

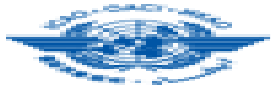
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**Workshop on the Interconnection of Aeronautical  
Surveillance Systems  
(Dakar, Senegal, 14 to 16 April 2014)**

# **Automatic Dependent Surveillance -ADS-C**

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# OUTLINE

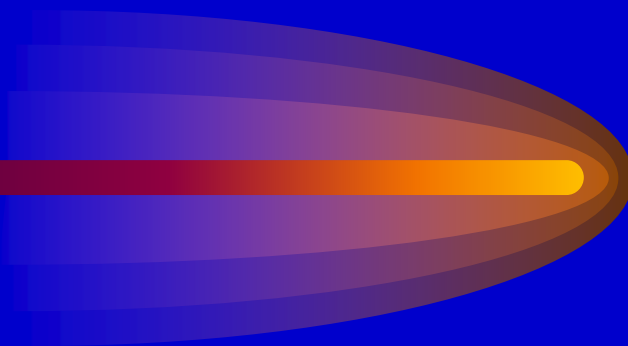
**I – Overview**

**II – Contract**

**III – Architecture**

**IV - ADS Functional objectives  
and services**

**V - Conclusions**





## 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

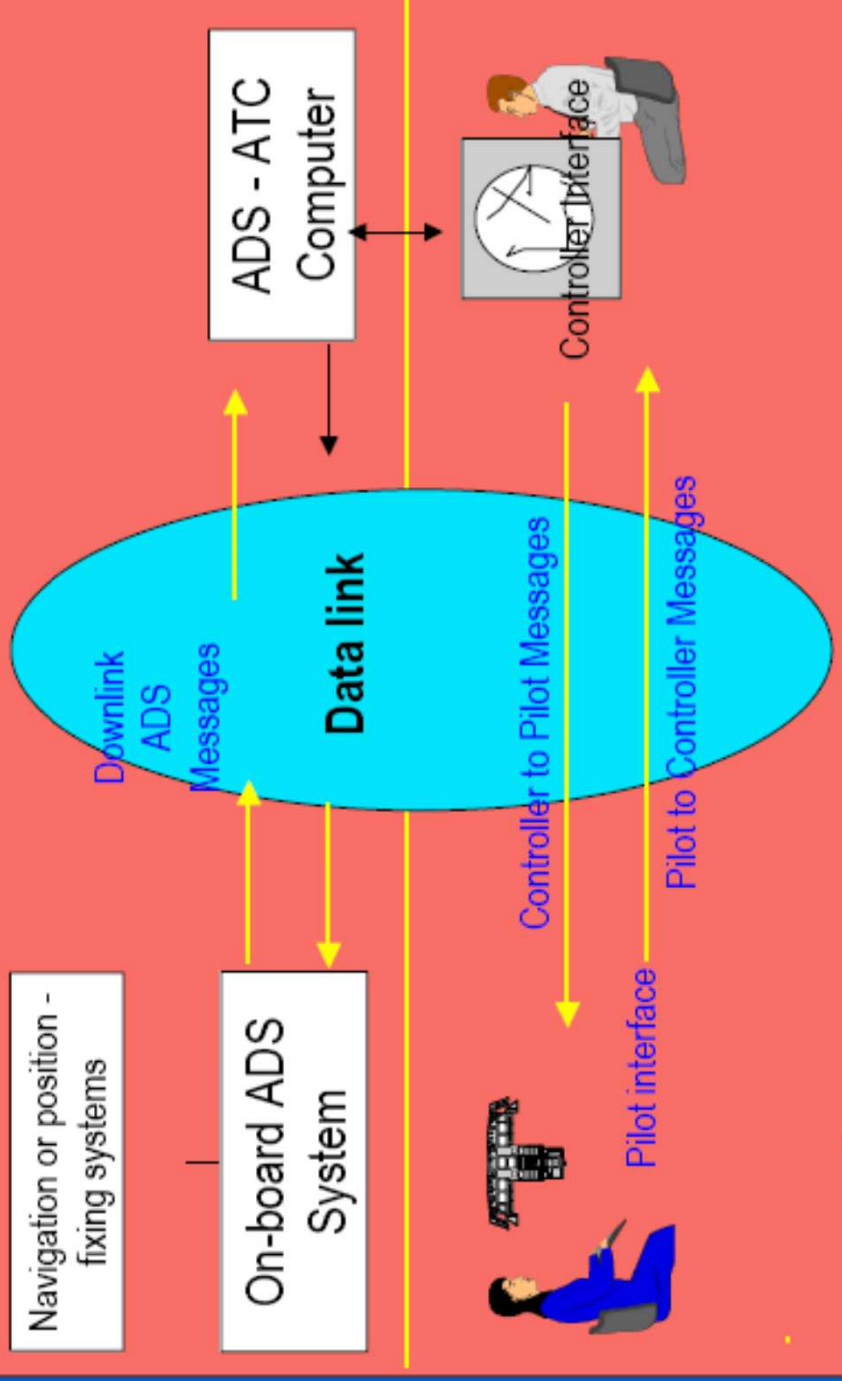
**A surveillance technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems, including :**

