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

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

Outline of lesson4

- Chapter 1 : Introduction
- Chapter 2 : Basis of APW
- Chapter 3 : Acquisition of data
- Chapter 4 : Filtering function
- Chapter 5 : Prediction function
- Chapter 6 : Conflict detection
- Chapter 7 : Alert process
- Chapter 8 : Conclusion

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1.1 Introduction : Concept

- Area intrusions by unwanted aircraft in civil aviation is a major problem
- This problem could become dangerous regarding military areas
- Controllers need a system to alert them when this situation arrive

- This system is APW : **A**rea **P**roximity **W**arning

1.2 Introduction : APW in France

- APW is a computer system with his own software
- APW is installed in APP for the major french airports
- APW displays alert on the label of the flight which will enter in a prohibited area
- In this case, controller is aware of the intrusion and can take action regarding this aircraft

1.3 Introduction : Two kinds of alert

- The controller is informed using 2 ways :
  - A visual alert on the label in the radar screen

  - A sound is emitted in the operational room

Outline

2.1 Basis of APW

- APW is an active system which prevent of intrusion area
- APW detects if a plane is present in an area
- APW predicts the trajectory (direction) and determine if it will be an intrusion or not
- Some filters are used like altitude or mode A (transponder code)

2.2 Basis : operational and technical requirement

- In operational conditions of use, some requirements are necessary
  - For the controller
  - For the responsible controller of the tower (manager of the team controllers)

2.3 Basis : Requirement for the controller

- In case of APW alert, he must take action to sustain or restore the safety
- In case of high priority, the reaction must be immediate and a procedure must exist to help the controller to apply adequate actions

2.4 Basis : Requirement for the supervisor controller

- He must configure APW to be in coherence with the others systems
- This configuration concerns area which area are enable or disable
- He can stop APW if there is too much false alerts

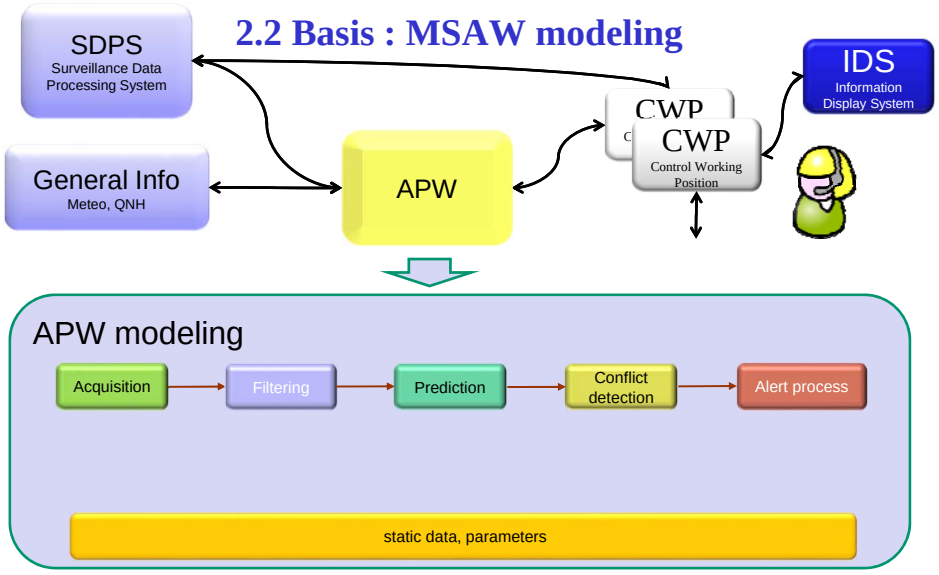
2.5 Basis : Operationnal use

- APW is a tool to help controller
- APW is a safety net
  - Use as the last defence of the system
- It must not be used as a control tool
  - The controller do not wait the intrusion alert to react
  - He must do his job to avoid this situation

2.6 Basis : Recommandation

- APW must detect :
  - VFR unauthorized in class airspace A, C, D
  - Civil flights entering in regulated area controlled
  - Military flights in class airspace A, C, D

