S14 – Safety nets
Short Term Conflict Alert
Minimum Safe Altitude Warning
…
Air Navigation Services
ATM SERVICES
ATM SYSTEMS
Technical Systems
29


AIRBUS
ENAC
Général view on the ATM data processing systems
AO
Aircraft Oparators
FMS
Flow Management System
FDPS
Flight Data Processing System
DST
Decision Support Tool
IDS
Information Display System
CWP
Control Working Position
Sensors
(Radars, ADS, multilateration)
SDPS
Surveillance Data Processing System
S-NETS
Safety Nets

1) Context and base concepts of CNS ATM Systems
2) ATC systems
3) Surveillance Data Processing systems
4) Flight plan Data Processing System
5) Others systems

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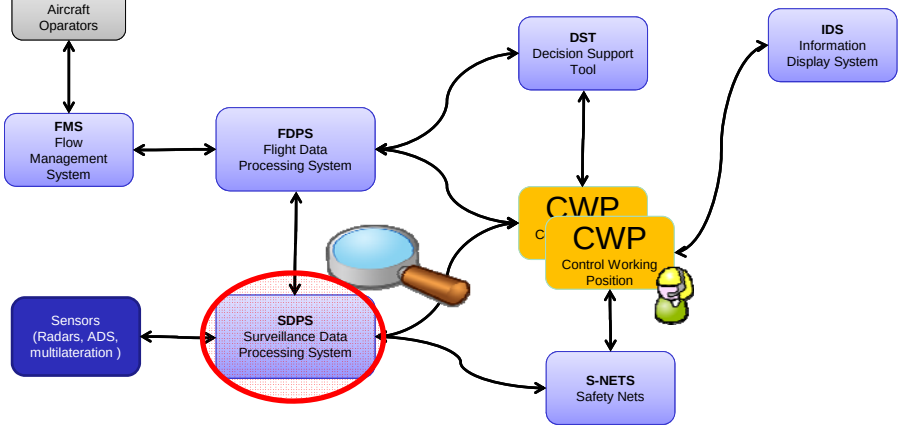
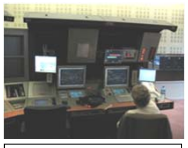
Général view on the ATM data processing systems



ATCO needs ?

Area Control Center

Control Working Position



Area Control Unit

Control Working Position

- Needs a airspace visualization :
  - Accurate
  - In **real time** (4 to 8 seconds)
- Visualize the airspace and the aircrafts positions to :
  - Verify the correlation between the flightplan and the real trajectory of the aircraft
  - Ensure the **separation** between aircrafts
- Have complementary information about the aircraft (information of flightplan)
- Needs automatic détection of conflicts (Safety Nets)

