For a “1309 System Approach” of the “Conflict Management”

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DASSAULT AVIATION
DIRECTION TECHNIQUE CERTIFICATION
Serge.LEBOURG@Dassault-Aviation.com

How Conflict Management is Handled Today

- **IN CONTROLLED AIRSPACE**
  - Strategic and tactical separation provided by the ATCo
  - Collision avoidance is provided by the pilots
    - ICAO Annex 2 *:"It is important that vigilance for the purpose of* ***detecting potential collisions*** *be not relaxed on board an aircraft in flight …*
      FAR 91-113 *: …"vigilance shall be maintained by each person operating an aircraft so as to* ***see and avoid*** *other aircraft… (FAR 91-113)*
  - TCAS is considered as a "Safety Net"

- **IN NON CONTROLLED AIRSPACE**
  - Pilots are in charge to assume "separation and so collision avoidance"
  - AC 90-48 C is there to remember pilots
    - *..that most MAC accidents and NMAC incidents occurred during good VFR weather conditions and during the hours of daylight."*

- **CONCLUSIONS**
  - Conflict management is handled by application of operational rules
  - There is no "safety analysis, no common failure mode detection"

Today Operations In Controlled airspace

Separation

ATM Controller

Method

Aircraft position from secondary radar
Distance : mode A transponder
Azimuth : Radar bearing
Altitude : Mode C transponder

Collision Avoidance

Aircraft Pilots

Method

By visual contact
See & Avoid principle

"Safety net"
TCAS

No analysis of the Common failure modes

What Means "1309 System Approach"?

- **SYSTEM APPROACH**

  To refer to the method developed for certification of the aircraft systems (FAR/CS 25/23)

  It's a comprehensive examination of the system functions to identify failures modes

  Consequences of the failure conditions are classified in categories
  Minor, Major, Hazardous, Catastrophic

  Failures modes are analyzed (safety analysis) ; associated probabilities are determined
  In CS/FAR 25 (large aircraft) catastrophic event is set at 10-9/h
  In FAR 23 Classe I (Single Reciprocal Engine) catastrophic event is set at 10-6/h

- **WHY "1309"**

  Because it is the paragraph number used the CS/FAR to request such analyses

  There are also AC/AMC to better defines the rules & methods
  AC/AMC 25-1309
  AC 23-1309-1D