2.2 Basis : MSAW modeling



Outline of lesson3

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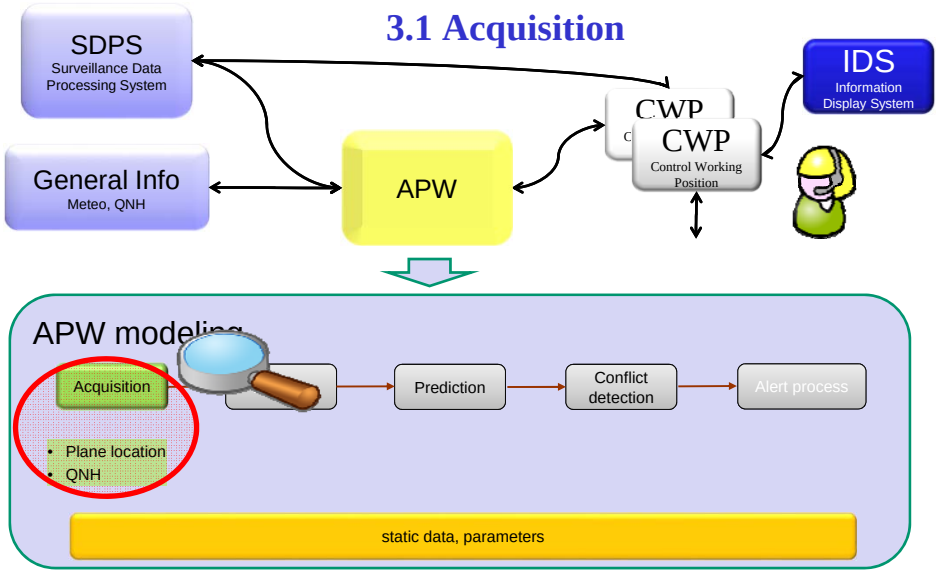
3.1 Acquisition

