# PBN Procedure Design Course 2026

## ICAO APAC FPP

## Beijing,China

(7-25/Sep/2026)

# TOLERANCE

# AND

# PROTECTION AREA

***GNSS Sensor***

# Objectives

- Remind which PBN application can be used according to area of operation
- For each PBN application remind the key elements regarding procedure designer perspectives
- Know how to calculate the tolerances for RNAV and RNP
  - Identify the components of the total system error
  - Identify the components of the cross track tolerance (XTT)
  - Identify the components of the along track tolerance (ATT)
- Establish the link between lateral error ( TSE) and protection area width
- Know and understand the global methodology to define area width for all specifications of navigation
- See examples for different applications

# Regulatory reference

## DOC 8168 Vol II Part III

- RNAV concept
  - Section 1 Chapter 1
- Area width for VOR/DME RNAV :
  - Section 1 Chapter 4
  - Tables III-1.4.1 to III-1-4-2
- Area width for DME/DME RNAV
  - Section 1 Chapter 3
  - Tables III-1-3-1 to III-1-3-8
  - Appendix to chapter 3
- Area width for GNSS RNAV
  - Section 1 Chapter 2

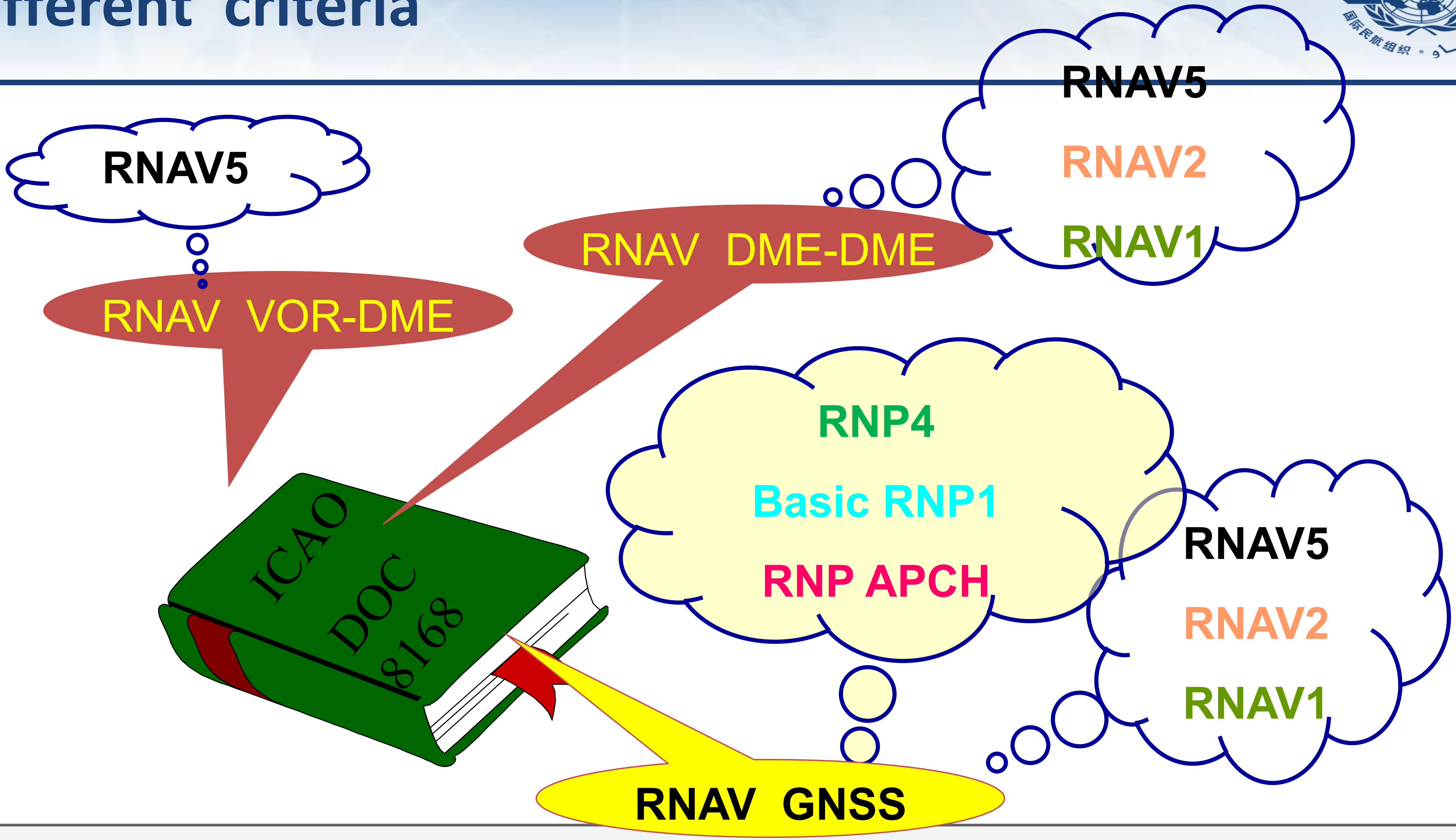
# Application in relation with area of operation

Nov 2014

| | | | | | |
|---|---|---|---|---|---|
| OCEANIC | RNAV10 | | RNP4 | RNP2 | ARNP |
| EN ROUTE | RNAV5 | RNAV2 | RNAV1 | RNP2 | ARNP |
| TERMINAL | RNAV2 | RNAV1 | | RNP1 | ARNP |
| APPROACH | | | RNP APCH | RNP AR APCH | ARNP |

| Navigation specification | | Navaid infrastructure | Leg type | Flyby | RNP (NM) | TSE (NM) |
|---|---|---|---|---|---|---|
| RNAV10 | En route Oceanic | GNSS – INS | - | - | - | ≤ 10 |
| RNP4 | En route Oceanic | GNSS | CF- DF TF | Yes | 4 | ≤ 4 |
| RNAV5 | En route continental | VORDME<br>DMEDME<br>GNSS | - | - | - | ≤5 |
| RNP1 | SID - STAR- Initial + intermediate + Missed approach | GNSS | IF CF TF DF VA VM VI CA FA FM | Yes | 1 | ≤ 1 |
| RNP2 | En route Oceanic<br>En route continental | GNSS | | Yes | 2 | ≤ 2 |
| RNAV2 | En route continental<br>SID – STAR | DMEDME<br>GNSS | | Yes | - | ≤ 2 |
| RNAV1 | En route continental<br>SID - STAR- Initial + intermediate + Missed approach | DMEDME<br>GNSS | | Yes | - | ≤ 1 |
| RNP APCH | Approach<br>• initial + intermediate + Missed approach<br>•Final | GNSS | IF TF DF<br>(CA FA) | Yes | 1<br>0.3 | ≤ 1<br>≤ 0.3 |
| Advanced RNP (A-RNP) | En route continental<br>SID - STAR- Initial + intermediate + Missed approach | GNSS | IF TF DF RF<br>(CA FA) | Yes | 2<br>1<br>0.3 | ≤ 2<br>≤ 1<br>≤ 0.3 |

# Different criteria



# Goal

- WHERE are aircraft located when navigating on published procedure loaded from a data base ?

**Identify an ENVELOP of ACCEPTABLE aircraft position flying the procedure**

**What does mean ACCEPTABLE ?**

**What are the components to define the envelop ?**

# Identify an envelop of acceptable aircraft positions flying the procedure

Question 1 : What does mean ACCEPTABLE ?