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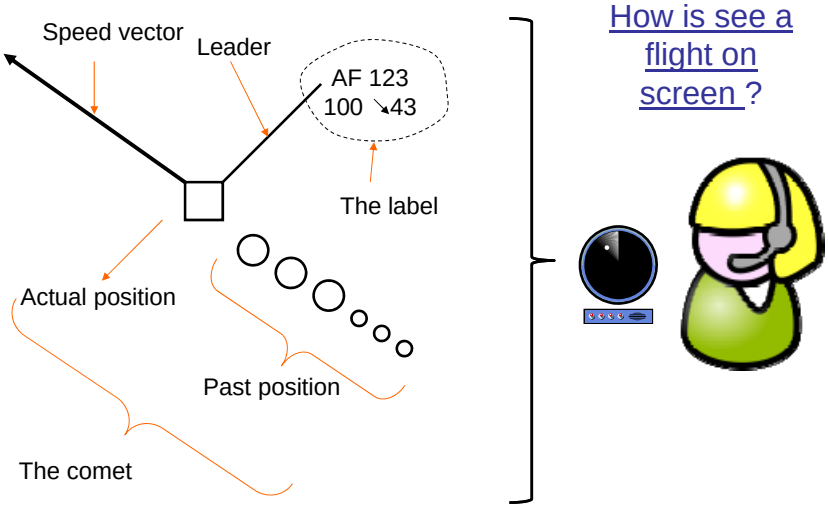
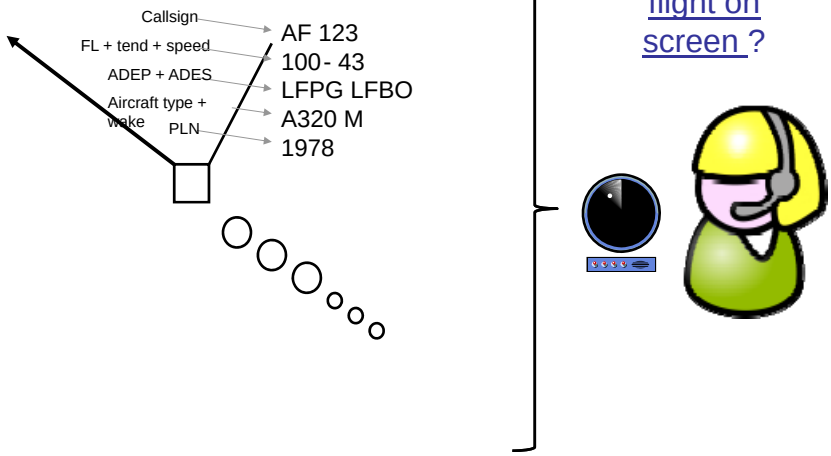
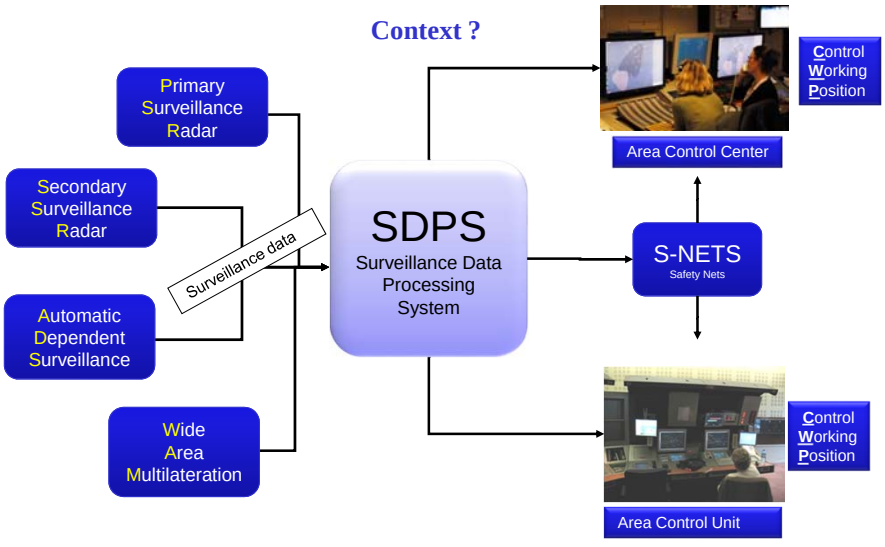


How is see a flight on screen ?


Callsign
FL + tend + speed
ADEP + ADES
Aircraft type + wake
PLN
AF 123
100- 43
LFPG LFBO
A320 M
1978
How is see a flight on screen ?