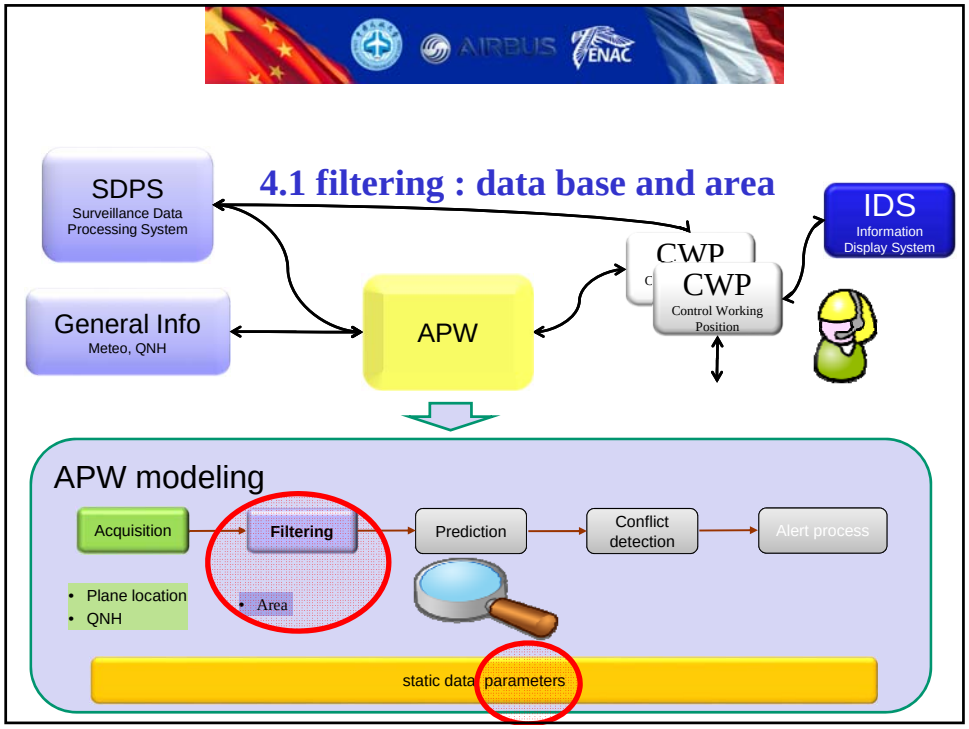


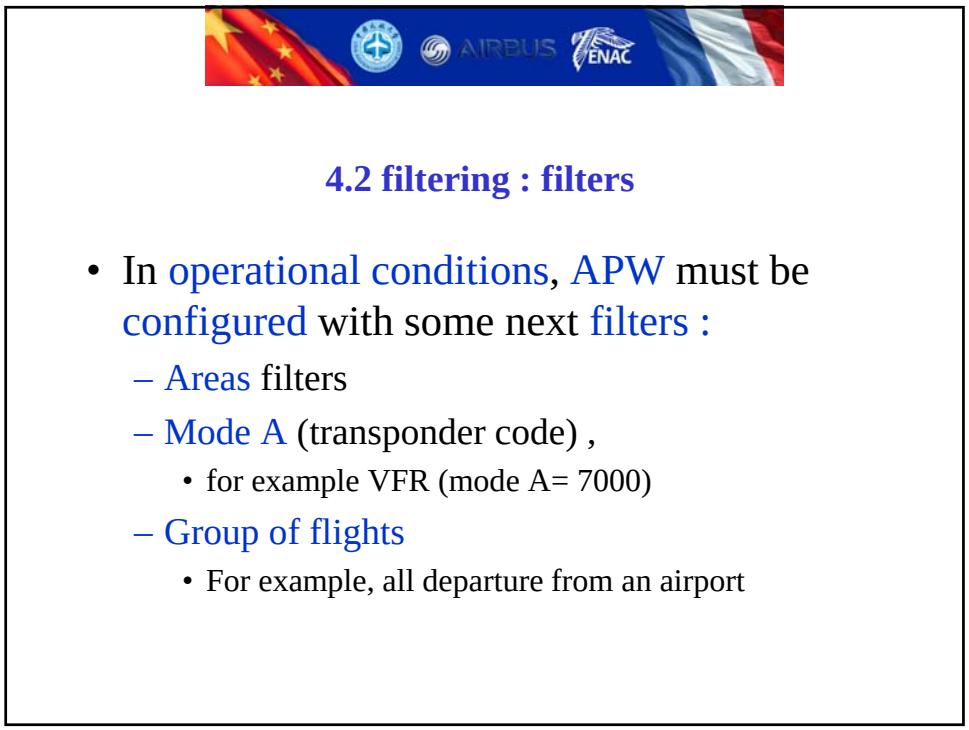
3.2 Acquisition : Inputs

- To work, APW needs some inputs
- As we see for tho others ground safety nets, APW needs :
  - Tracks from SDPS
  - QNH

- Using tracks, it is possible to predict the future position
- Using QNH, all flight level of each aircraft is transformed in altitude
- Areas are defined in the system

Outline of lesson3





4.2 filtering : filters

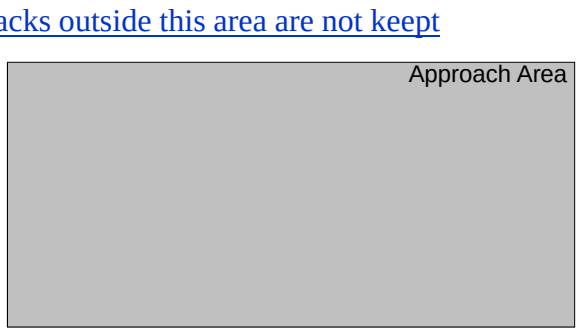
- In operational conditions, APW must be configured with some next filters :
  - Areas filters
  - Mode A (transponder code) ,
    - for example VFR (mode A= 7000)
  - Group of flights
    - For example, all departure from an airport

4.3 filtering : Kind of area configuration

- To detect conflict we have to define differents areas
- There are 3 kinds of area in APW :
  - The approach area
  - The processing area
  - The conflict area

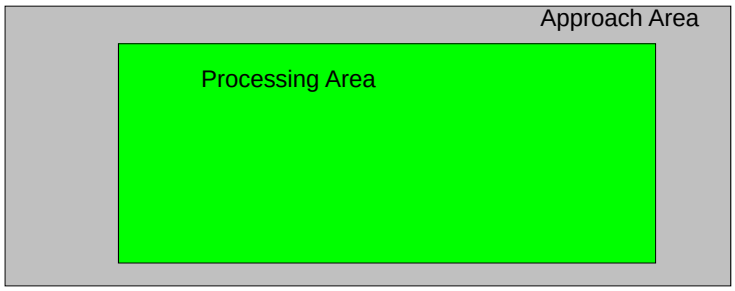
4.4 filtering : Approach area

- It is the global volume where the system uses tracks from RDPS to process conflict detection
- The tracks outside this area are not keept



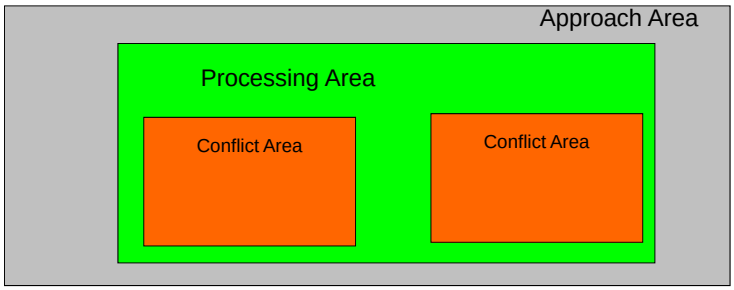
4.5 filtering : Processing area

- In this area, APW process the tracks
- This area must be inside the approach area