Answer : Correspond to the system performance required for each PBN application

*e.g. RNAV1 required 1 NM of lateral accuracy 95% of the flight time*

Lateral accuracy is named TSE (Total System Error)

# Components of the Lateral TOTAL SYSTEM ERROR (TSE)

Navigation System Error (NSE)

TSE

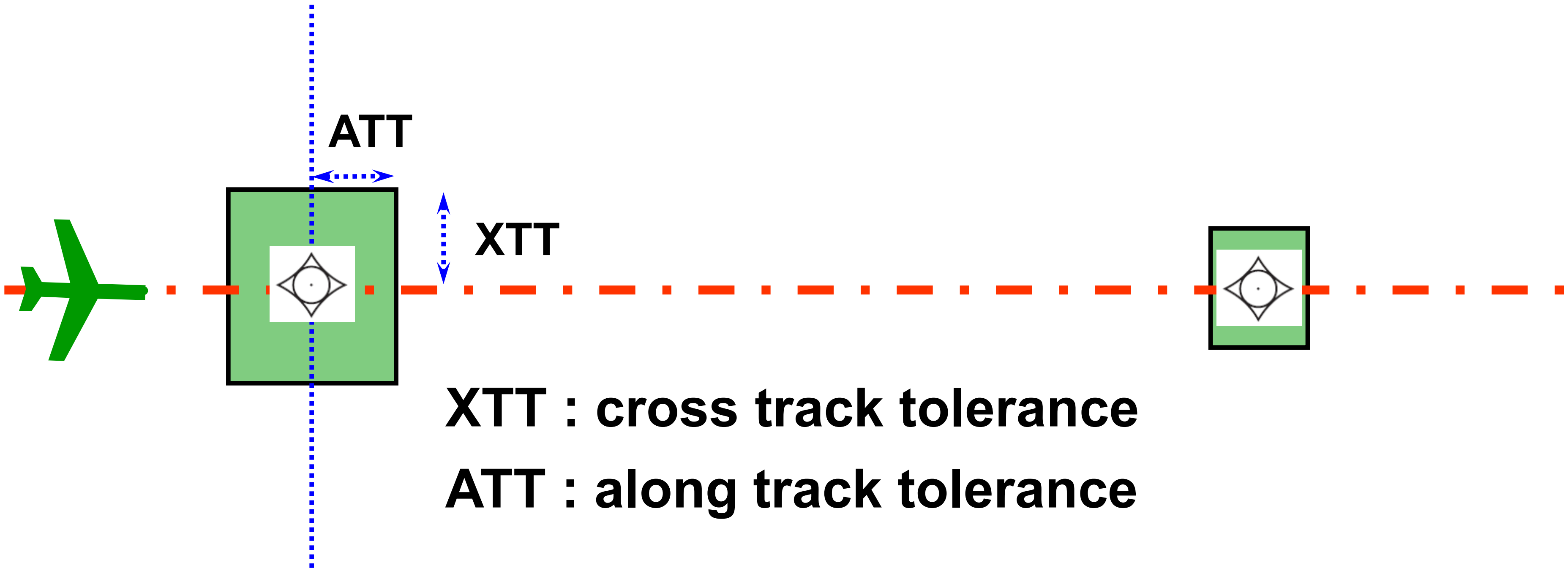
Path Definition Error : (PDE)

Flight Technical Error : FTE

# Waypoint tolerance

- The fix tolerance represents where A/C is assumed to be regarding the fix position and the ACCEPTABLE PROBABILITY

- The tolerance addresses a 2 SD  (standard deviation) value




**XTT : cross track tolerance**

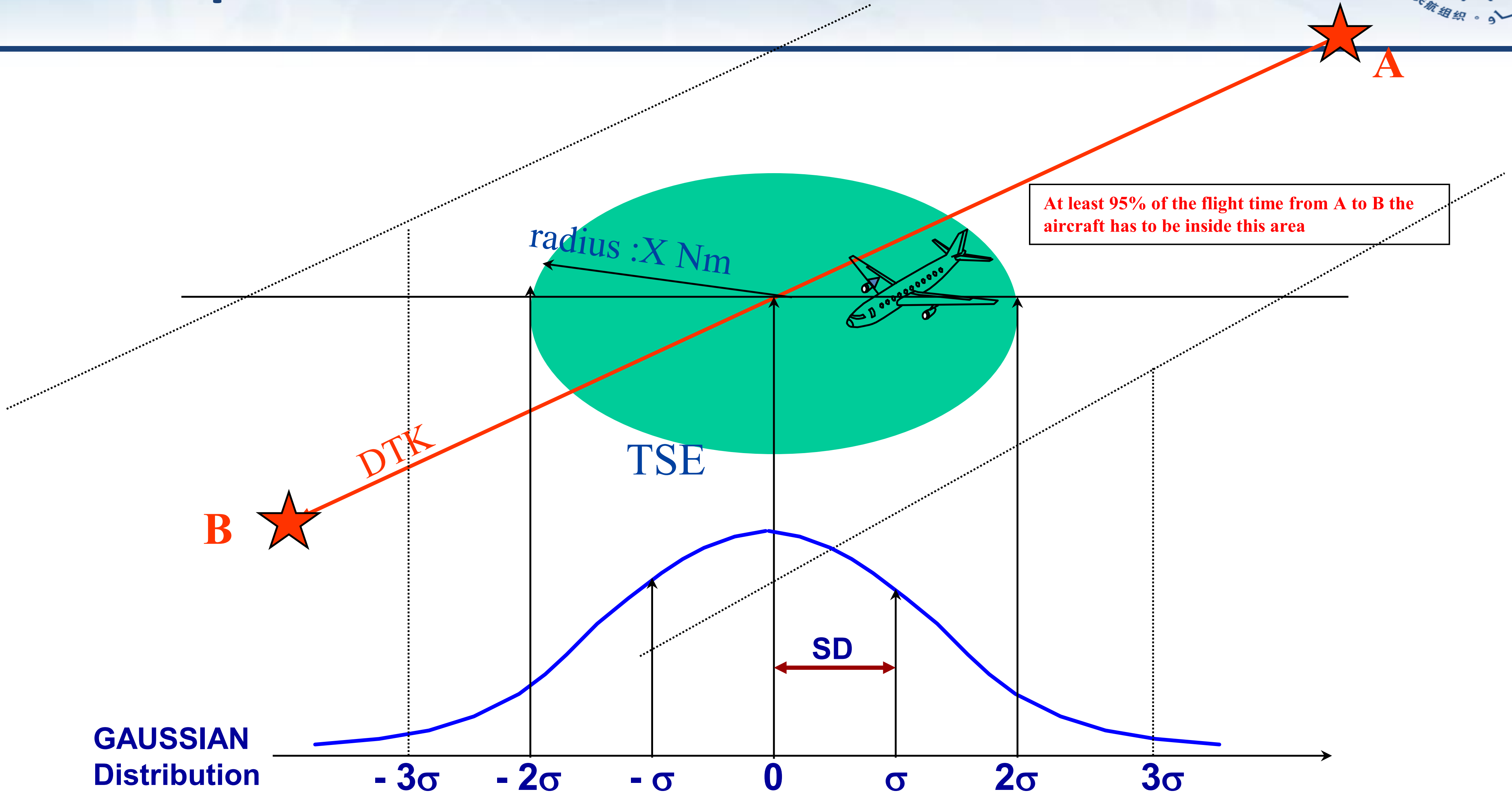
**ATT : along track tolerance**

# How TSE is calculated ?

- As all the errors are INDEPENDANT
  - Gaussian distribution to address a 2SD  (Standard Deviation).
  - TSE = Root Sum Square (RSS) of different errors

- TSE  is defined for each navigation specification

# TSE Representation



# How TSE is calculated ?

- Regarding TSE
  - NSE depends on the system performance
    - NSE for GNSS = 0.08 Nm
    - NSE for VORDME or DMEDME vary
  - FTE is a fixed value per navigation specification
    - For RNAV, FTE = ½ required navigation accuracy
    - For RNP $\geq$ 0.5, FTE = ½ RNP
    - For RNP $\leq$ 0.5, FTE = 463 m (0.25 NM)
  - PDE corresponds to the system computation tolerance ST and is a fixed value 0.25 Nm