Context ?
Primary Surveillance Radar
Secondary Surveillance Radar
Automatic Dependent Surveillance
Wide Area Multilateration
Surveillance data
SDPS
Surveillance Data Processing System
S-NETS
Safety Nets
Control Working Position
Area Control Center
Control Working Position
Area Control Unit
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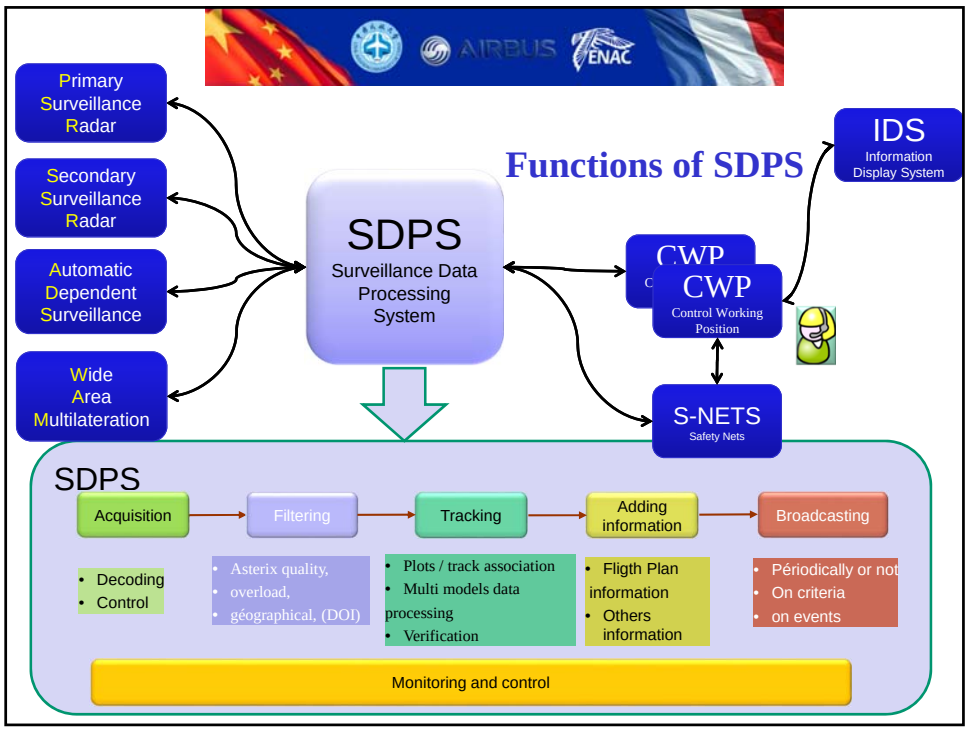

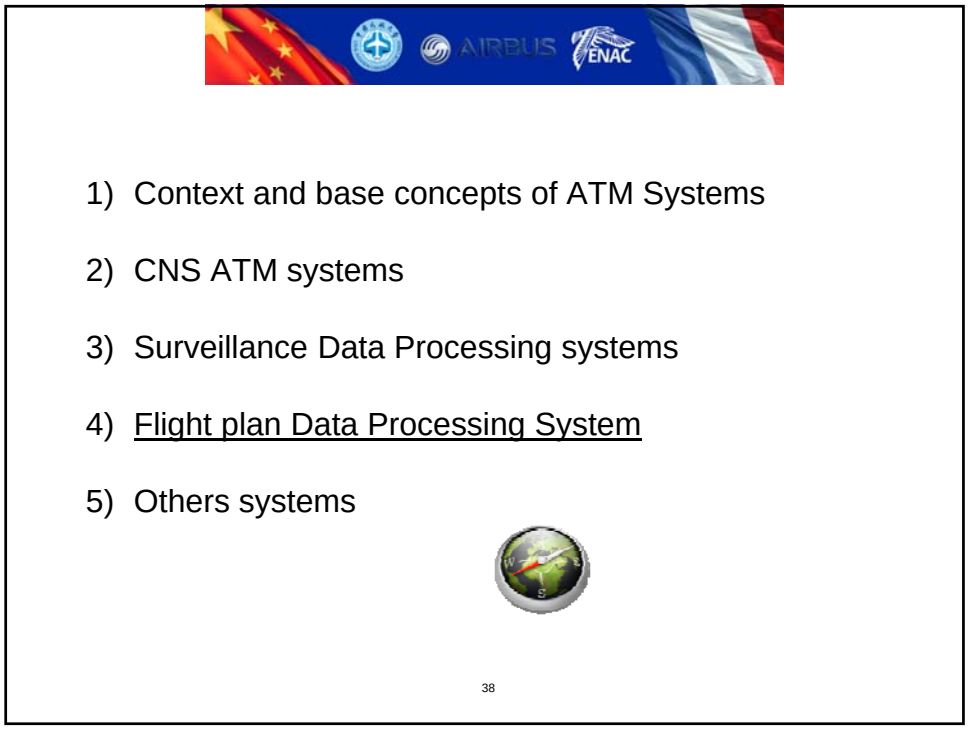

1) Context and base concepts of ATM Systems
2) CNS ATM systems
3) Surveillance Data Processing systems
4) Flight plan Data Processing System
5) Others systems