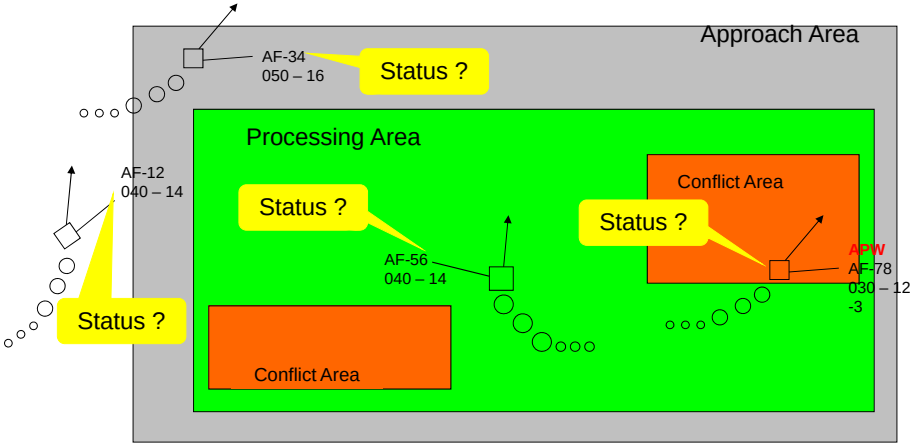


4.6 filtering : Conflict areas

- Those areas must be inside the processing area
- If a plane enter in a conflict area, then an alert will appear
- Conflict area are configured to be with the priority (low, high or with Notice time)

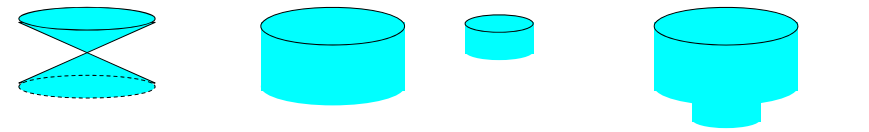


4.7 filtering : Mixing areas



4.8 filtering : Design of the areas

- All the areas must be :
  - Closed
  - With a minimun altitude
  - With a maximum altitude
- Areas are a volume

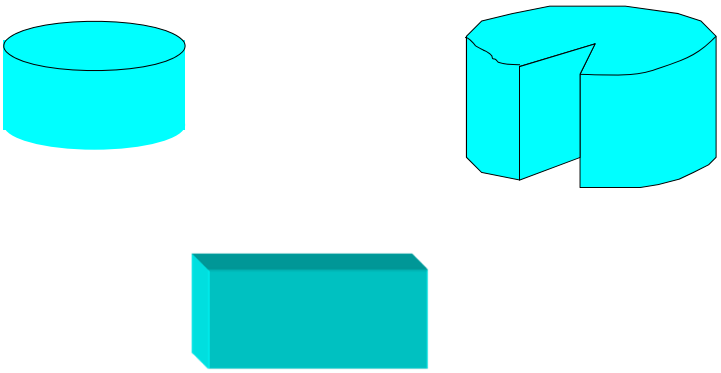


No correct area because no connex

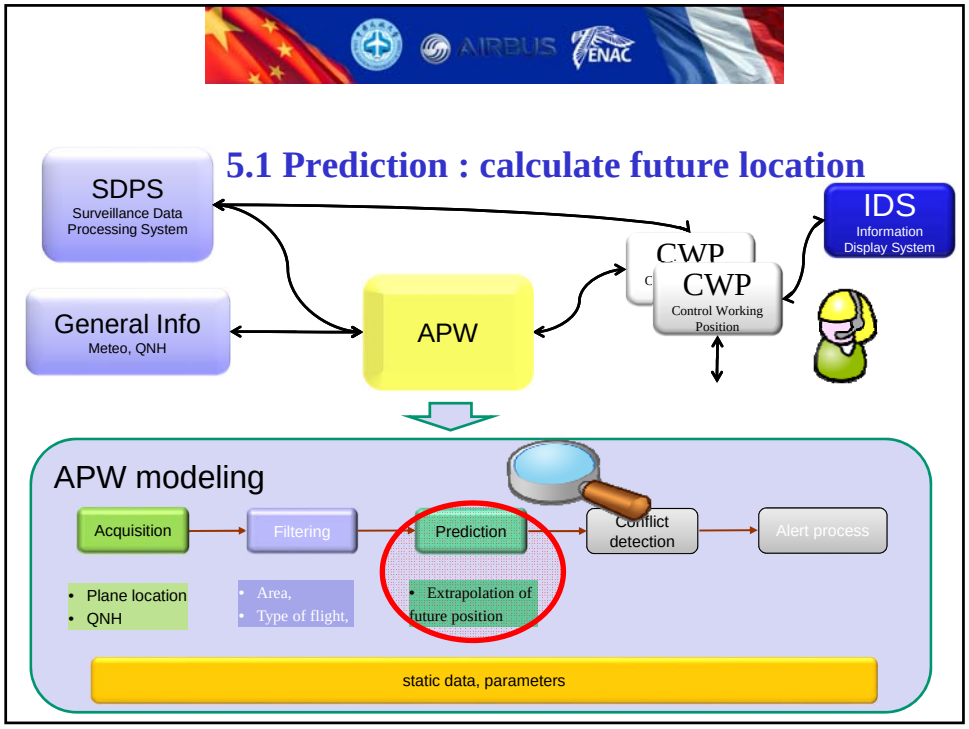
No correct area because 2 differents polygons

