**ASECNA Workshop on ADS-B
(Dakar, Senegal, 22 to 23 July 2014)**

Automatic Dependent Surveillance -ADS-C

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OUTLINE

Surveillance definition

provision of data and information

with quality required for :

- identification of all aircraft
- representation of their accurate position and kinetic characteristics

as needed for Air Traffic Management.

A.D.S.
Automatic Dependent Surveillance

- Automatic: aircraft reports without intervention

- Dependent: position communicated is determined
on board the aircraft,

- Surveillance: purpose is to allow the observer
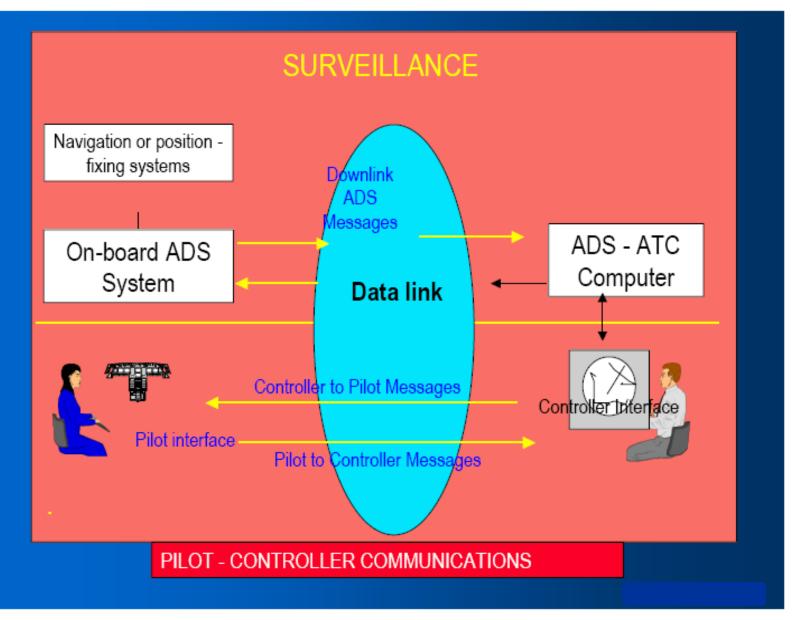to know the position of specific aircraft
on the ground,

ICAO Definition

A surveillance technique

in which aircraft automatically provide,

via a data link,

data derived from on-board navigation and position-fixing systems, including :

- aircraft identification,
- four-dimensional position,
- additional data as appropriate.

ADS is a data link application

SURVEILLANCE

Navigation or position - fixing systems

On-board ADS System

Downlink ADS Messages

Data link

ADS - ATC Computer

Controller to Pilot Messages

Pilot interface

Pilot to Controller Messages

Controller Interface

PILOT - CONTROLLER COMMUNICATIONS

SURVEILLANCE - ADS Reports

A- Basic ADS report
Latitude, Longitude
Altitude, Time
Figure Of Merit (F.O.M)

B- Ground Vector
True Heading
Ground Speed
Vertical rate

C- Air Vector
Heading
Mach number
Vertical rate

D-Meteorological report
Wind speed
Wind direction
Temperature
turbulence

E- Flight identification

SURVEILLANCE - ADS Reports

E- Flight identification

F- Projected Profile
Next Waypoint (WPT)
Estimated altitude at next WPT
Estimated time at next WPT
Next + 1 WPT
Estimated altitude at next + 1 WPT

G- Short -term intent
Latitude at projected position
Longitude at projected position
Altitude at projected position
Time of projection

SURVEILLANCE - ADS Reports

I- Extended projected profile

Next WPT + Altitude + Estimated time
Next +1 WPT , Altitude + Estimated time
etc...
Next + 128 WPT, altitude + Estimated time

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SURVEILLANCE - ADS Contracts

A contract = agreement between air and ground
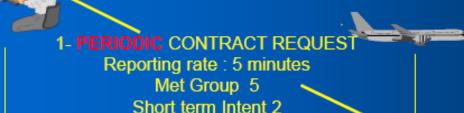on information to transmit to the ground.