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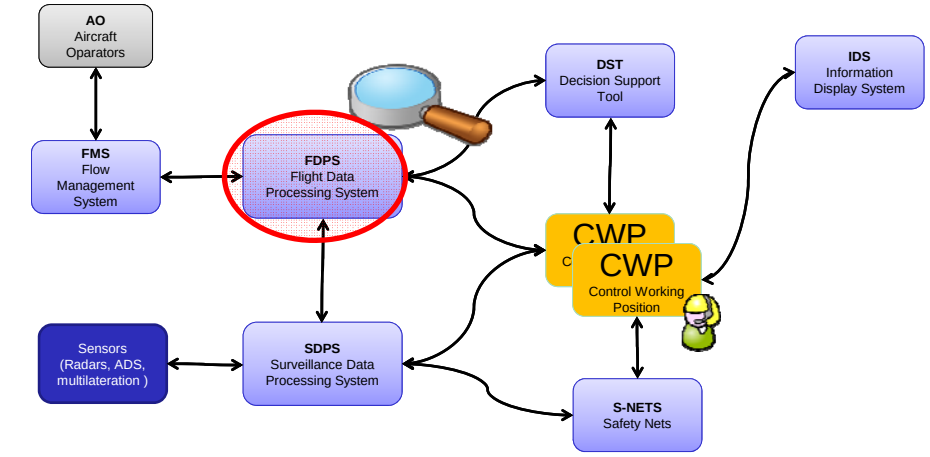
Général view on the ATM data processing systems



Context ?

Flight PLan

Control Working Position

CWP in ACC

Flight plan Data Processing System

Control Working Position

CWP in approach center

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Context ? Flight plan data

- Recipient
- File time
- Sender
- Aircraft identification or flight id or code
- flight rules
- Type of flight
- Number
- Aircraft Type
- Turbulence category
- Equipment
- Departure aerodrome
- Time
- Speed
- Level
- Road
- destination aerodrome
- Estimated Total
- First alternate
- Second alternate
- Information (nbr passengers, autonomy, beacon, life jackets ...)
- …

Flight plan Data Processing System

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ATCO needs

Control Working Position

Area Control Center

Control Working Position

Area Control Unit

Flight plan Data Processing System

- Have flight information at the right CWP at the right time
- Have assistance in monitoring the flight plan and coordination.
- Act on flight plans, ensuring that actions are valid (availability actions, action settings).
- Consult the flights plans information
- adapt the resources (configuration of the room) with traffic forecasts
- To enable or disable zones
- …

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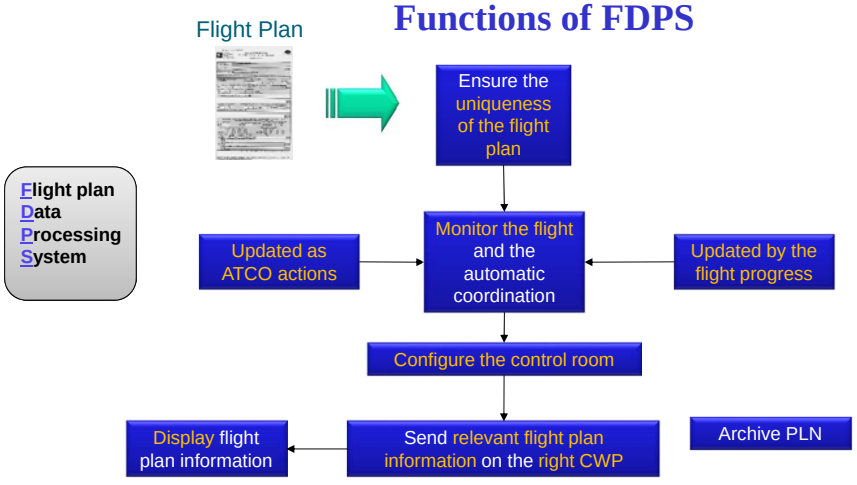
Requirements induced

- Know the intentions of flights and regulate the upstream traffic
- PLN distribute information at the right control working position at the right time
  - On the right sector, depending on :
    - The path followed by the flight (profile of flight)
    - Current sectoring
    - Data tape
  - At the right time
    - various states of flight
- Update data based depending on flight progress
- Assist the coordination (inter-center, foreign, military centers)
- Identify uniquely flights
- Linking the radar data and flight plan information.