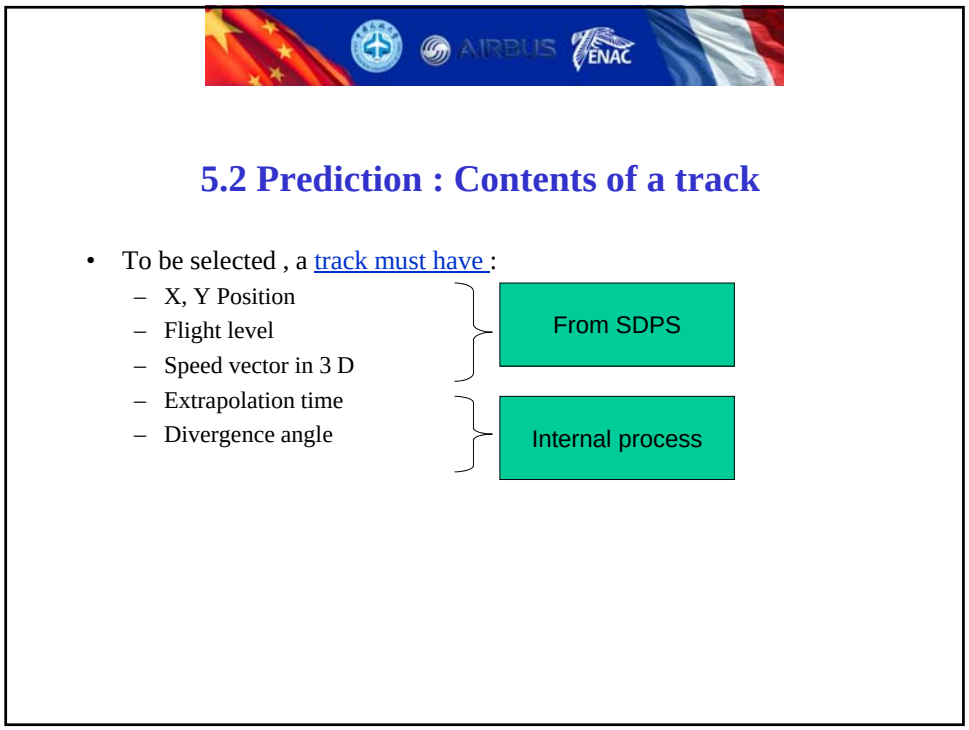
No correct area because low volume under high volume

4.9 filtering : Possible areas configuration



Outline of lesson3





5.2 Prediction : Contents of a track

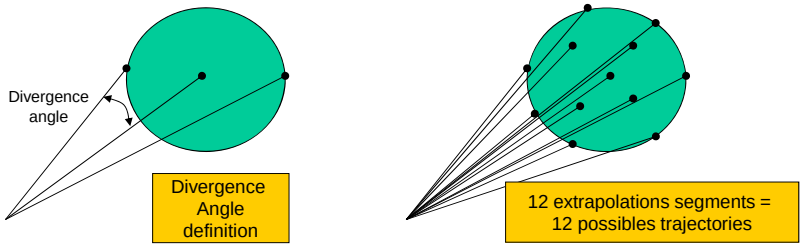
- To be selected , a track must have :
  - X, Y Position
  - Flight level
  - Speed vector in 3 D
  - Extrapolation time
  - Divergence angle