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

**ADS is a data link application**



# SURVEILLANCE



# 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**



## 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 (ground/air/vertical rate)
  - F.O.M.
- **Deviation** from the cleared route or altitude



## ADS Contracts - Specifics

In addition an Urgent Mode can be initiated by the pilot :  
Transmission of basic group with a pre-defined reporting interval + aircraft Identification

An aircraft can support up to 4 contracts with 4 ATS  
different ground systems ↻ access control

Theoretical reporting rate can vary from 1s to 30 minutes  
↻ avionics specs (64 sec typical)



## 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**



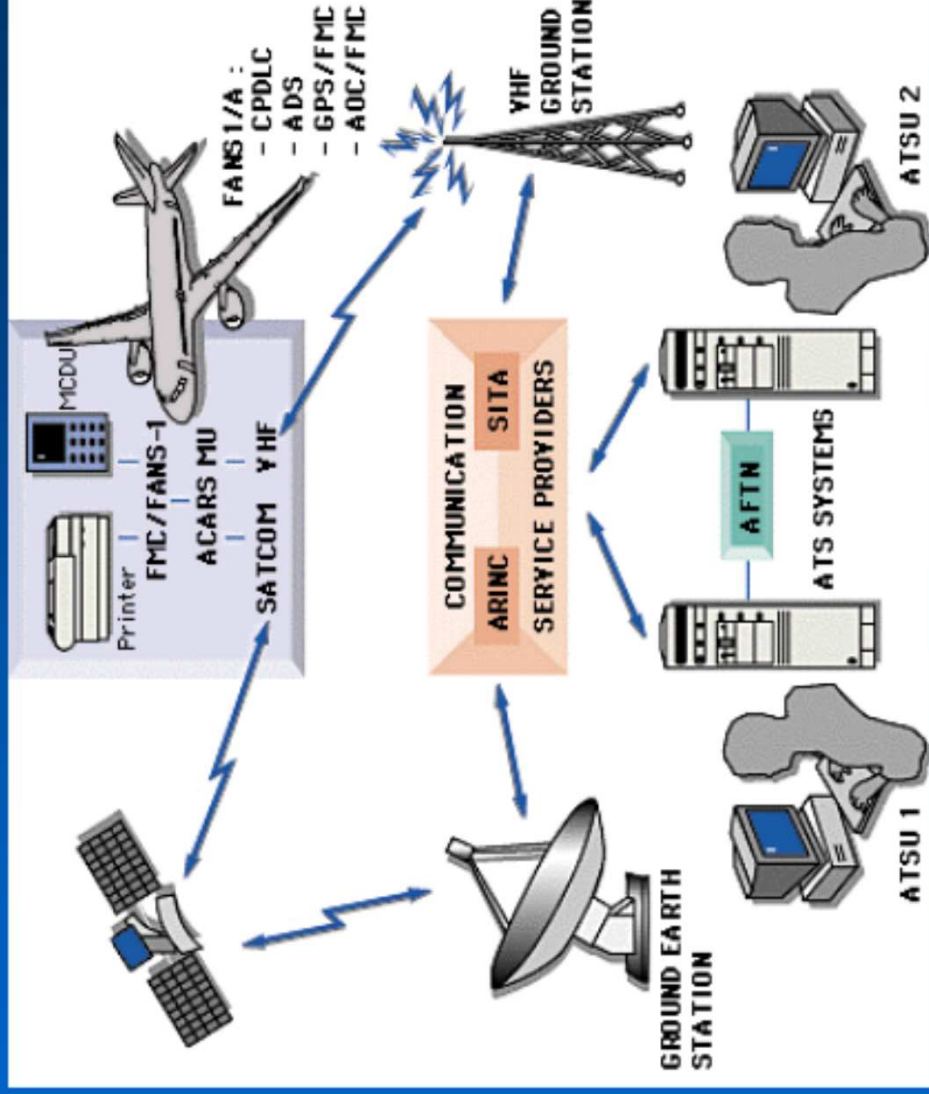
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# ADS technical architecture and context