Flight plan Data Processing System

Functions of FDPS



1) Context and base concepts of ATM Systems
2) CNS ATM systems
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4) Flight plan Data Processing System
5) Others systems

8 – Ground movement Processing

•Ground surveillance : Ground radars,
• Markup and stop bars

ATCO needs on airport

Area Control Unit

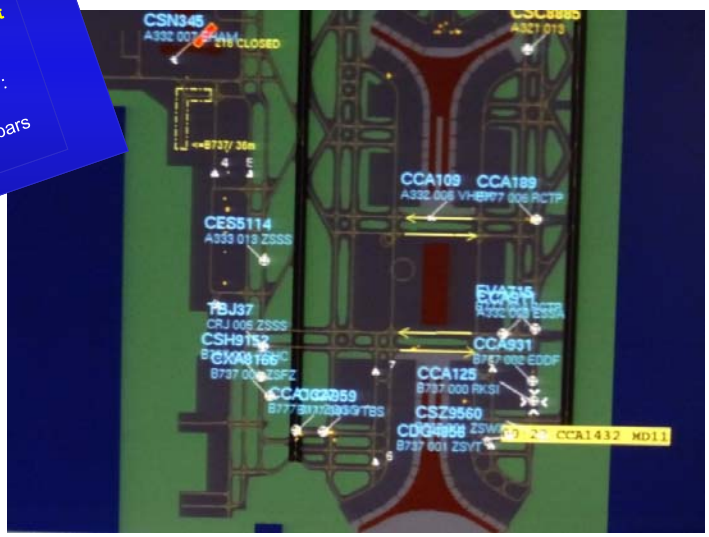
Control **W**orking **P**osition

- Follow the ground movement of aircraft in poor visibility (fog, heavy rain ...)
- Know the parking source or destination of aircrafts
- Follow the movements of mobiles (other birddog) ground
- Survey the use of runways

Objectives :
- Optimize ground movements
- Avoid collisions between mobiles on taxiway and on runways

8 – Ground movement Processing

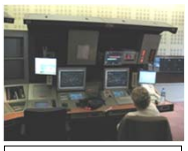
- Ground surveillance : Ground radars,
- Markup and stop bars



9 – General information Supply

- ATIS / ISATIS
- Météo
- Aeronautical data banq

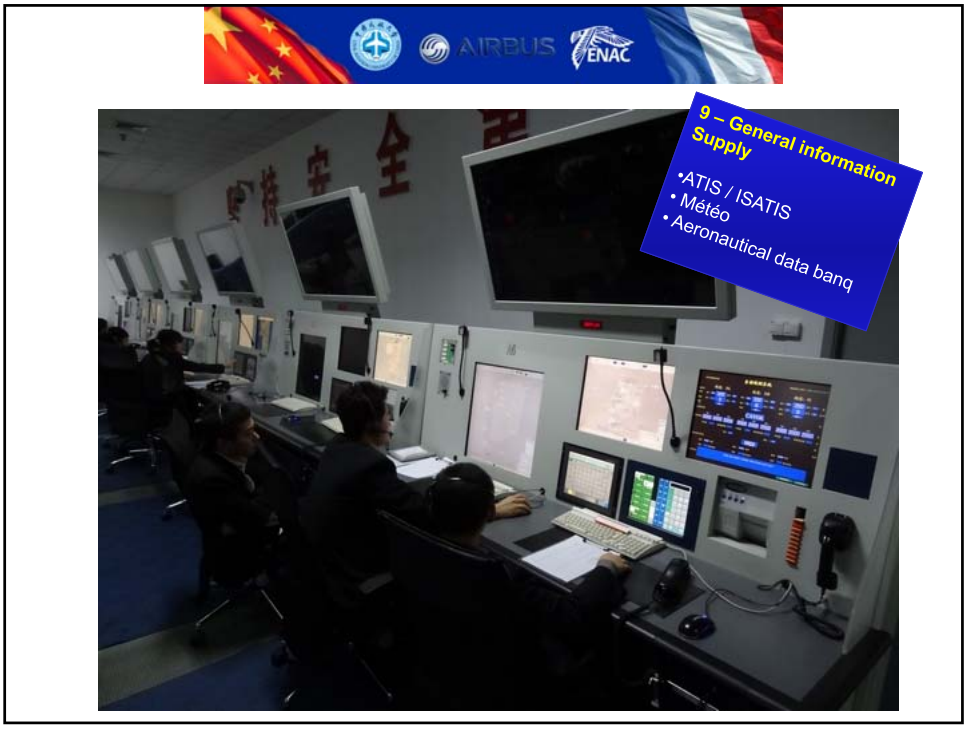
ATCO needs



Area Control Unit

Area Control Center

- Know the state of the airport platform (taxiway under construction, runways used ...)
- Know the local and remote weather conditions (QFE, QNH, QFU, runway visibility, weather conditions…)