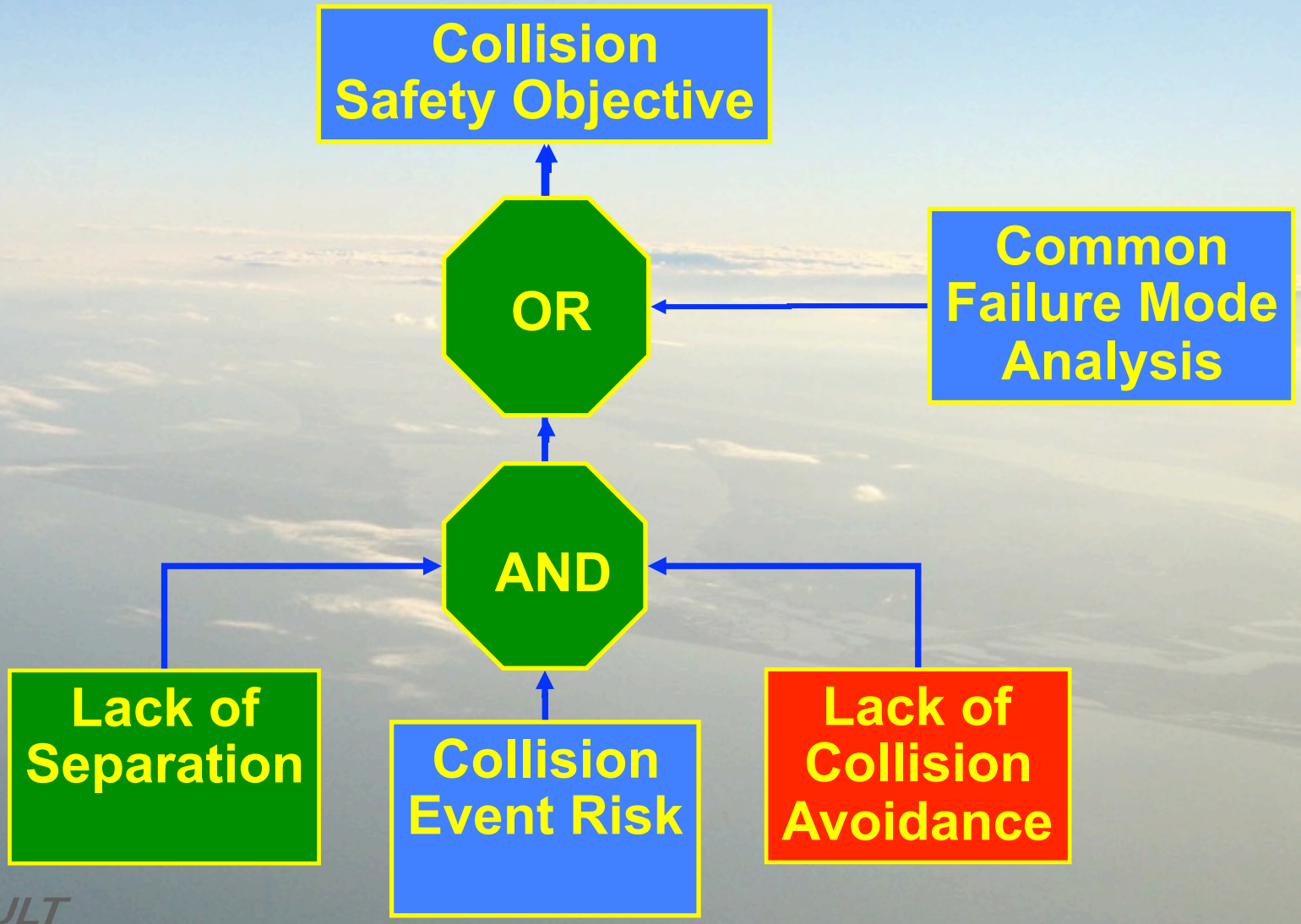
A New Concept for ATM Safety

- **THE CONCEPT JUSTIFICATIONS**
  - It will no longer be possible to separate on board functions & activity from ATC ones
  - Due to the function integration a global approach based on complex system will be required

- **CONCEPT FOR "AIRCRAFT SEPARATION & COLLISION AVOIDANCE"**
  - There is a need for a complete new approach of aircraft separation / collision avoidance
  - A concept based on technology and no longer on physiologic pilot capacities
    - *"See & avoid" no longer considered as the primary means of collision avoidance*
  - A concept considering a global approach of the problem (Ground & airborne segments)
  - A concept based on safety objectives (1309 minded), validated by safety analyses
  - A concept considering and analyzing all common failure modes

- **WHY SUCH A CONCEPT**
  - To allow safe operation of all types of aircraft : Civil (large to ultra light), UAS, State
  - To replace "uncontrolled airspace", by "controllable airspace"
  - To select and validate the systems used for separation & collision avoidance

The Method


Collision Safety Objective
OR
Common Failure Mode Analysis
AND
Lack of Separation
Collision Event Risk
Lack of Collision Avoidance

Aircraft System Safety Objectives

- **CASTASTROPHIC EVENT PROBABILITY IN AVIATION (one scenario)**
  - **10^{-9}/h** : Transport aircraft (CS 25) or commuter (FAR23)
  - **10^{-8} /h** : Aircraft over 6000 lbs (FAR 23) (VLJ aircraft)
  - **10^{-7}/h** : Single turbine Engine or Multi reciprocating engines (FAR 23)
  - **10^{-6}/h** : Single reciprocating engine (FAR 23), Combat Aircraft, Large UASs
  - ***10^{-5}/h :*** *Ultra light machines, Gliders, VLA, UASs (less than 4000 lbs)*

- **CATASTROPHIC AIRCRAFT LOSS (Global)**
  - **10^{-7}/h** : System Global objective for Transport aircraft (CS 25)
    - ***10^{-6}/h :*** *taking into consideration all factors (ATM, MMI, Weather) (reality slightly better : 3.10^{-7}/h)*
  - ***10^{-6}/h :*** *System Global Objective for Transport Aircraft (CS23 ,VLJ)*
  - ***10^{-5}/h :*** *System Global Objective for General Aviation (CS/FAR 23)*
  - ***10^{-5}/h :*** *System Global Objective for Combat Aircraft*