# XTT and ATT calculation for RNP application

- XTT = TSE value = RNP Value
- For ATT,
  - FTE do not affect longitudinal error
  - Raleigh distribution is considered so
    - ATT = 0.8 x XTT

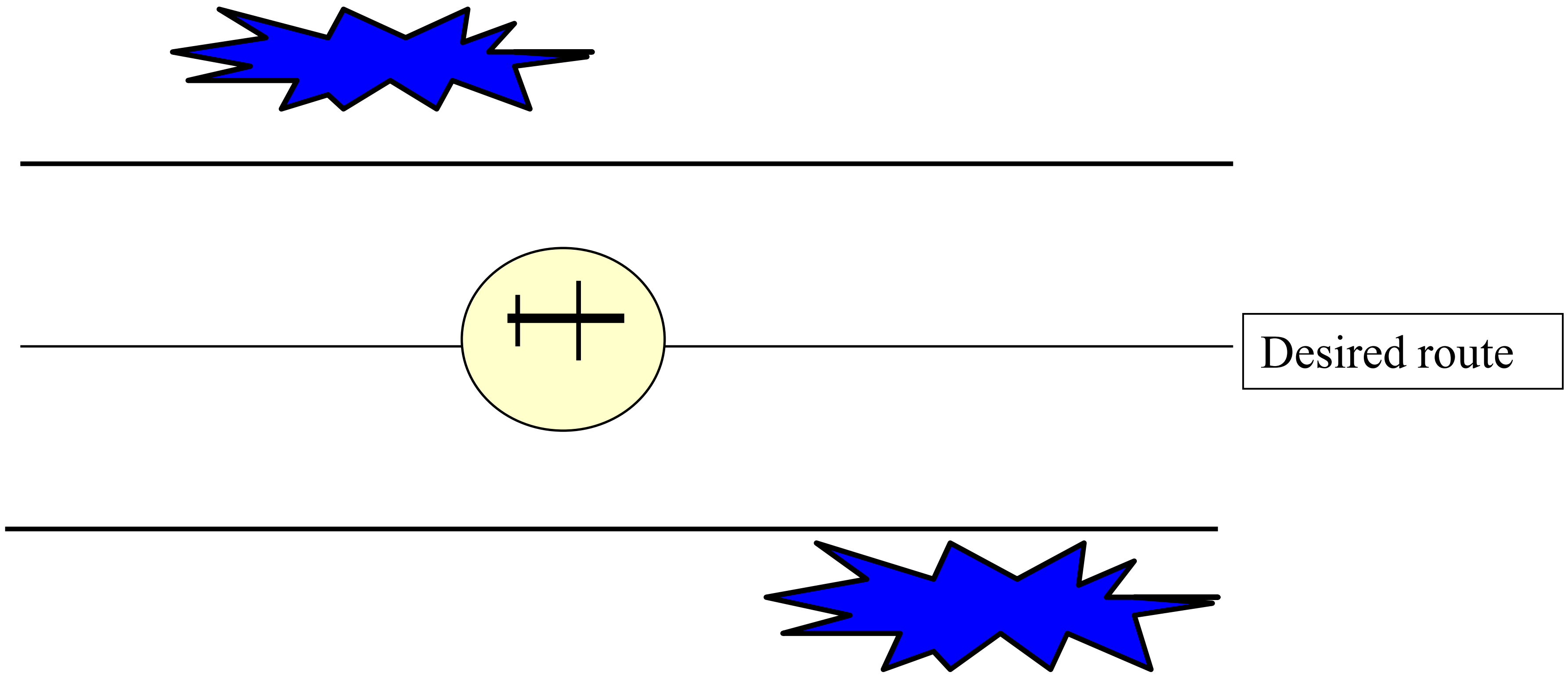
# XTT and ATT calculation for RNAV application

- Sensor dependant
  - For ground based sensor
    - Tolerance depends on TSE
  - For GNSS sensor
    - Tolerance depends on either TSE or IMAL
    - If IMAL is GREATER than FTE, XTT depends on IMAL

# For GNSS sensor , RNAV application

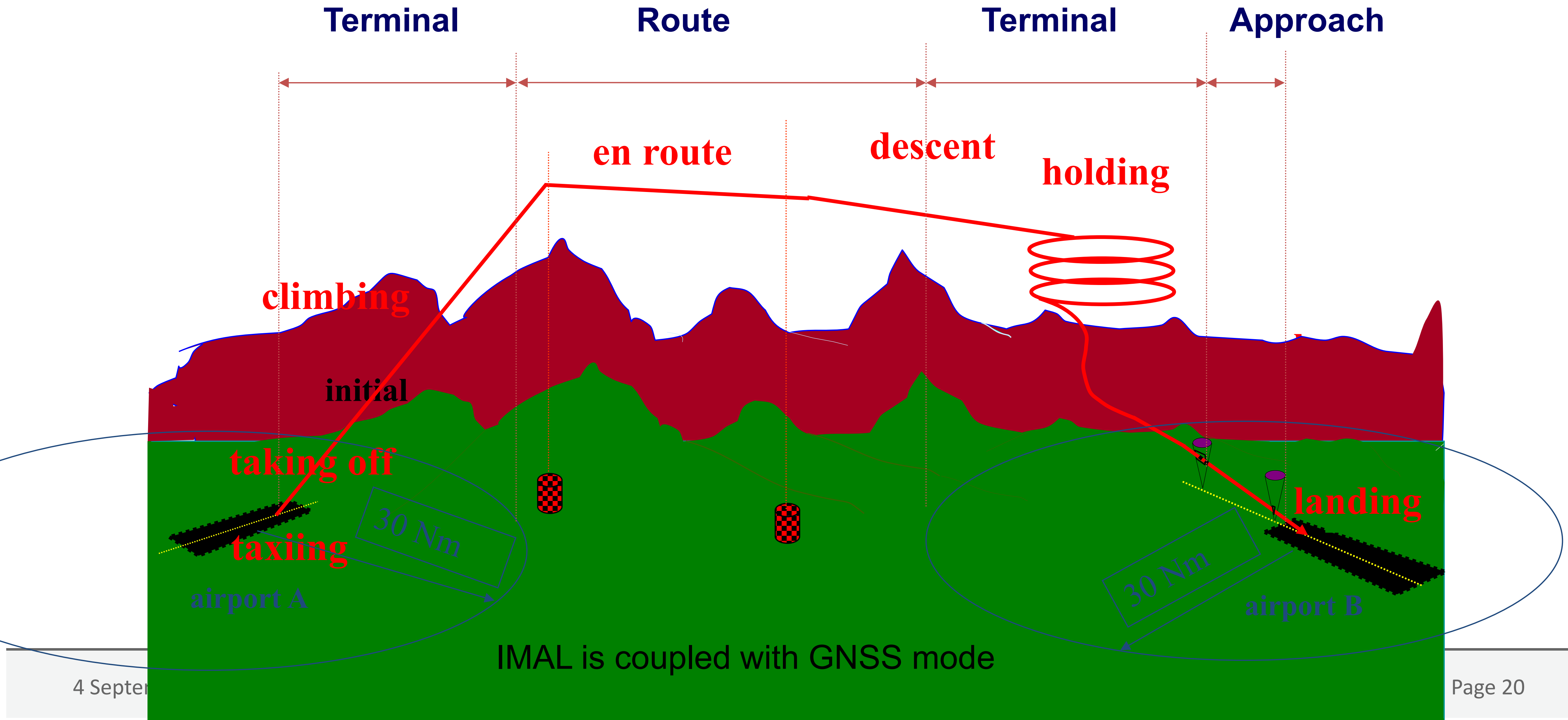
# IMAL: Integrity Monitoring Alarm Limit