AIRBUS
ENAC
9 – General information Supply
•ATIS / ISATIS
• Météo
• Aeronautical data banq

AIRBUS
ENAC
9 – General information Supply
•ATIS / ISATIS
• Météo
• Aeronautical data banq
跑道: 36L
跑道: 36R
跑道: 0
320
330
340
2
8
8
CAVOK
TDZ
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10 – Decision support

•Departure MANanger ,
• Arrival MANanager
• EG : En Route Air Traffic Organization

ATCO needs

Area Control Unit

Area Control Center

- DMAN: Optimize the flow of departures to avoid delays on the taxiway and runway threshold. This increases the safety level of ground displacement and avoids additional consumption of aircraft.
- AMAN: Optimize the flow of arrival at the airport to avoid being stacked aircraft before landing. This increases the safety level and avoids additional costs to airlines.

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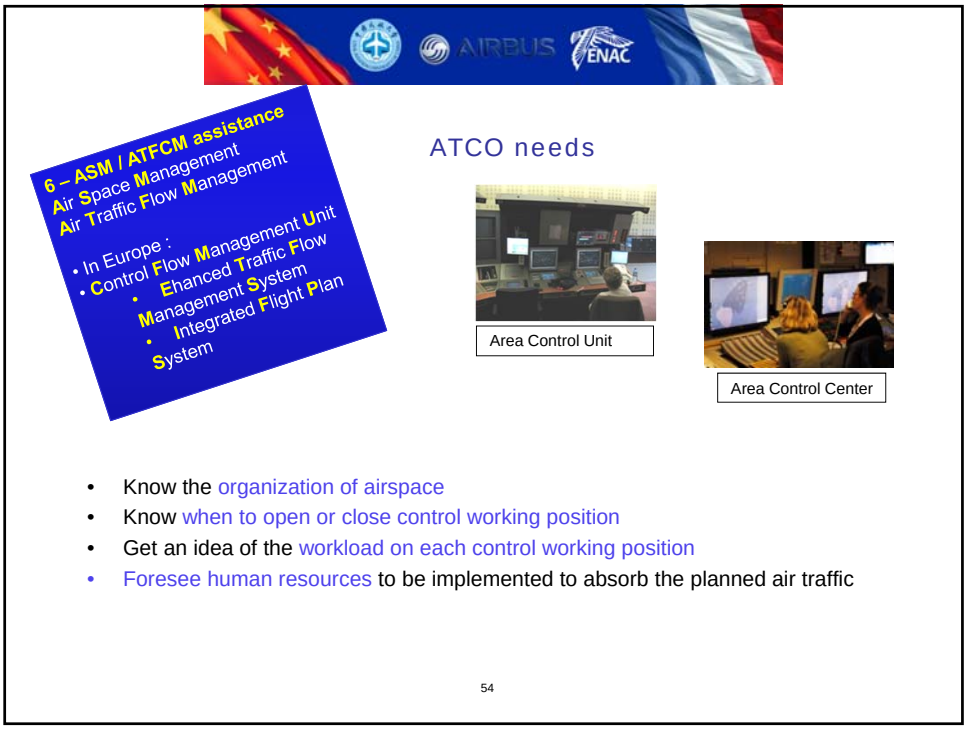
10 – Decision support

•Departure MANanger ,
• Arrival MANanager
• En Route Air Traffic Organization

TSAT
10 – Decision support
•Departure MANanger ,
• Arrival MANanager
• En Route Air Traffic Organization


