CINQUIEME SEMESTRE
Spécialité Avionique et Systèmes de Contrôle du Trafic Aérien

SB508
Ground based Safety Nets

Nov 2016

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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

Objectives of the training

- Be aware of the ground based safety nets
- Understand how do ground based safety nets work
- Ready to compare with airborne safety nets

What we will see during this training

- This training gives you the basic knowledge of the Ground Based safety nets
- We will explain the basics of each Ground based-safety nets.
- We will describe what they need and how they work.
- We will see also main parameters to tune them.
- Of course as it is a generic training, we will not describe the software and the hardware.

Lesson 2
Safety nets in general

Outline

- Chapter 1 : Pilot and ATCO needs
- Chapter 2 : Description of safety nets
- Chapter 3 : What are the safety nets ?
- Chapter 4 : What are the benefits of safety nets ?
- Chapter 5 : Safety nets Modeling
- Chapter 6 : To sum up …

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1.1 Automation and human concepts

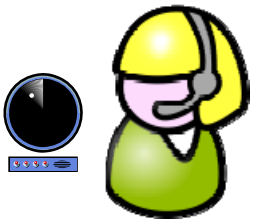
- Safety is very important in aviation. Since, the “Convention of Civil Aviation” in Chicago, states provides Air traffic Service in safe conditions.
- A lot of complex services with computers, networks, communication, and electronics are provided. But human activity , with the controllers, is present and stay in the center .

1.2 Model and strategy

- ATCO and pilots works building a mental model of the traffic and the airspace.
- they have to establish a plan and control the situation and can make decisions.
- So they can generate a strategy and tactic to handle the traffic and potential conflicts.

1.3 New informations

- During the execution of his plan, they, manage also new information for examples, errors, exceptions, changes, emergencies and distractions.

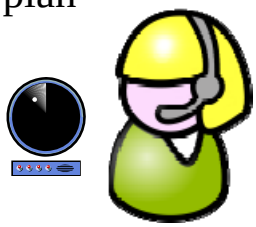


1.4 ATCO needs

- In the Air Traffic Management, the controllers use tools to see the traffic and then to separate it.
- Those tools are radars, computers and screens to display the traffic.
- Even if those systems are safe, sometimes incidents or accidents appears.
- Why ?
  - New conditions during the flight
  - Changing conditions (weather)
  - Technical problems …

1.4 ATCO needs

- A situation becoming dangerous can generate an accident if the controller do not detect the conflict on his plan



1.5 Safety nets

- ATCO and Pilots needs a system :
  - to prevent automatically imminent or actual dangerous situations.
  - To work in better conditions, with a comfort zone, and to reduce and eliminate accidents
- This kind of system is called : SAFETY NETS
- SAFETY NETS are the last safety defence against accidents

1.5 Safety nets

- But the pilots and the controller do not change their way of working using safety net.
- Those systems provide an additional safety margin.
- Using safety nets, the risk is reduce up to a factor of ten

Outline

2.1 Principle

- Safety nets have to provide alerts to ATCO and Pilots, of an increased risk
- Impacts of accidents in aviation, are very high, so different safety defences are provided.
- ATCO and Pilots, have to be prevented of the risk.

2.2 Two types of safety nets

- ATCO and Pilots needs safety nets this is why we find Safety Nets on :
  - airborne (inside the cockpit and used by the pilots)

  - the ground based (in the ATM center and used by the Air traffic Controllers)

It is important to note that Ground-based safety nets and Airborne safety nets
- predict conflicts but the predictions are different
- operate independently

2.2 Two types of safety nets

- It is important for the ATCO and the Pilots to know how to used information from safety nets.
- Ground based safety nets and Airborne safety nets do not always send alerts at the same time.
- Those two systems are totally independent, so in some case, alerts will be in sequence and in other case, it will be not .
- Of course it depends of the context and the situation.

2.2 Two types of safety nets

- Priority between alert generated by a ground based and an Airborne safety net :

In case of simultaneous alert given by Ground and Airborne safety nets, as the Airborne safety nets can give a “Resolution Advisory” the pilot must execute the action recommended by the airborne system.

2.3 Ground Predictions

- The predictions for **Ground based safety nets are up to 2 minutes**
- When a controller receive an alert from a ground safety net, he must :
  - inform the pilots of the risk
  - must take appropriate action to avoid the accident giving instructions to the pilots.

2.4 Airborne Predictions

- The predictions for **Airborne safety nets are up to 40 s.**
- The airborne safety nets provide
  - Alert and
  - Advisories.
- Pilots have to take appropriate avoiding action.