From SDPS

Internal process

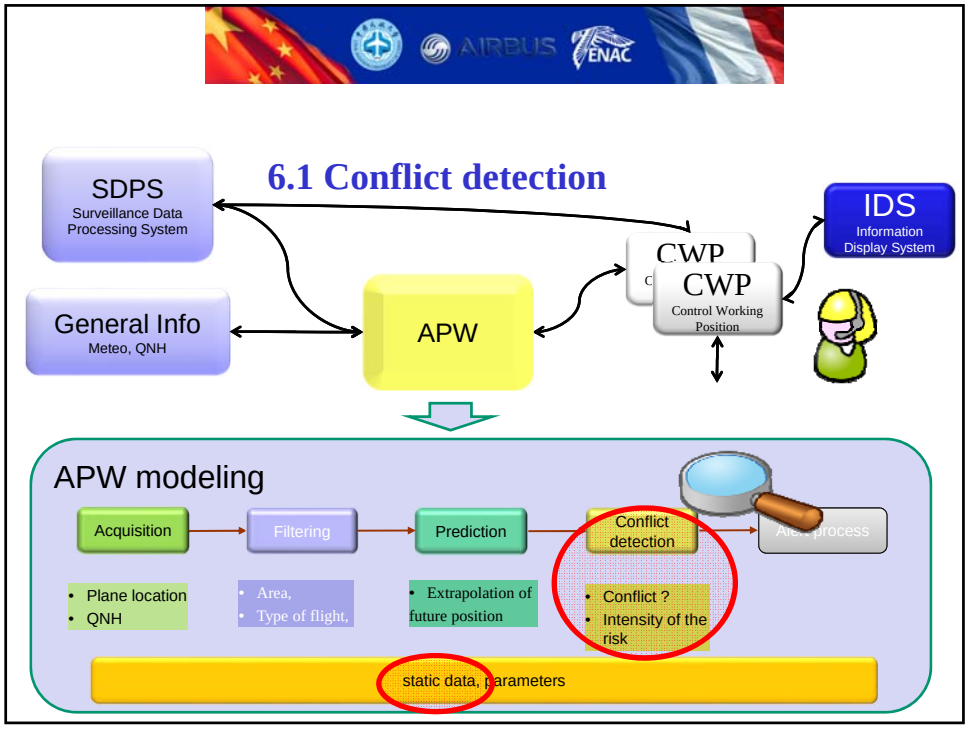
5.3 Prediction : Trajectory prediction

- With those data an extrapolation (prediction) position is made
- This extrapolation is a conic type, because there is a doubt on the speed vector of the plane
- A cone is determined with the divergence angle (in France da=0)
- At the end 12 extrapolations segments are calculated. Each segments are a possible trajectory



5.4 Prediction : No use of a turning trajectory

- The system do not use a turning trajectory prediction
- Too difficult …



6.2 Conflict detection : Set up an area : Conflict areas

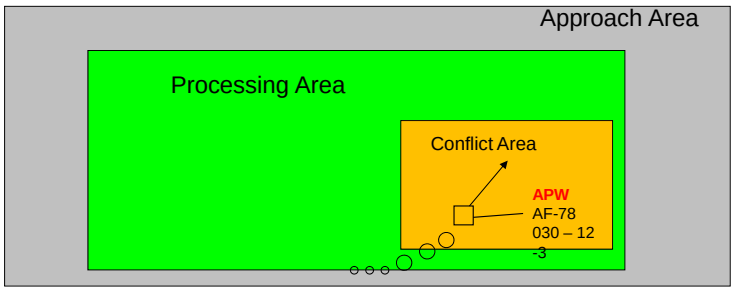
- Specific configuration of conflict detection are possible for the conflict area
  - A : Alert specificity
  - B : Mode A include or exclude
  - C : Airport configuration

6.3 Conflict detection : Set up an area: Alert specificity

- A : Alert specificity (see slides before)
  - low
  - With Notice time
  - high

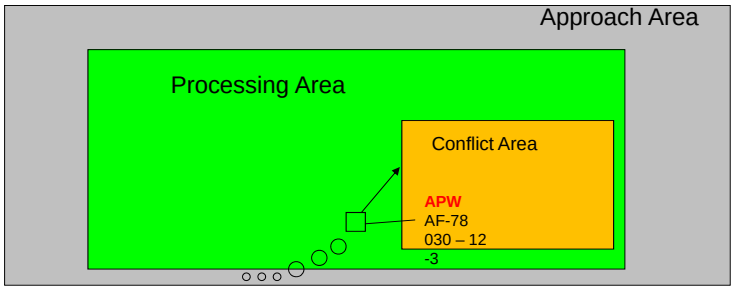
6.4 Conflict detection : Low or high alert priority

- For low and high priority:
  - Conflict detection appears when the aircraft is present in the area



6.5 Conflict detection : with Notice time

- With Notice Time:
  - Conflict detection appears when the aircraft is expected to be present in the area at Notice time