6 – ASM / ATFCM assistance
Air Space Management
Air Traffic Flow Management
• In Europe :
• Control Flow Management Unit
• Enhanced Traffic Flow Management System
• Integrated Flight Plan System
ATCO needs
Area Control Unit
Area Control Center
• Know the organization of airspace
• Know when to open or close control working position
• Get an idea of the workload on each control working position
• Foresee human resources to be implemented to absorb the planned air traffic
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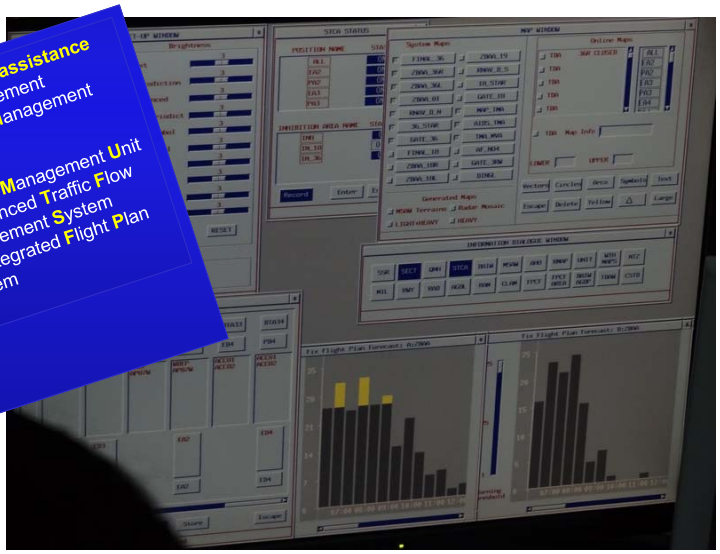
6 – ASM / ATFCM assistance
Air **S**pace **M**anagement
Air **T**raffic **F**low **M**anagement

- In Europe :
- **C**ontrol **F**low **M**anagement **U**nit
  - **E**hanced **T**raffic **F**low **M**anagement **S**ystem
  - **I**ntegrated **F**light **P**lan **S**ystem



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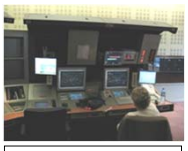
12 – Safety nets
Short **T**erm **C**onflict **A**lert
Minimum **S**afe **A**ltitude **W**arning
Area **P**roximity **W**arning
…

ATCO needs



Area Control Unit

Area Control Center

- Be warned in time (2-3 minutes) conflict between an aircraft and :
  - **Another plane : conflict between aircraft**
  - **The ground : conflict with the terrain**
  - **A prohibited area or temporarily unavailable: intrusion detection**

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12 – Safety nets

Short **T**erm **C**onflict **A**lert
Minimum **S**afe **A**ltitude **W**arning
Area **P**roximity **W**arning
…