Three types of contract defined :

A- Periodic Contract
ADS basic group (interval T) +
a set of additional groups with for
each group a reporting rate defined
as multiple of the basic reporting

B- Demand Contract
Basic group + a set of
additional groups

C- Event Contract
Basic Group with a flag to indicate
the event triggering the report

1- **PERIODIC** CONTRACT REQUEST
Reporting rate : 5 minutes
Met Group 5
Short term Intent 2

2- ACKNOWLEDGEMENT
OR
NEGATIVE ACKNOWLEDGEMENT
OR
NON COMPLIANCE NOTIFICATION

3- BASIC GROUP + SHORT TERM INTENT +
MET GROUP

4- BASIC GROUP

5- BASIC GROUP + SHORT TERM INTENT

Details on Periodic Contract

Details on EVENT contract

When this contract is set up reports containing
the basic group are sent when the event defined occurs

Pre-defined Events are :

-**Passing** of :
- a WPT
- a specified altitude
- a specified longitude
- a specified latitude

- **Change** of :
- next or next + 1 WPT
- heading
- altitude
- speed (grond/air/vertical rate)
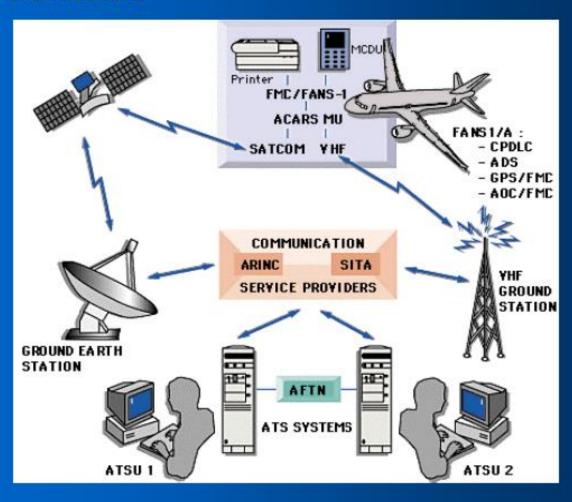- F.O.M.

- **Deviation** from the cleared route or altitude

ADS connection establishment

- **Identification** of the ADS **capability** of the aircraft by ground system

- **Establishment** of a data **link** between aircraft and ground system

- **Comparison** of the aircraft 3D profile with ground **flight plan**

- Identification and **allocation** of the appropriate ADS **contract**

ADS technical architecture and context

ADS end to end technical architecture

Air architecture : a system approach

- **GPS Navigation:** UTC synchronised time (Time stamping), Required Navigation Performance certification (RNP4)

- **AFN (logon): HANDSHAKE**
Aeronautical Facility Notification

- **CPDLC: Controller Pilot Data Link Communication**

- **ADS-C: Automatic Dependant Surveillance - Contract**

- AOC: Airline Operational Communication

- RTA: Required Time of Arrival

FANS-1 /A
combined CPDLC/ADS operational concept expected benefits

- **Safety** : Improve pilot-controller communications

- **Economy** : Optimum routes "Flextracks" based on wind forecast
  Single and then multiple re-routings per day

- **Capacity / Economy** : Reduction of separation standards

  15 minutes longitudinal
  100NM lateral $\longrightarrow$ 50NM $\longrightarrow$ 30NM

Functional objectives

- <u>Data Link Application= toolbox</u>

The notion of "Data-Link Application" has been defined by ICAO Manual of ATS datalink applications doc 9694-ed1-99

as: "the implementation of datalink technology to achieve specific Air Traffic Management operational functionalities".

ADS FUNCTIONAL OBJECTIVES

a) Increase flight **safety**, through the capability to provide surveillance services to aircraft outside radar coverage.
Oceanic -remote areas

b) Better notification and increased **accuracy** of the aircraft position in emergency situations.
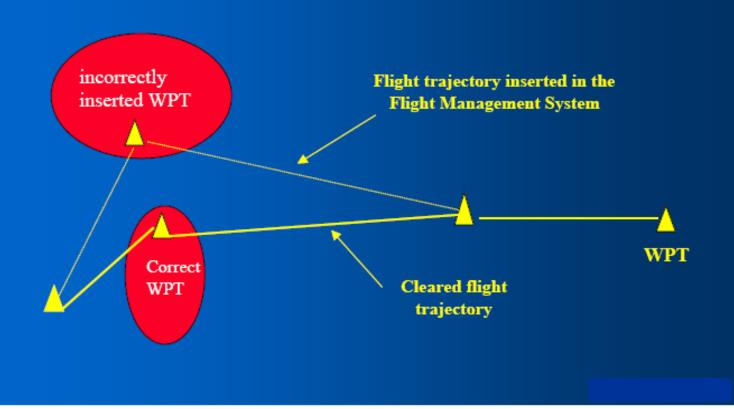
Search and Rescue operations eased

c) **Complement** to radar (low altitudes, radar failure)