6.6 Conflict detection : Set up an area: Mode A for a conflict area

- B : Mode A (transponder code) can be associated with a conflict area
- Two lists of mode A exist:
  - include list :
    - Conflict detection possible if mode A is present on the list
  - exclude list :
    - No conflict detection possible if mode A is present on the list

6.7 Conflict detection : Departure/Arrival airport for a conflict area

- C : departure list of airport can be associated to a conflict area.
  - It is used to detect plane from a departure which do not have to enter in an area
- An arrival list of airport can be associated to a conflict area
  - It is used to detect plane from an arrival airport which land to a wrong airport

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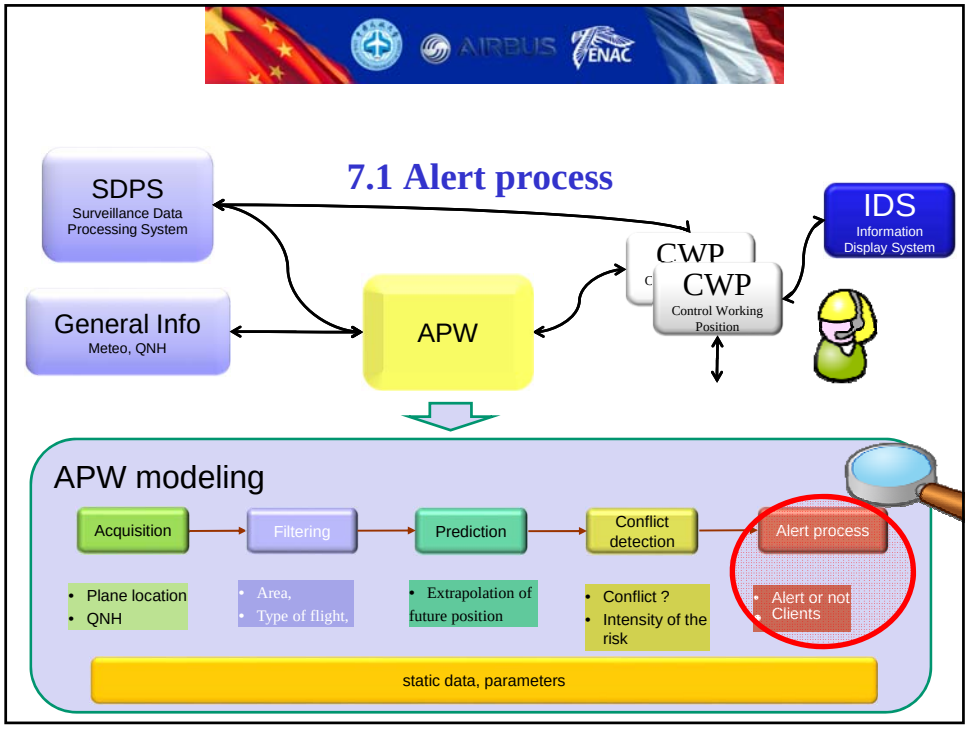
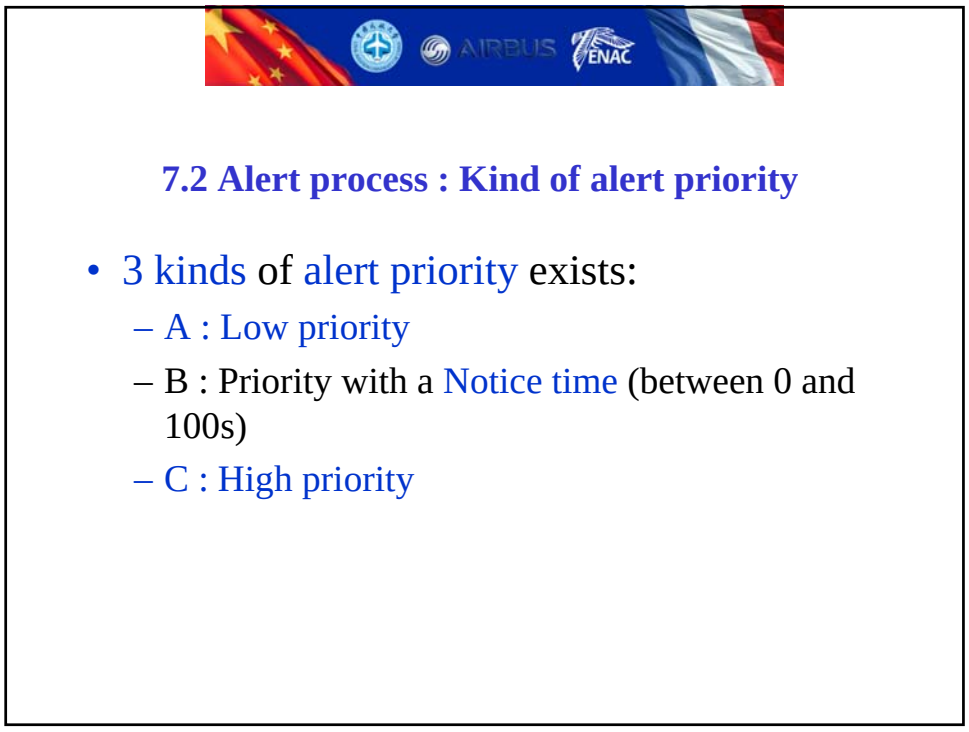