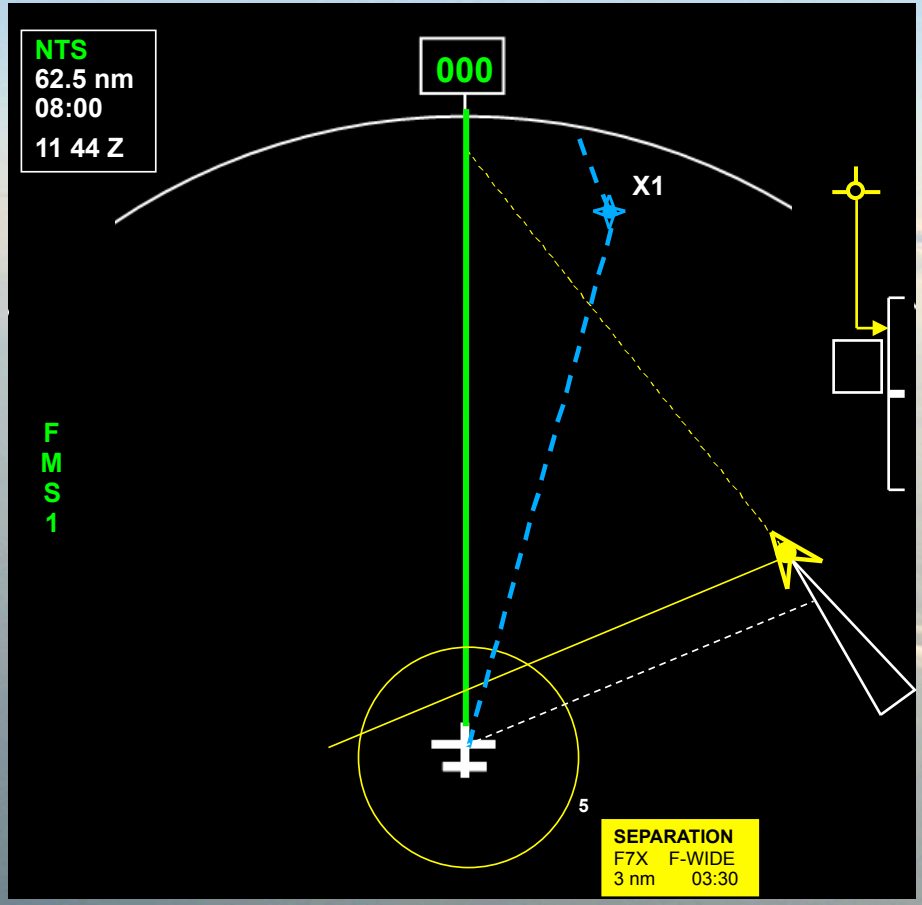
Note : Italic to indicate that these figures are extrapolated from Regulations