## 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 → 50NM → 30NM  
100NM lateral



## Functional objectives

- Data Link Application= toolbox

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

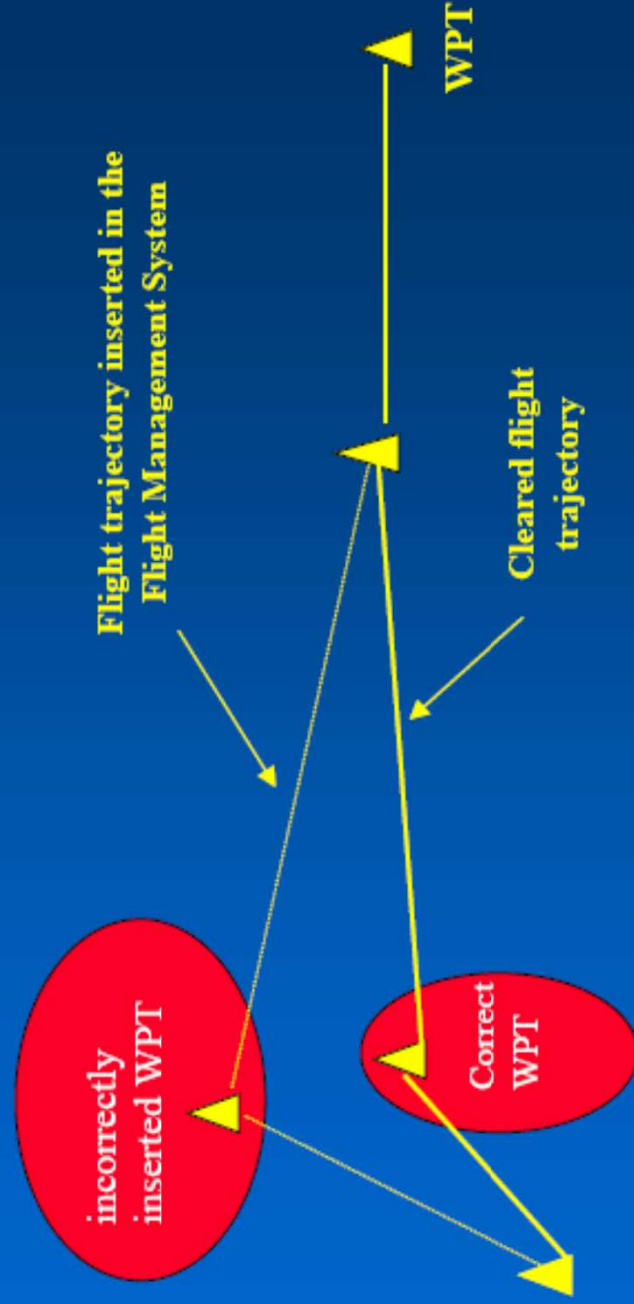
c) **Complement to radar** (low altitudes, radar failure)