- IMAL allows AIRCREW to DETECT that the SIGNAL IN SPACE (NSE) is not achieving the navigation PERFORMANCE REQUIRED




GNSS sensor, for RNAV application

# GNSS mode



Terminal
Route
Terminal
Approach
en route
descent
holding
climbing
initial
taking off
taxiing
30 Nm
airport A
30 Nm
airport B
landing
IMAL is coupled with GNSS mode

# NSE and IMAL for GNSS

- Whichever the phase of flight
  - NSE = 0.08 NM
    - PDE (ST) is negligible
    - Regarding TSE, FTE is the MAJOR component
- IMAL is coupled with GNSS mode
  - En route (greater then 30 NM/ARP) : 2 Nm
  - Terminal ( within 30 NM/ARP) : 1 Nm
  - Approach ( 2 Nm prior /FAF) : 0.3 Nm

GNSS sensor, for RNAV application

# ATT – XTT calculation for RNAV application with GNSS sensor :

| Tolerance GNSS | Tolerance GNSS |
|---|---|
| WHERE FTE > IMAL | WHERE FTE $\leq$ IMAL |
| ATT = 0.8 x XTT<br>XTT = $\sqrt{NSE^2 + FTE^2 + ST^2}$ | ATT = 0.8 x IMAL<br>XTT = IMAL |

GNSS sensor, for RNAV application

# ATT - XTT calculation - summing up

RNP APPLICATION

ATT = 0.8 XTT

XTT =TSE =RNP

GROUND BASED SENSOR

$ATT = \sqrt{NSE^2 + ST^2}$

$XTT = \sqrt{NSE^2 + FTE^2 + ST^2}$

RNAV APPLICATION

GNSS SENSOR

ATT = 0.8 x XTT

$XTT = \begin{cases} \text{IMAL or} \\ \sqrt{NSE^2 + FTE^2 + ST^2} \end{cases}$

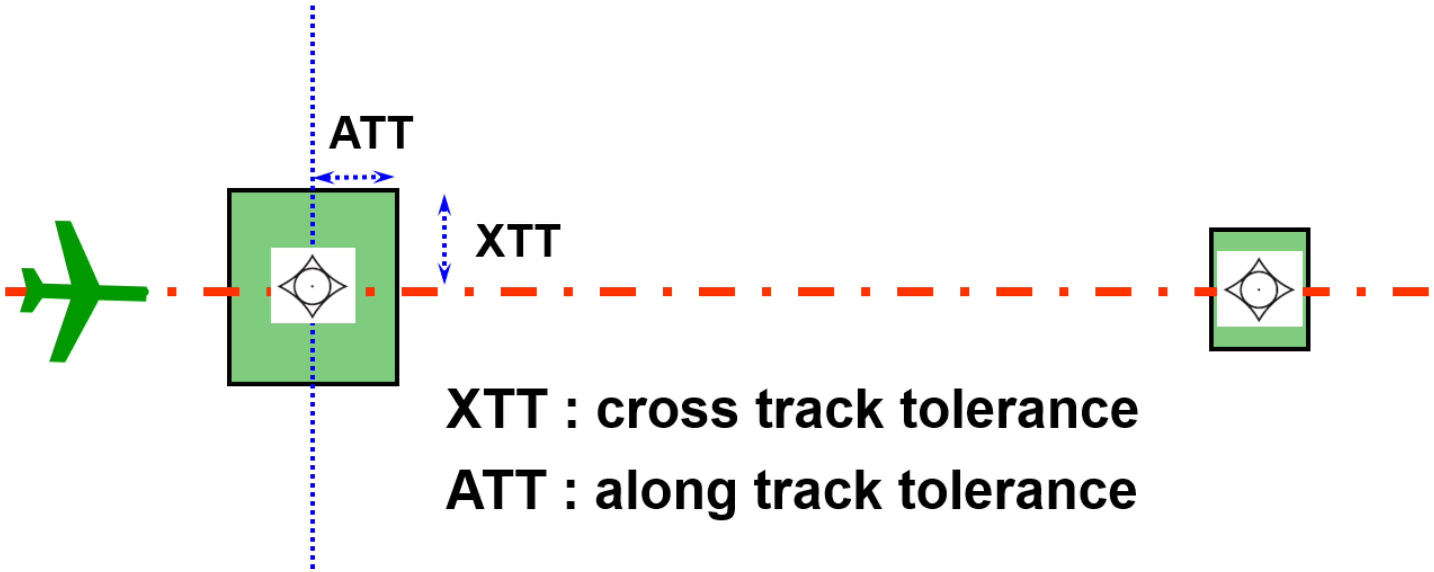
# HOW TO CALCULATE THE AREA WIDTH ?

# Area width (A/W ) - Calculation method

- Semi area width is based on 3σ  standard deviation
  - 2 σ value  corresponds to XTT
  - 3 σ value  corresponds to 1/2 A/W

$$3\sigma = 1.5\ XTT$$

- **The tolerance addresses a 2 SD  (standard deviation) value**

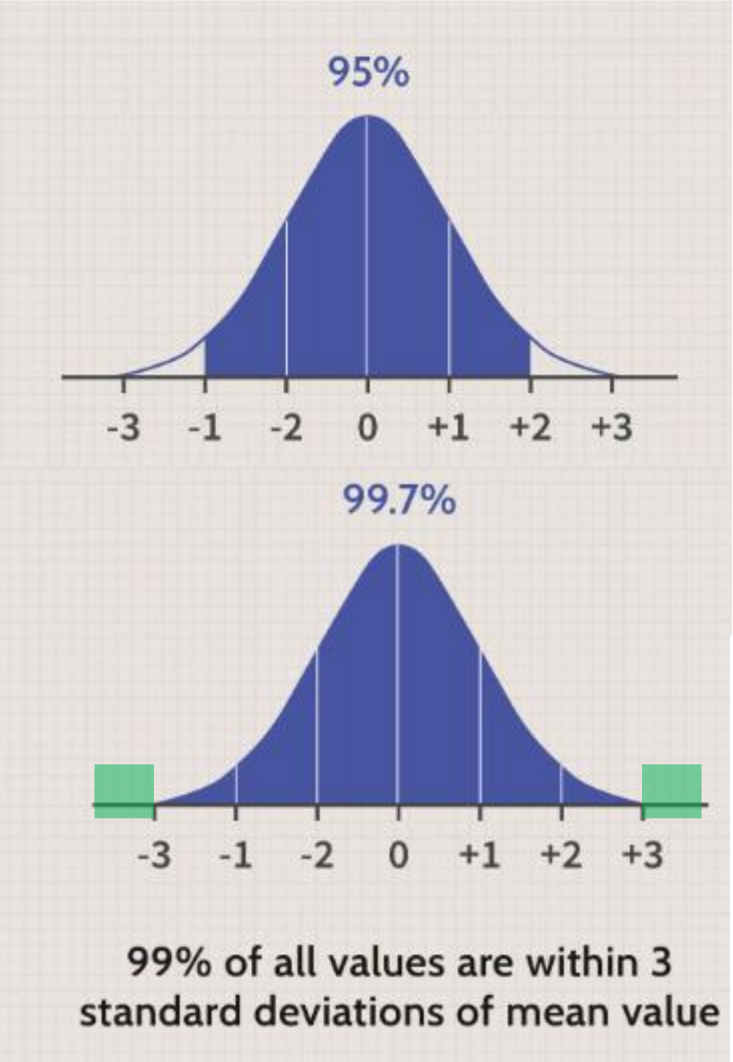


# Area width (A/W ) - Calculation method

1/2 A/W = 1.5 XTT + BV

- Why Buffer Value ( BV)?
  - to cater for BLUNDER ERRORS
  - to cater for TAIL OF DISTRIBUTION