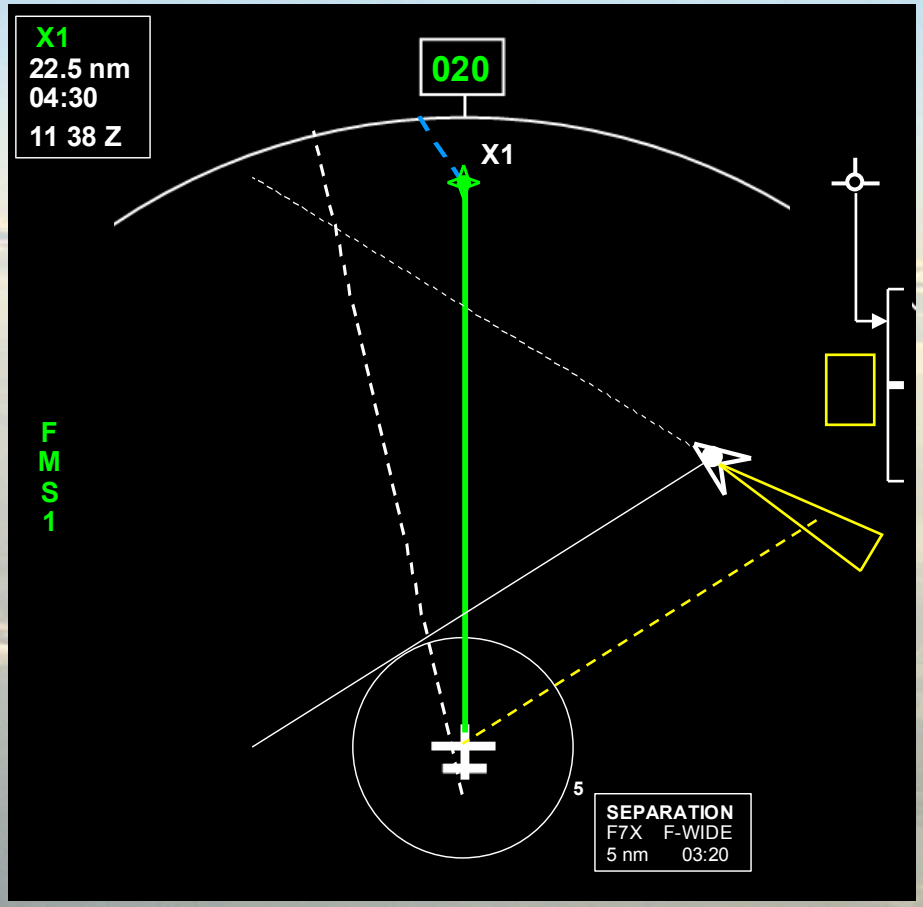
Future Controlled Airspace

- **TOMORROW SEPARATION**
  - ATC remains in charge of aircraft separation (ADS-B)
  - ATC might delegate separation activity to pilots (ADS-B ASAS)
- **COLLISION AVOIDANCE**
  - No longer based on “see & avoid” but on “TCAS” technology (mode S)
  - See & Avoid becomes the “safety net”
- **COMMON FAILURE MODES**
  - Altitude baro (ADS-B et mode C/S)
    - Solution is to receive intruder GPS / Baro altitude difference and to compare it with onboard one
  - 1090ES frequency saturation (ADS-B & mode S used by the TCAS)
    - Solution : avoid saturation and even in the future adopt UAT technology (RTCA recommendation)
  - The pilot himself which will be in charge of separation & collision avoidance
    - Solution : In case of TCAS TA & RA, to remove all ASAS symbology

ADS-B : Automatic Dependence Surveillance System
TCAS : Traffic Collision Avoidance System
ASAS : Airborne Separation Assistance System
TA : Traffic Alert
RA : Resolution Advisory

ASAS with Wake Vortex Symbology





ASAS : Airborne Separation Assistance System
ADS-B : Automatic Dependence Surveillance Broadcast

Uncontrolled Airspace

- **PREREQUISITES**
  - All the users have to become “cooperative” and so have to report positions (ADS-B)
    - Technologies will have to be adapted to the users (1090ES, UAT, FLARM, GSM…)
  - TIS (Traffic Info Service) broadcast to all users
    - Various means of transmission (UAT, GSM, WiMax in airport area)
  - FIS (Flight Info Service) to provide all the necessary information
    - “Dynamic Airspace Allocation” can be used in real time to provide “advisory separation” to a user
  - Uncontrolled airspace will become “controllable airspace” (controlled by the users)

- **SEPARATION & COLLISION AVOIDANCE PROVIDED BY THE USERS**
  - Risks will have to be determined and accepted by the users
    - Collision risk in light aviation is high today, technology will be a real plus to reduce the risk
    - See & avoid will remain an element of safety (safety net)
  - Access to local airports for Business Aviation & even light Air transport
    - Advisory separation provided by “Remote Tower” & “Dynamic Airspace allocation”
    - Self separation based on the fact that all users are now cooperative
    - Associated risk will nevertheless be higher than in controlled airspace

UAT : Universal Access Transmitter

Safety is Paramount for all the Users

- **SAFETY IN ALL THE AIRPACE**
  - Controlled airspace as today uncontrolled airspace
  - Safety based more on technology than on application of “operational rules”
  - Elimination of “common failure modes”
- **SAFETY FOR ALL THE USERS**
  - Meaning that all the users have to become “cooperative”
  - ADS-B technologies have to be adapted to user specificities
  - “See & Avoid” no longer the main principle of separation & collision avoidance
- **UAS ARE COMING**
  - They have to find their ways to operate
  - All the other users have to consider them

THE BEST WAY TO PREDICT THE FUTURE IS TO CREATE IT

Peter Drucker

Questions?