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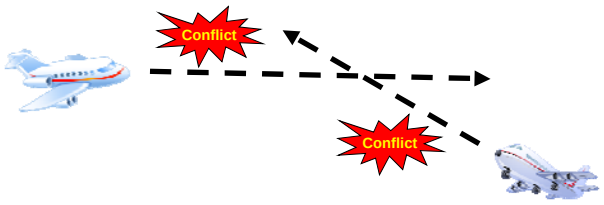
3.1 The Ground based safety nets

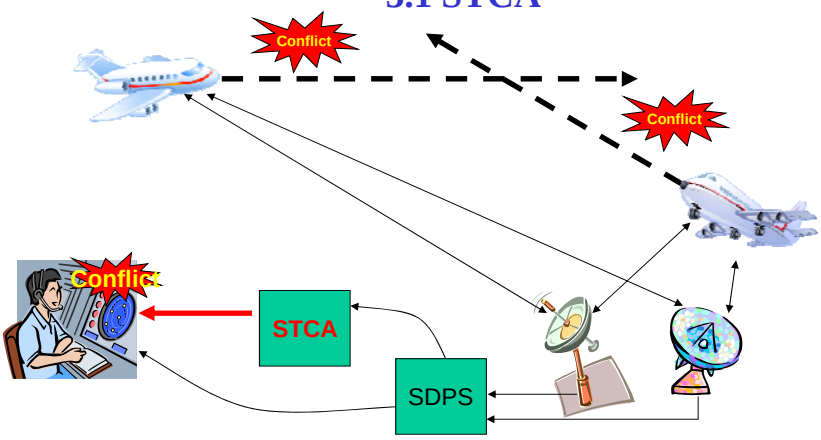
- In the ground based safety nets, we find the four next systems :
  - STCA : Short Term Conflict Alert
  - APW : Area Proximity Warning
  - MSAW : Minimum Safe Altitude Warning
  - APM : Approach Path Monitor

3.1 STCA

- STCA : Short Term Conflict Alert
- Objective : informs controller in predicting collision between aircrafts. This system generates, in a timely manner, an alert of a future or actual infringement of separation minima

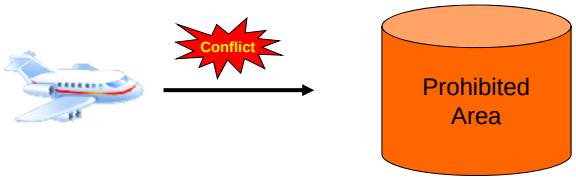


3.1 STCA

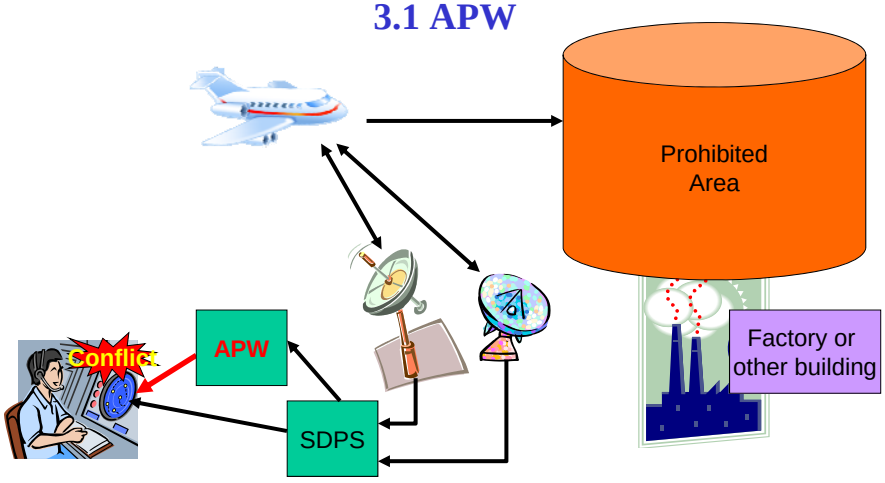


3.1 APW

- APW : Area Proximity Warning
- Objective : informs the controller when a flight enters in an unauthorised airspace volume. This system generates, in a timely manner, an alert of a future or actual infringement of the required spacing to that airspace volume