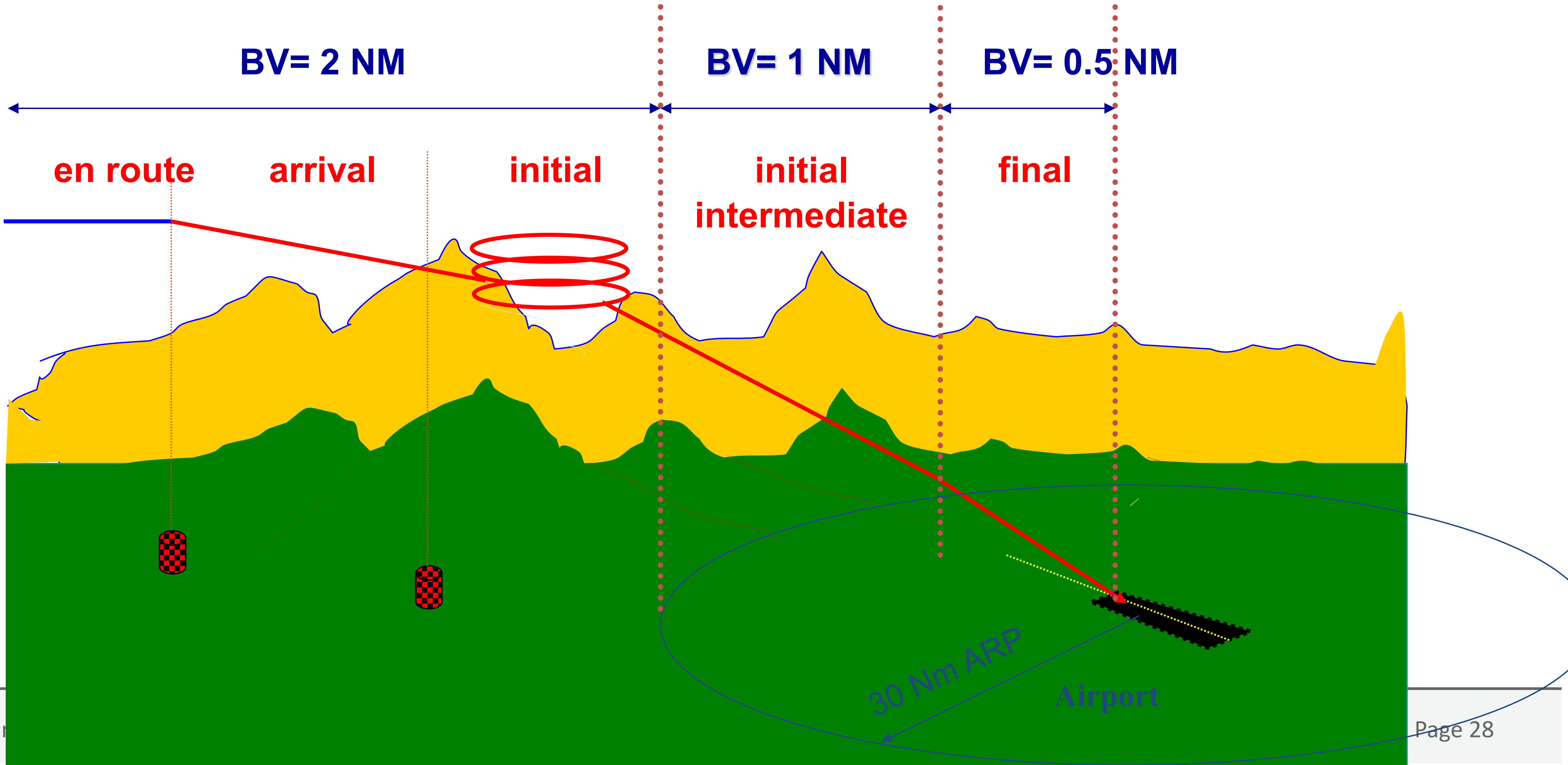
- Buffer Value depends on
  - PHASE OF FLIGHT
  - AIRCRAFT characteristic ( helicopter or airplane)



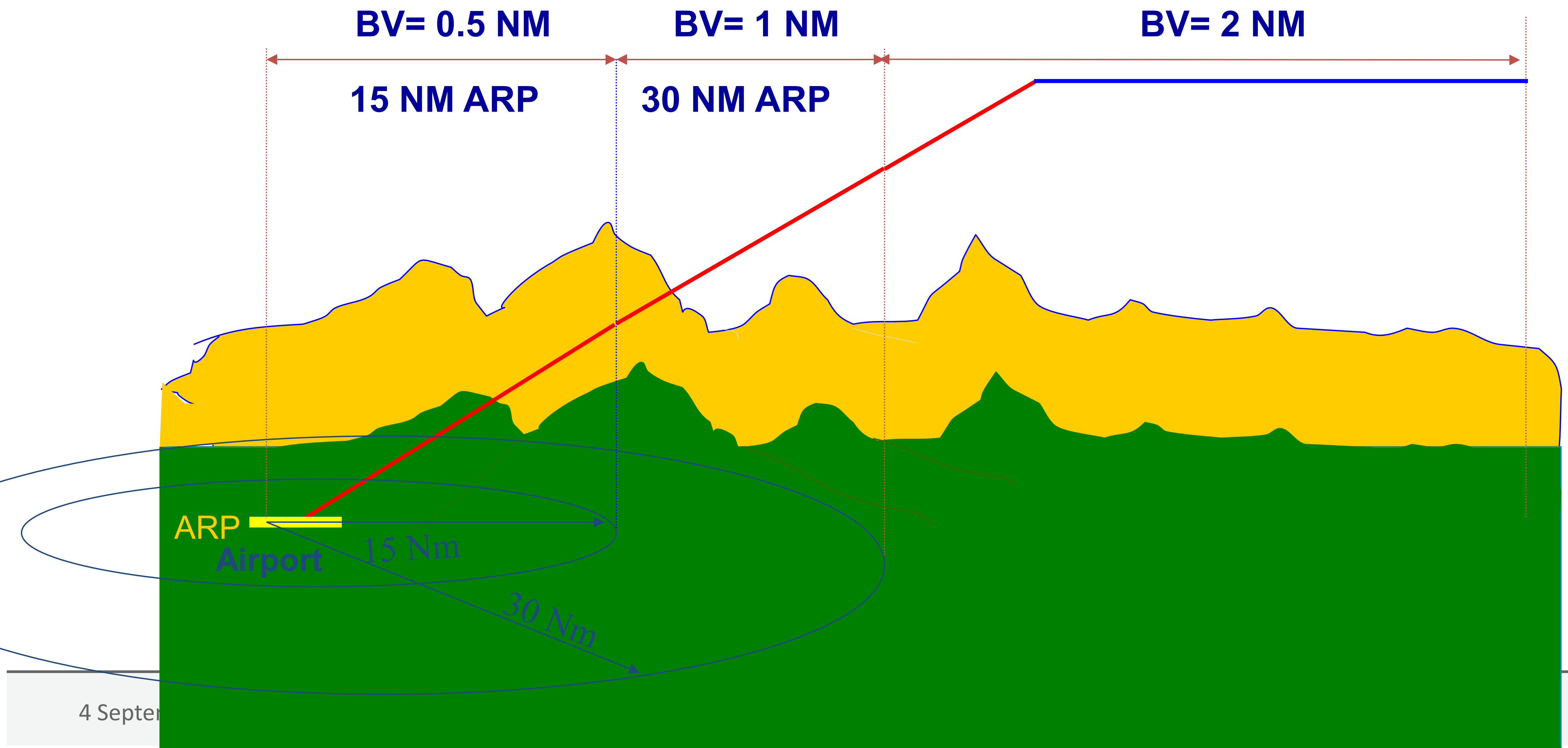
# Buffer Value Table

| *Phase of Flight* | BV for CAT A-E | BV for CAT H |
|---|---|---|
| En-route (More than 30 NM from departure or destination ARP) | 2 NM | 1 NM |
| Terminal (STARs, Initial and Intermediate Approaches within 30 NM of the ARP; and SIDs and Missed Approaches within 30 NM of the ARP but more than 15 NM from the ARP) | 1 NM | 0.7 NM |
| Final Approach | 0.5 NM | 0.35 |
| Missed Approaches and SIDs WITHIN 15 NM OF the ARP | 0.5 NM | 0.35 |