7.2 Alert process : Kind of alert priority

- 3 kinds of alert priority exists:
  - A : Low priority
  - B : Priority with a Notice time (between 0 and 100s)
  - C : High priority

7.3 Alert process : Low / Hight priority

- For low priority
  - Alert is only displayed

- For high priority
  - Alert is displayed
  - A sound alert is sent to the controller

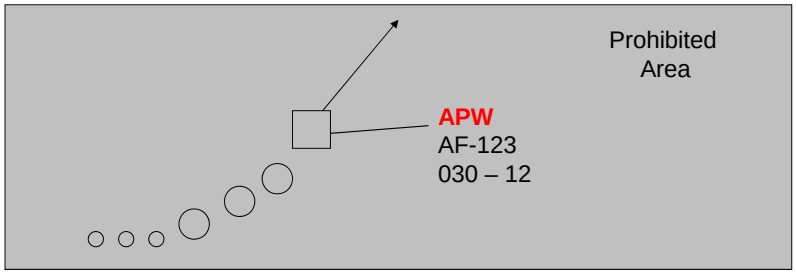
7.4 Alert process : Alert priority with a Notice time

- For alert with notice time
  - Alert is low before the intrusion
    - Displayed
      - during time configured in notice time

  - Alert is high during the intrusion
    - Displayed
    - Sound sent

7.5 Alert process : Broadcasting & Displaying alert

- In any case of the alert priority, the word « APW » appears on the first line of the label when the alert is broadcast to all the controllers



7.6 Alert process : Alert

- The type (low, high, with notice time) of alert is defined offline in a file
- The type of alert for an area is defined with the controller before the installation in operational condition
- In case of multiple conflict, high priority alerts are predominants

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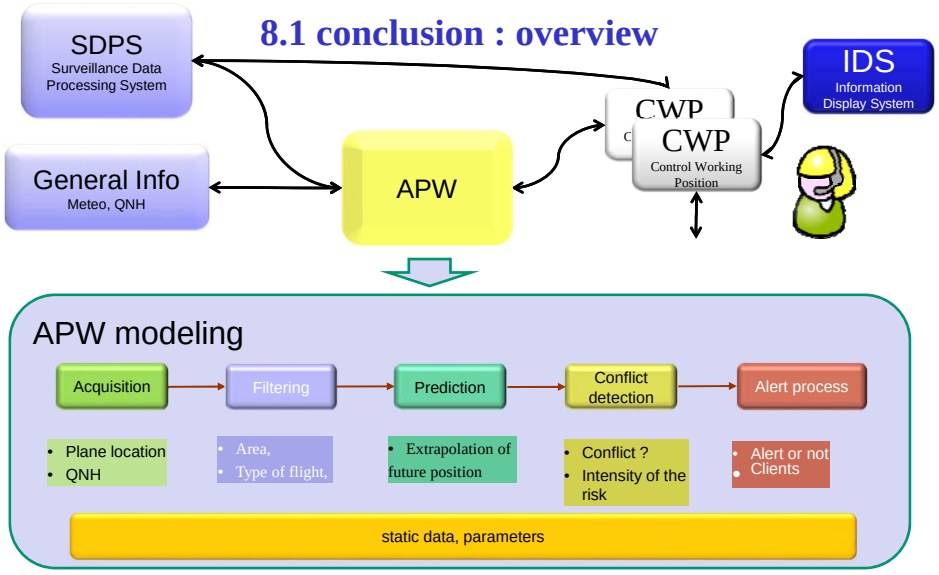
8.1 conclusion : overview



8.2 conclusion : Use of APW

- APW is a based safety net
- There is no equivalent on board
- APW is very useful for the controller, regarding intrusion in specific area like military airspace

8.3 conclusion : Improvement of safety

- The configuration of APW is or could be complex
- The aim of APW is to warn controller and with this system, safety is improved
- APW with the other ground based safety nets is a real good system and controllers in the approach are very confident with it