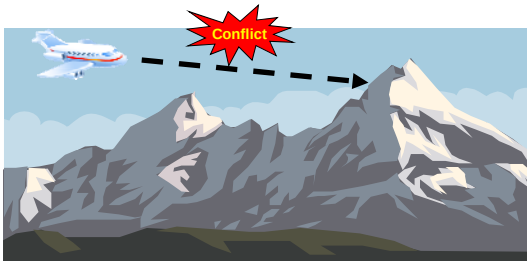


3.1 APW

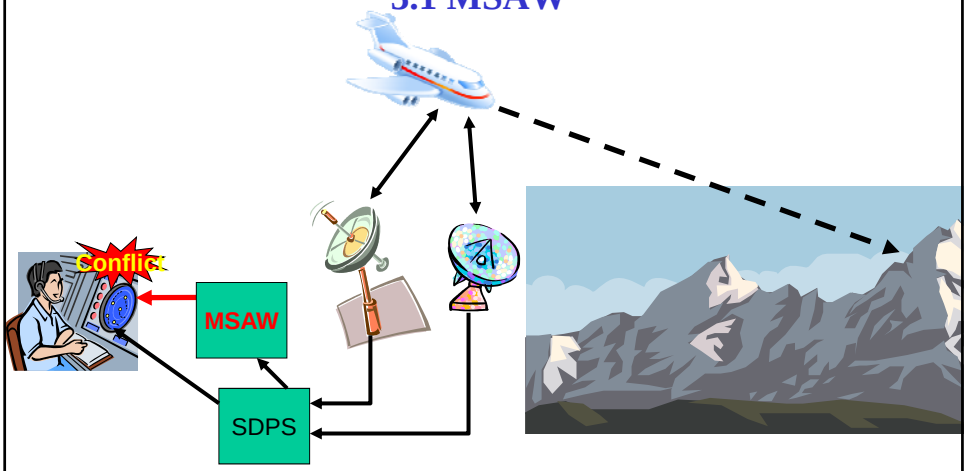


3.1 MSAW

- MSAW : Minimum Safe Altitude Warning
- objective : informs the controller about an increased risk of controlled flight into terrain (CFIT) accidents. This system generates, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

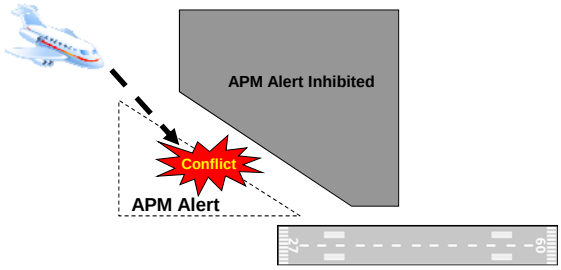


3.1 MSAW

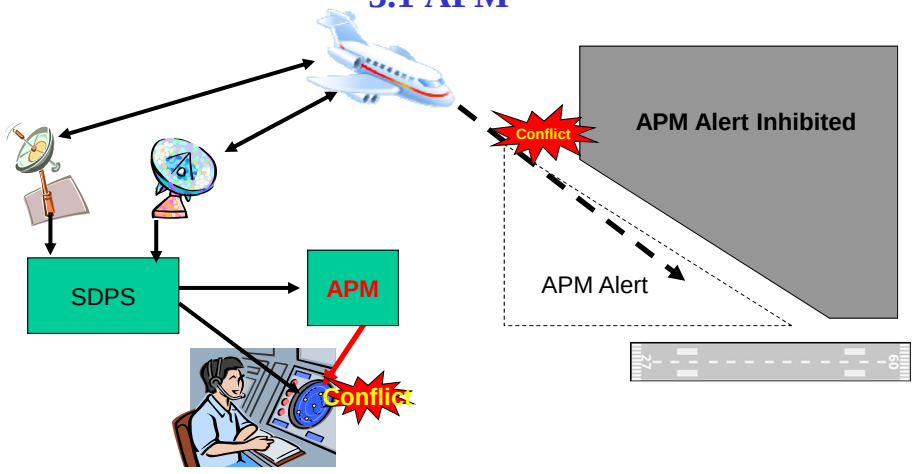


3.1 APM

- APM : Approach Path Monitor
- Objective : informs the controller about increased risk of controlled flight into terrain (CFIT) accidents. This system generates, in a timely manner, an alert of aircraft proximity to terrain or obstacles during final approach