# Buffer Value and phase of flight except climbing phase



# Buffer Value and different phases of flight for climbing phase



# General method for calculation of protection Area Width

XTT calculation

**Identify phase of flight**
**For Buffer Value (BV)**

**Semi-Area Width calculation**
**1/2 A/W = 1.5 XTT + BV**

# Key point : Area Width  for RNAV application

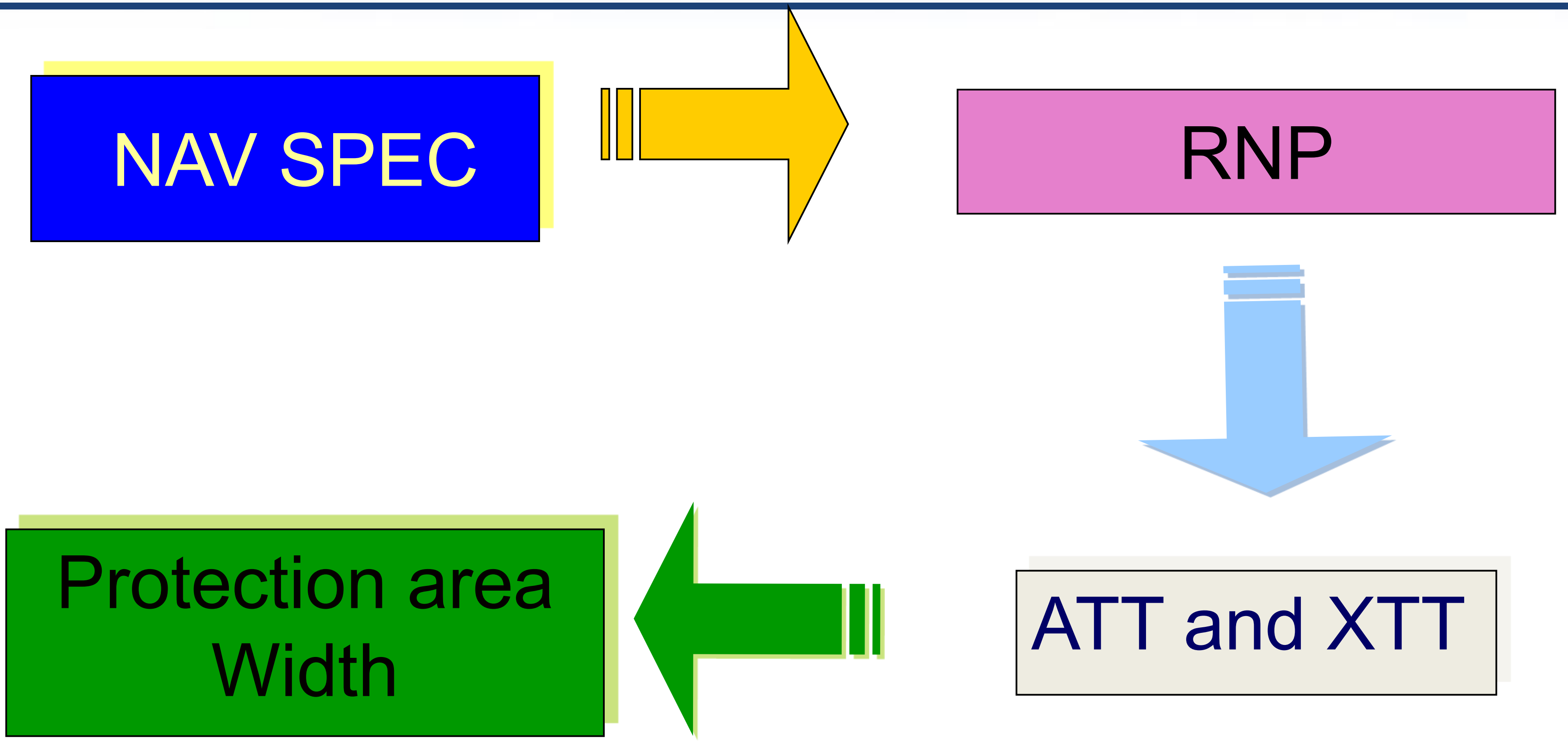
NAV SPEC
+
**SENSOR (s)**

ATT and XTT

**PLAN FOR  ALL  ADEQUATE SENSORS**

Protection area Width

# Key point: Area Width  for RNP application



# XTT- ATT- ½ AW calculation

| Navigation specification | | RNP | FTE | IMAL | ATT | XTT | BV | 1/2AW |
|---|---|---|---|---|---|---|---|---|
| RNP4 | En route | 4 | 2 | | | | 2 | |
| RNAV5 | En route | | 2.5 | 2 | | | 2 | |
| RNP1 | greater than 30 Nm ARP | 1 | 0.5 | | | | 2 | |
| | < 30 Nm ARP | 1 | 0.5 | | | | 1 | |
| | SID<15 NM | 1 | 0.5 | | | | 0.5 | |
| RNAV2 | greater than 30 Nm ARP | | 1 | 2 | | | 2 | |
| | < 30 Nm ARP | | 1 | 1 | | | 1 | |
| | SID <15 NM ARP | | 1 | 1 | | | 0.5 | |
| RNAV1 | greater than 30 Nm ARP | | 0.5 | 2 | | | 2 | |
| | < 30 Nm ARP | | 0.5 | 1 | | | 1 | |
| | SID<15 NM ARP | | 0.5 | 1 | | | 0.5 | |
| RNP APCH | < 30 Nm ARP | 1 | 0.5 | | | | 1 | |
| | FAF | 0.3 | 0.25 | | | | 1 | |
| | MAPT | 0.3 | 0.25 | | | | 0.5 | |
| | MA <15 NM ARP | 1 | 0.5 | | | | 0.5 | |

**For RNAV NAVIGATION SPECIFICATION ,values in the table are applicable for airplane and for GNSS sensor only**

# XTT- ATT- ½ AW calculation

| Navigation specification | | RNP | ~~FTE~~ | ~~IMAL~~ | ATT | XTT | BV | 1/2AW |
|---|---|---|---|---|---|---|---|---|
| RNP4 | En route | 4 | ~~2~~ | | 3.2 | 4 | 2 | 8 |
| RNP1 | greater than 30 Nm ARP | 1 | ~~0.5~~ | | 0.8 | 1 | 2 | 3.5 |
| | < 30 Nm ARP | 1 | ~~0.5~~ | | 0.8 | 1 | 1 | 2.5 |
| | SID<15 NM | 1 | ~~0.5~~ | | 0.8 | 1 | 0.5 | 2 |
| RNP APCH | < 30 Nm ARP | 1 | ~~0.5~~ | | 0.8 | 1 | 1 | 2.5 |
| | FAF | 0.3 | ~~0.25~~ | | 0.24 | 0.3 | 1 | 1.45 |
| | MAPT | 0.3 | ~~0.25~~ | | 0.24 | 0.3 | 0.5 | 0.95 |
| | MA <15 NM | 1 | ~~0.5~~ | | 0.8 | 1 | 0.5 | 2 |