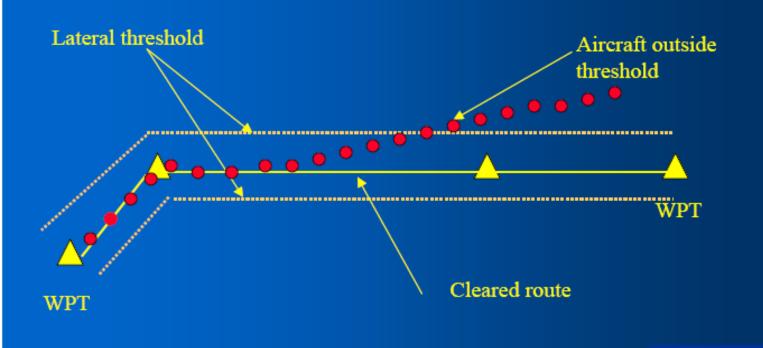*Not an alternate to radar, just a complement*

ADS FUNCTIONAL OBJECTIVES

e) Reduction of separation minima in procedural airspace (still argued for FANS)

f) Enhanced conflict detection and resolution capabilities

g) More flexible use of airspace due to the increased level of tactical control

ADS FUNCTIONAL OBJECTIVES

h) Flight path monitoring and early detection of deviation from the cleared route

ADS based services- Definition

- <u>Data Link Service = one use of tools</u>

The notion of "Data-Link Service" has been defined by ICAO Manual of ATS datalink applications doc 9694-ed1-99
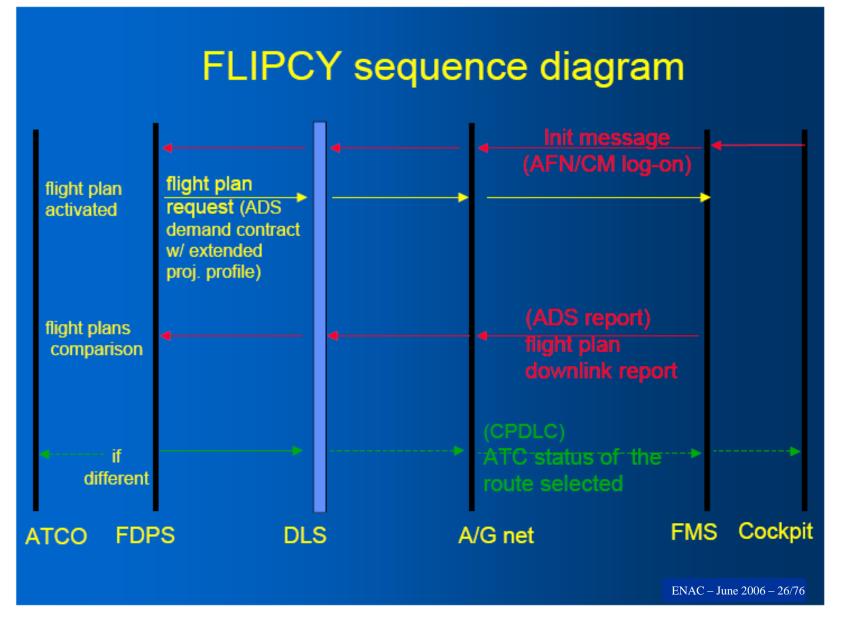
as: "A set of ATM related transactions, both system supported and manual, within a datalink application, which have a clearly defined operational goal".

FLIPCY sequence diagram

ATCO — FDPS — DLS — A/G net — FMS — Cockpit

- Init message (AFN/CM log-on)
- flight plan activated
- flight plan request (ADS demand contract w/ extended proj. profile)
- flight plans comparison
- (ADS report) flight plan downlink report
- if different
- (CPDLC) ATC status of the route selected

CAP functional objectives

CAP Controller Access Parameters is the *service*

DAP Downlink of Aircraft Parameters is the *sub-application*

- High level objectives :
    - Increasing traffic **capacity** per sector
    - Increasing **safety** by reducing both controllers' and pilots' workload
    - Decrease of R/T channel **congestion**
    - Better controllers' traffic and meteorological **situation awareness**

- 3 main DAP-enhanced tools envisioned:
    - Enhanced controller tools in en-route airspace
    - Enhanced surveillance in non-radar, low-density airspace; and
    - Enhanced support tools for arrival management at major airports.

CAP benefits & constraints

- **Expected Benefits**
- direct provision of up-to-date aircraft parameters to the Controller,
- reduction of the risk of error,
- extension of the domain of common reference for Aircrew and Controller,
- improvement of the capacity of pre-regulation (e.g. sequencing) in terminal sectors,
- reduction of the Controller workload by reducing uncertainty concerning expected behaviour of the aircraft,
- **Anticipated Constraints**
- transmission delay (air-ground and airborne).
- **Associated Human Factors**
- An appropriate Controller Human Machine Interface
- Impact on cockpit Aircrew procedures with regard to Aircrew selected altitude.

Thank you for your Kind attention !
Any Question????