*Not an alternate to radar, just a complement*



## ADS FUNCTIONAL OBJECTIVES

### d) Early detection of waypoint insertion errors





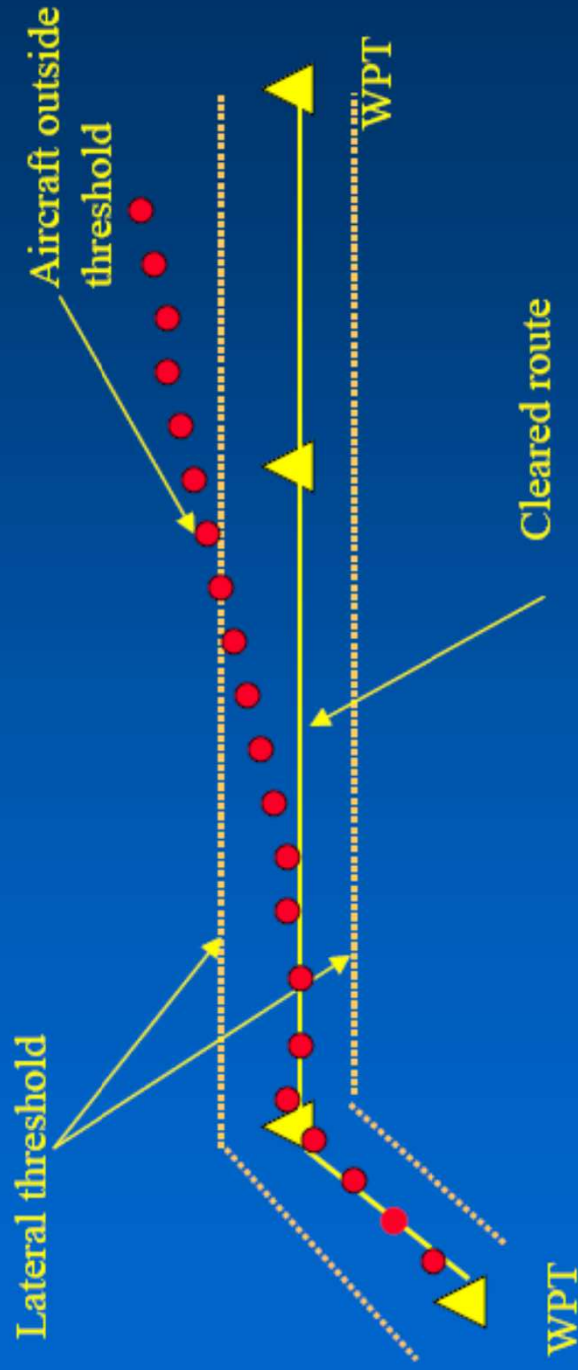
## ADS FUNCTIONAL OBJECTIVES

- 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

- Data Link Service = one use of tools

*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".