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12 – Safety nets

Short **T**erm **C**onflict **A**lert
Minimum **S**afe **A**ltitude **W**arning
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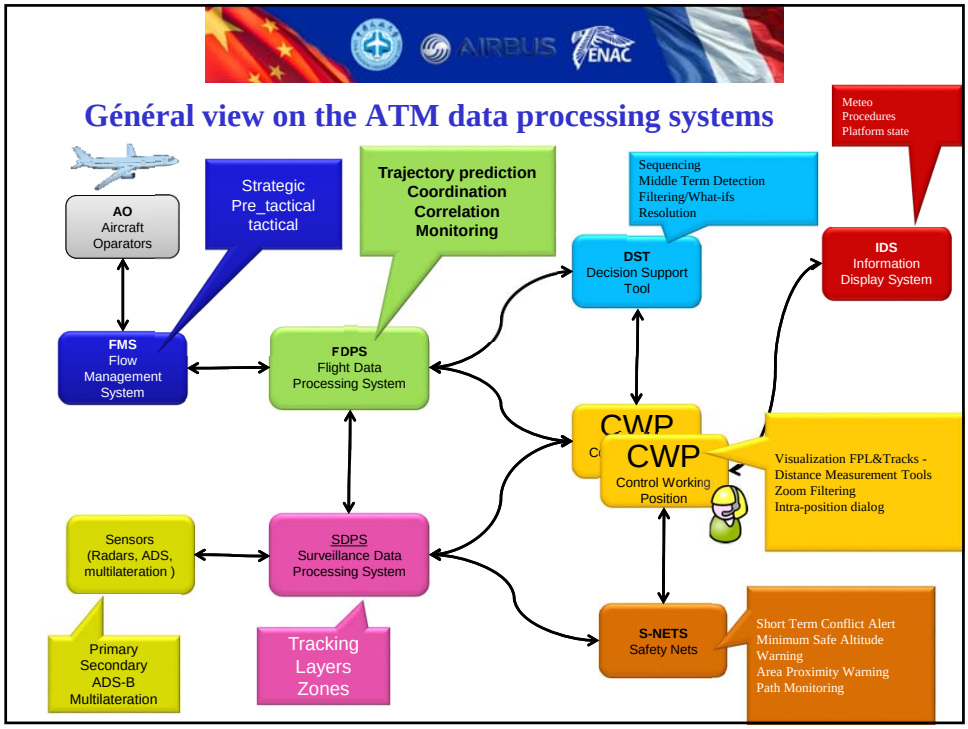
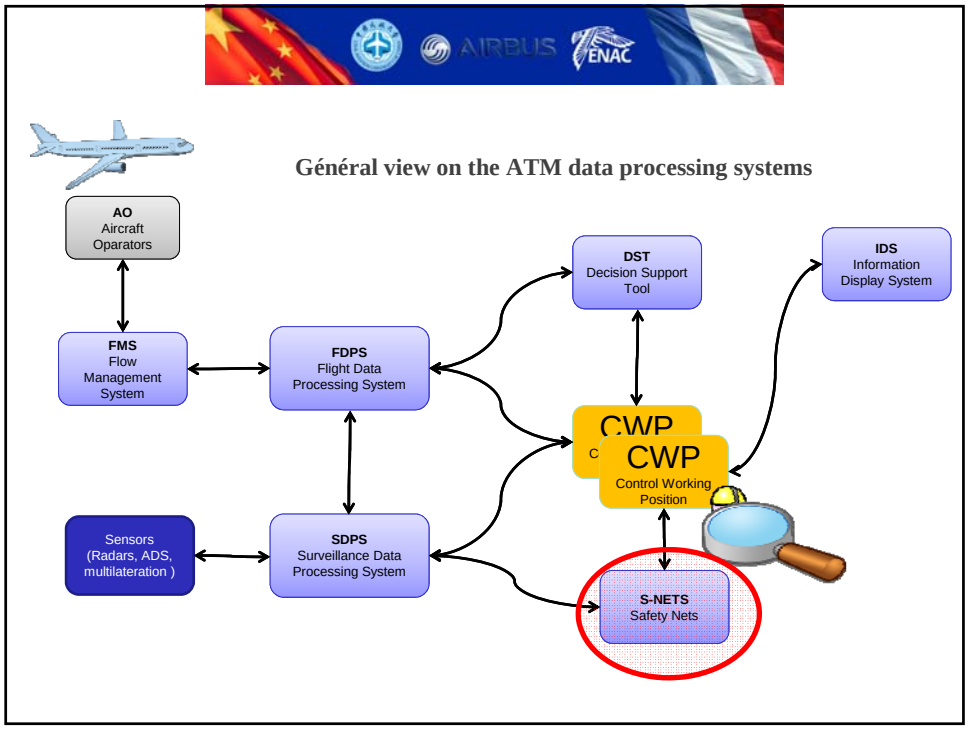
…


Général view on the ATM data processing systems
Meteo
Procedures
Platform state
AO
Aircraft
Oparators
Strategic
Pre_tactical
tactical
Trajectory prediction
Coordination
Correlation
Monitoring
Sequencing
Middle Term Detection
Filtering/What-ifs
Resolution
DST
Decision Support
Tool
IDS
Information
Display System
FMS
Flow
Management
System
FDPS
Flight Data
Processing System
CWP
Control Working
Position
Visualization FPL&Tracks -
Distance Measurement Tools
Zoom Filtering
Intra-position dialog
Sensors
(Radars, ADS,
multilateration)
SDPS
Surveillance Data
Processing System
S-NETS
Safety Nets
Short Term Conflict Alert
Minimum Safe Altitude
Warning
Area Proximity Warning
Path Monitoring
Primary
Secondary
ADS-B
Multilateration
Tracking
Layers
Zones


Général view on the ATM data processing systems
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