3.1 APM



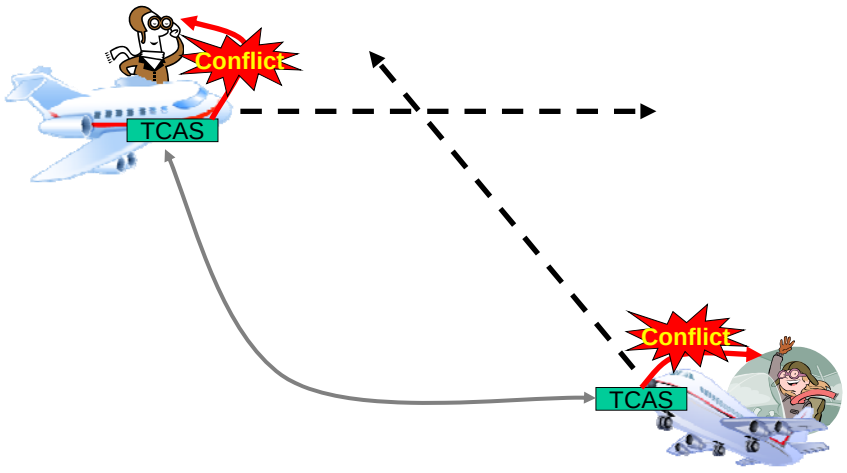
3.2 The Airborne safety nets

- In the airborne safety nets, we find two systems:
  - TCAS : **T**raffic alert and **C**ollision **A**voidance **S**ystem
  - GPWS : **G**round **P**roximity **W**arning **S**ystem

3.2 TCAS

- TCAS is member of ACAS (Airborne Collision Avoidance System) works as STCA.
- TCAS helps pilot in predicting collision between near aircrafts.
- TCAS generate information and resolution to the pilot when a predictive conflict is detected.

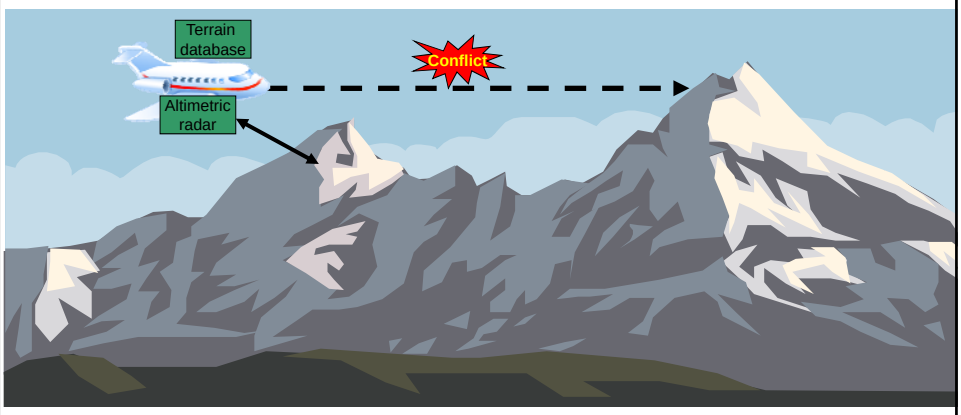
3.2 TCAS



3.2 GPWS

- GPWS (or EGPWS - Enhanced Ground Proximity Warning System) is member of TAWS (Terrain Awareness and Warning System).
- GPWS works as MSAW .
- GPWS helps pilot in predicting accident into terrain

3.2 GPWS



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Chapter 4 : Safety benefits

- Because Ground-based safety nets are news, we don't have enough characteristics to demonstrate the benefits with quantified performance.
- But some ANSP (Air National Service Provider) which installed and used ground based safety nets report reductions in incidents since they installed STCA and APW.

4.1 Tune the system

- Controller will be helped by ground safety nets
- Pilot will be helped by Airborne safety nets.
- But :

  All the systems must be tuned to generate good alerts. (If the system are bad tuned, too much alerts will appear and the users, controller or pilot, will not be confident using safety nets. At the end they will reject them. This is why , it's very important to reduce the false alert rate)

  Instead , if the safety nets are well tuned, the users know that the safety nets are a defence and they will help them successfully.

  In the same way, safety nets will be knew to reduce incident, so a trust attitude is established between users and the system.

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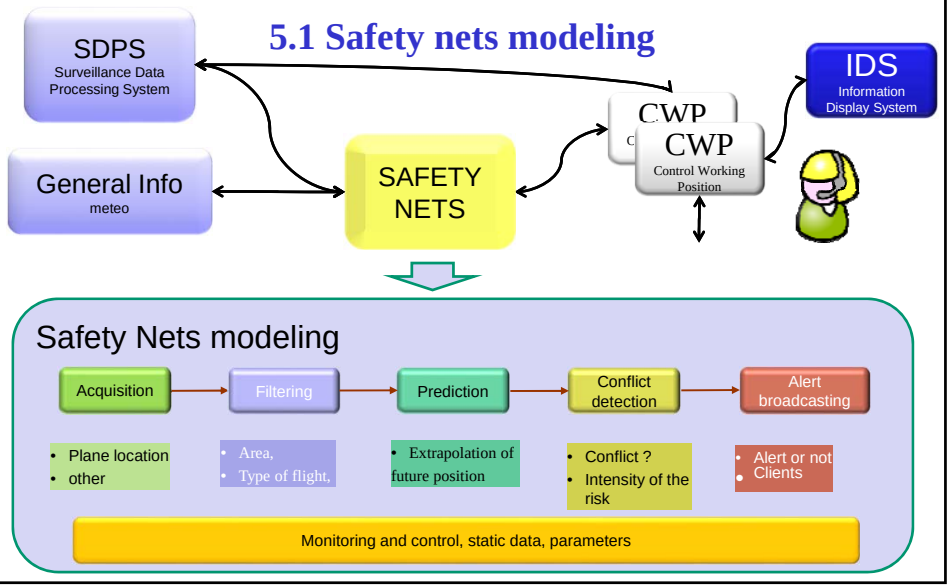
5.1 Safety nets modeling