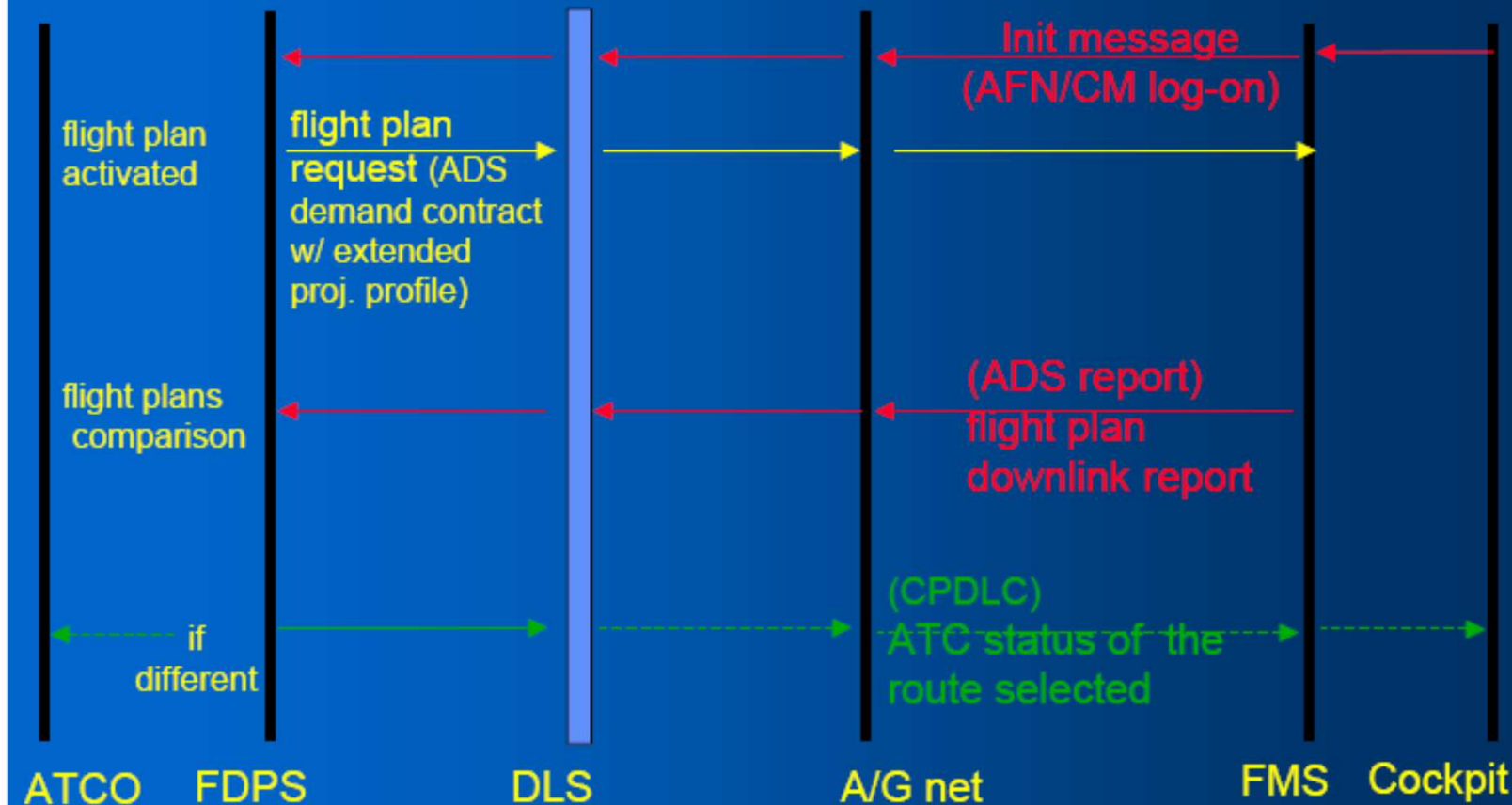


## ADS based services - List

- **Conformance Services**
  - Flight Plan (Route) Conformance (FLIPCY)
  - ADS Conformance Monitoring
  - Automatic Distance Verification
  - Dynamic Air Route Planning (DARP)
- **Controller Access Parameters Service**
  - Baseline 1 CAP Service
  - Turbulence Downlink Dialogue