RNP APPLICATION → 

XTT = TSE = RNP
ATT = 0.8 XTT

½ AW= 1.5 x XTT + BV

# XTT- ATT calculation for RNAV

NSE = 0.08 ST =0.25

| Navigation specification | | ~~RNP~~ | FTE | IMAL | ATT | XTT | BV | 1/2AW |
|---|---|---|---|---|---|---|---|---|
| RNAV5 | En route | | 2.5 | 2 | 2.01 | 2.51 | 2 | 5.77 |
| RNAV2 | greater than 30 Nm ARP | | 1 | 2 | 1.6 | 2 | 2 | 5 |
| | < 30 Nm ARP | | 1 | 1 | 0.8 | 1 | 1 | 2.5 |
| | SID <15 NM | | 1 | 1 | 0.8 | 1 | 0,5 | 2 |
| RNAV1 | greater than 30 Nm ARP | | 0.5 | 2 | 1.6 | 2 | 2 | 5 |
| | < 30 Nm ARP | | 0.5 | 1 | 0.8 | 1 | 1 | 2.5 |
| | SID<15 NM | | 0.5 | 1 | 0.8 | 1 | 0,5 | 2 |

RNAV APPLICATION

GNSS sensor only

WHERE FTE > IMAL

ATT = 0.8 x XTT

XTT = $\sqrt{NSE^2+FTE^2+ST^2}$

WHERE FTE ≤ IMAL

ATT = 0.8 x IMAL

XTT = IMAL

½ AW= 1.5 x XTT + BV

# XTT- ATT- ½ AW calculation

RNP 2 in different phase of flight (NM)

En-route / STAR / SID (>30 NM ARP)

| XTT | ATT | ½ A/W |
|---|---|---|
| 2.00 | 1.60 | 5.00 |

Advanced-RNP (ARNP) in all phases of flight (NM)

| RNP | En-route (Continental & Remote) | | | STAR/SID (>30NM ARP) | | | STAR/SID (<30NM ARP) IAF/IF/Missed Approach | | | FAF | | | MAPt | | | Missed Approach / SID (<15NM ARP) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | XTT | ATT | 1/2 A/W | XTT | ATT | 1/2 A/W | XTT | ATT | 1/2 A/W | XTT | ATT | 1/2 A/W | XTT | ATT | 1/2 A/W | XTT | ATT | 1/2 A/W |
| 2 | 2 | 1,6 | 5 | | | | | | | | | | | | | | | |
| 1 | 1 | 0,8 | 3,5 | 1 | 0,8 | 3,5 | 1 | 0,8 | 2,5 | | | | | | | 1 | 0,8 | 2 |
| 0,3 | | | | | | | | | | 0,3 | 0,24 | 1,45 | 0,3 | 0,24 | 0,95 | | | |

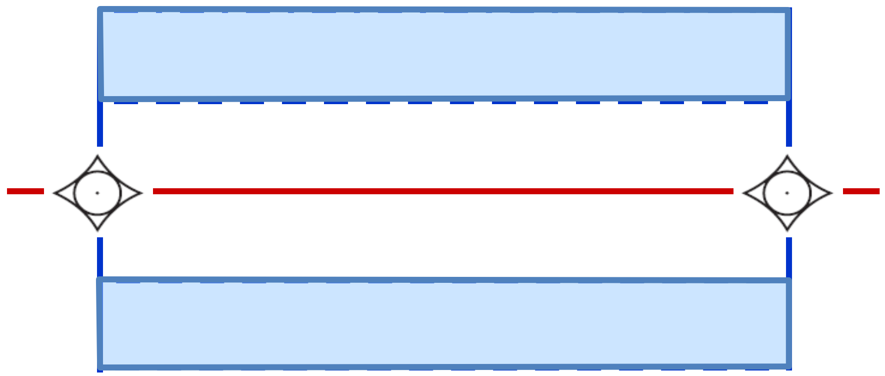
# Area Width global methodology

- Whatever the navigation application is, area width depends on two elements:
  - XTT
  - BV
- Where  NEITHER XTT NOR BV are changing
  - Area width is a CORRIDOR
- Where at least one of the two elements changes, to calculate the area width, three questions are  to be answered:
  - Question 1 : AT THE LOCATION where XTT is changing  which value is taken into account for area width calculation ?
  - Question 2 : AT THE LOCATION where BV is changing  which value is taken into account for area width calculation ?
  - Question 3 : How to CONNECT the two areas ?

# STRAIGHT AREA

Primary and secondary area apply

- Where no change of phase nor XTT :
- Area is a corridor



# Area width value at the location where XTT change

- AT THE LOCATION where XTT is changing which value is taken into account for area width calculation?
  - First case :

    when PRECEDING area width is LARGER than the SUBSEQUENT one
  - Second case :

    when PRECEDING area width is SMALLER than the SUBSEQUENT one

- What are the conditions that induce the change of XTT?
  - Change of value of RNP
  - Change of accuracy for RNAV application

# At the location where XTT is changing which value is taken into account for Area Width calculation?

- Assumption
  - At the point where the change of RNP / accuracy is required, the RNP/ accuracy is achieved.
- Conclusion and answer to the question :

1. **When PRECEDING area width is LARGER than the SUBSEQUENT one**

**Where area 1 > area 2, AT the LOCATION where XTT is changing, take the XTT of the SUBSEQUENT phase.**

# At the location where XTT is changing which value is taken into account for Area Width calculation?

- Assumption
  - The A/C is assumed to maintain the most accurate performance until the point of change.
- Conclusion and answer to question :

1. **When PRECEDING area width is SMALLER than the SUBSEQUENT one**

**Where area 1 < area 2 AT the LOCATION where XTT is changing, take the XTT of the PRECEDING phase.**

# Area Width value at the location where XTT change

- Summing Up

**AT the LOCATION where XTT is changing, Take the SMALLER value of XTT.**

Example :

- At FAF RNP changes from 1 to 0.3 Nm
- For RNP application : XTT= RNP

**XTT = 0.3 NM**

# Area Width value at the location where Buffer Value change

- AT THE LOCATION where BV is changing which value is taken into account for area width calculation ?
- Assumption
  - BV address tail of distribution
- Conclusion and answer to question :

**AT THE LOCATION where BV is changing, take the BV of the PRECEDING phase.**

# Calculation for FAF

- At FAF BV changes from 1 to 0.5 Nm

| |
|---|
| **AT THE LOCATION where BV is changing, take the BV of the PRECEDING phase.** |