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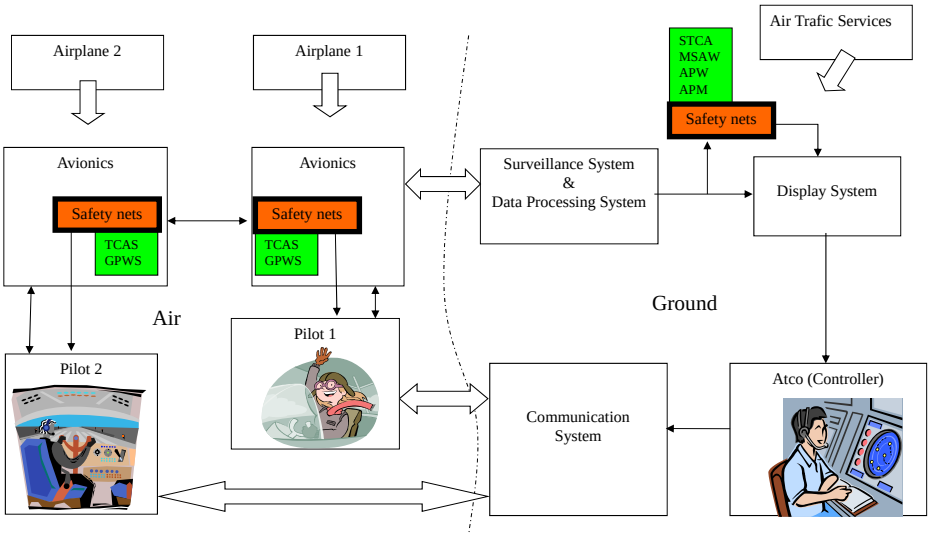
Chapter 5 : To sum up …

- Global view
- Overall diagram
- SDPS, a track, …

5.1 An overall view

- In the next slide , we see a global view of safety nets
- For a better understanding , this slide presents an example with two aircrafts
- We see also how safety nets are connected, and their independance



5.2 Ground based safety nets

- The bases for ground safety nets
- What system we need for ground based safety net
  - In the aircraft (avionics) :
    - Pressure altitude
    - Transponder
  - On the ground, in the ATM system
    - Secondary Surveillance Radars
    - Surveillance Data Processing System
    - Operational Display System

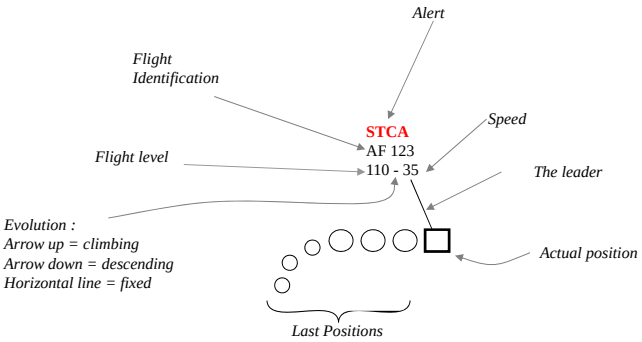
5.3 SDPS

- What is a track ?
  - A track « is a plane in the SDPS »
- Plane information are :
  - Position
  - Flight Identification
  - Flight Level
  - Tendance
  - Speed

5.4 Remember …

- What is a SDPS ……..

Displaying a track



5.5 Remember …

What is the flight level ? ……..

- What is a transponder ? ……..
- What is mode A……..
- What is mode C……..

5.6 Remember …

- SSR
  - A Secondary surveillance radar send an interrogation for all aircraft, asking the flight level (mode C) and the transponder code (mode A), using a specific frequency (1030 MhZ).
- the transponder
  - On board this electronic equipment (the transponder) receive this question from the radar and the transponder reply using another frequency (1090Mhz), sending the altitude pressure (mode C) and a code using 4 digits (mode A).