# FLIPCY sequence diagram





## 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.



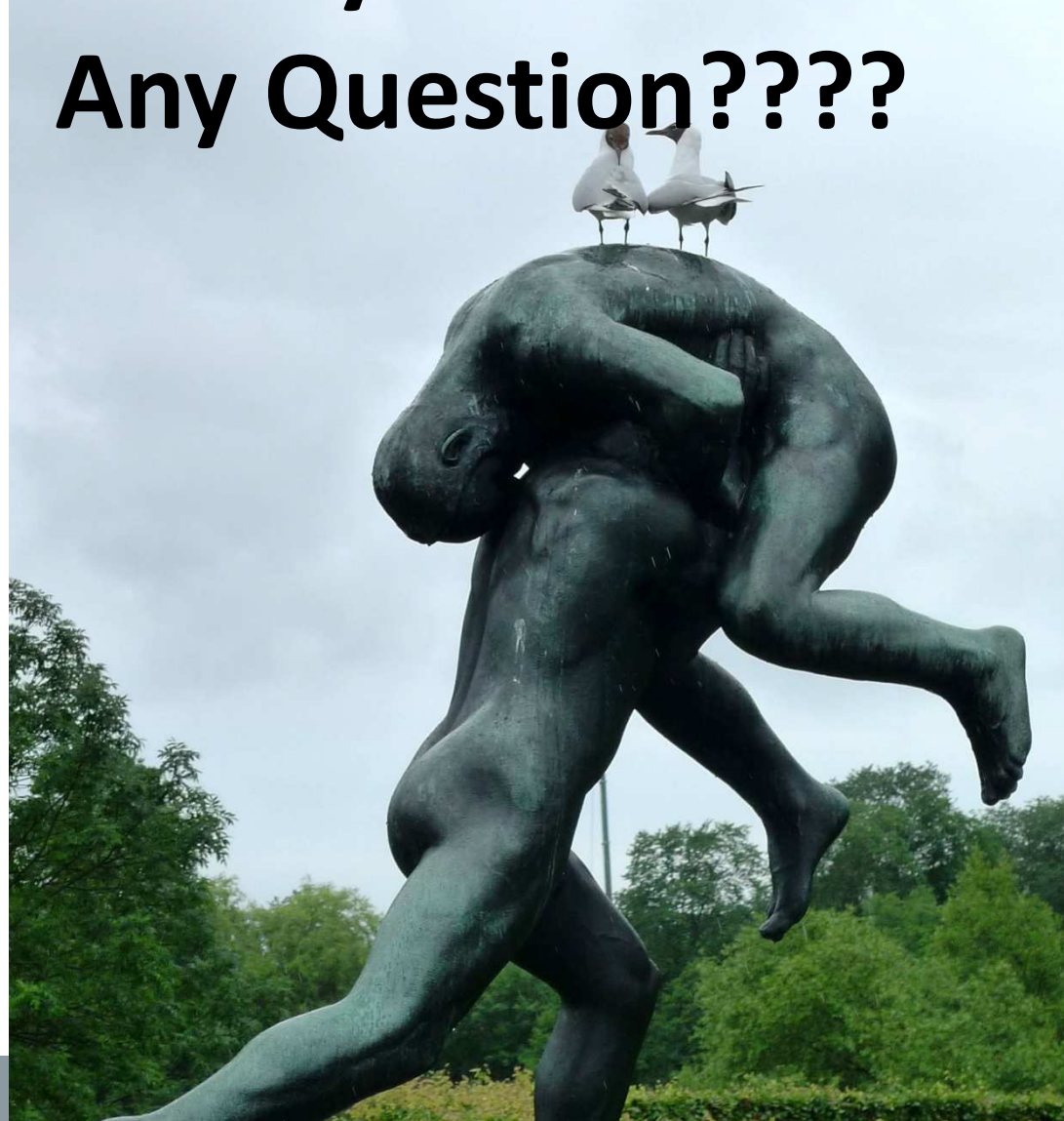
## CAP benefits & constraints

- **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????**



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