**BV = 1 Nm**

**½ AW = 1.5 x 0.3 + 1 = 1.45 Nm**

# How to connect area width ? 1st Merging methodology

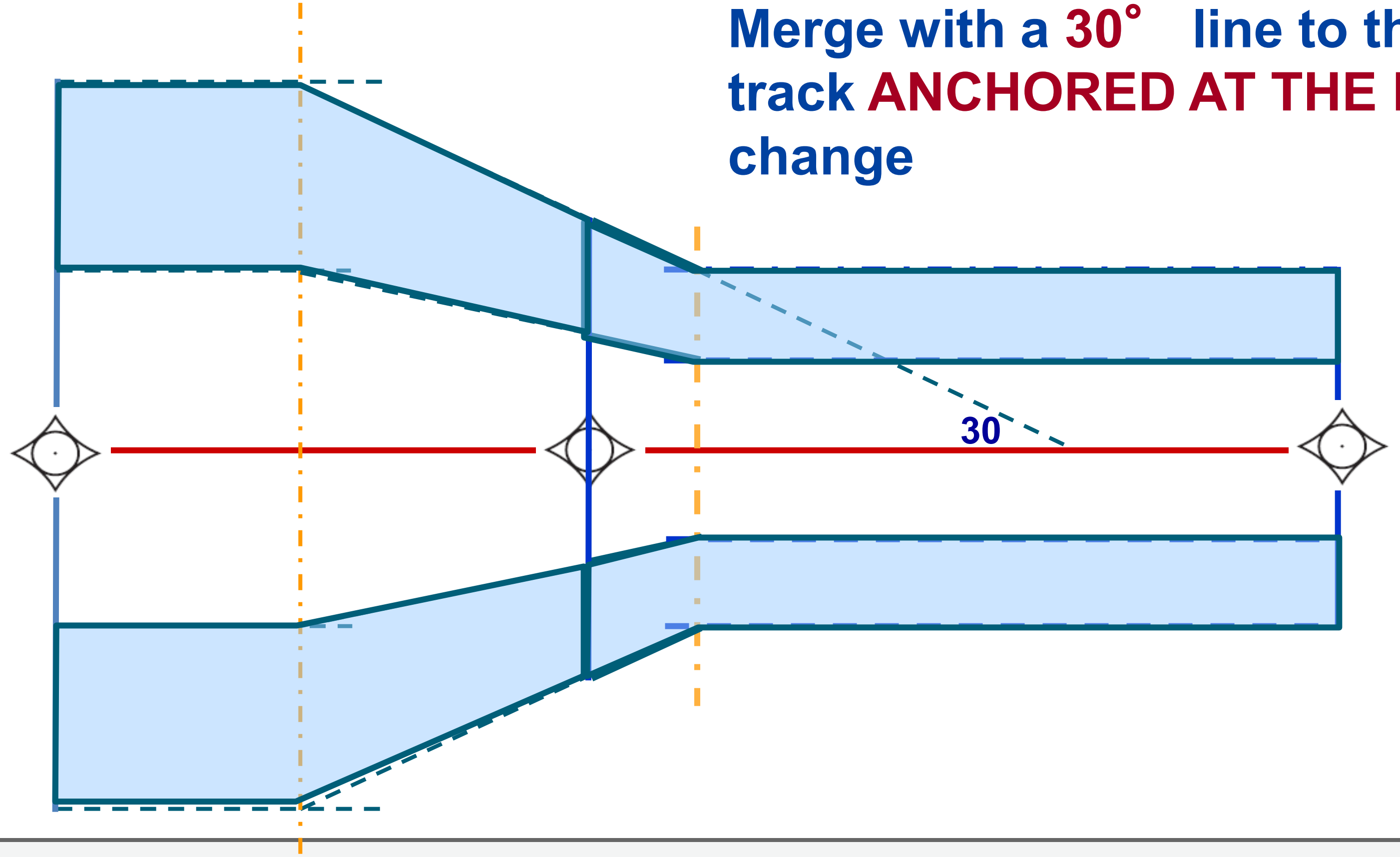
- Where AREA WIDTH of the SUBSEQUENT segment is SMALLER than area width of the PRECEDING one
  - When BV is changing merge with a 30° line to the NOMINAL track ANCHORED AT THE POINT of change

- Where AREA WIDTH of the SUBSEQUENT segment is GREATER than area width of the PRECEDING one
  - Merge with a 15° SPLAY from the area WIDTH of the PRECEDING segment at the EARLIEST limit of the point of change

# Straight area where change of phase or area width value occurs

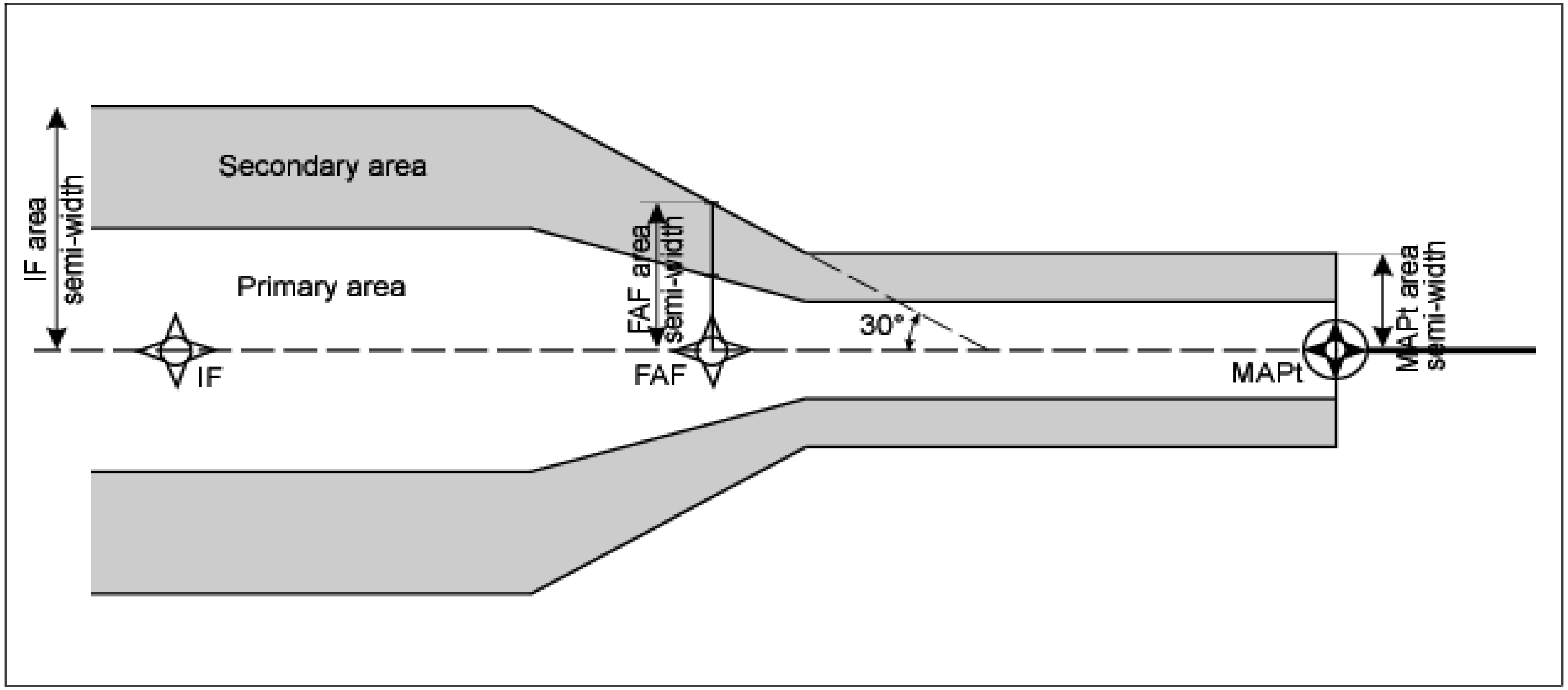
- Case where area width of the subsequent segment is smaller than the preceding one

Merge with a 30° line to the NOMINAL track ANCHORED AT THE POINT of change




Horizontal view

# Example at FAF for RNP APCH



# Location where a change of BV or XTT occurs

- For RNP1, RNAV 1/2  with GNSS sensor only, it occurs at
  - 30 NM of ARP
  - 15 NM of ARP

- For RNP APCH it occurs at
  - 30 NM of ARP
  - FAF
  - MAPt
  - 15 NM of ARP

**These changes occur at a waypoint, or at a specific location whether  a waypoint is located or not.**

e.g.

# CALCULATION FOR 30NM ? (RNAV2 / RNAV1)

# Calculation for RNAV 1/2 STAR with GNSS sensor AT 30 NM ARP

- At 30 NM ARP XTT changes from 2 to 1 Nm

**AT the LOCATION where XTT is changing, Take the SMALLER value of XTT.**

**XTT = 1 NM**

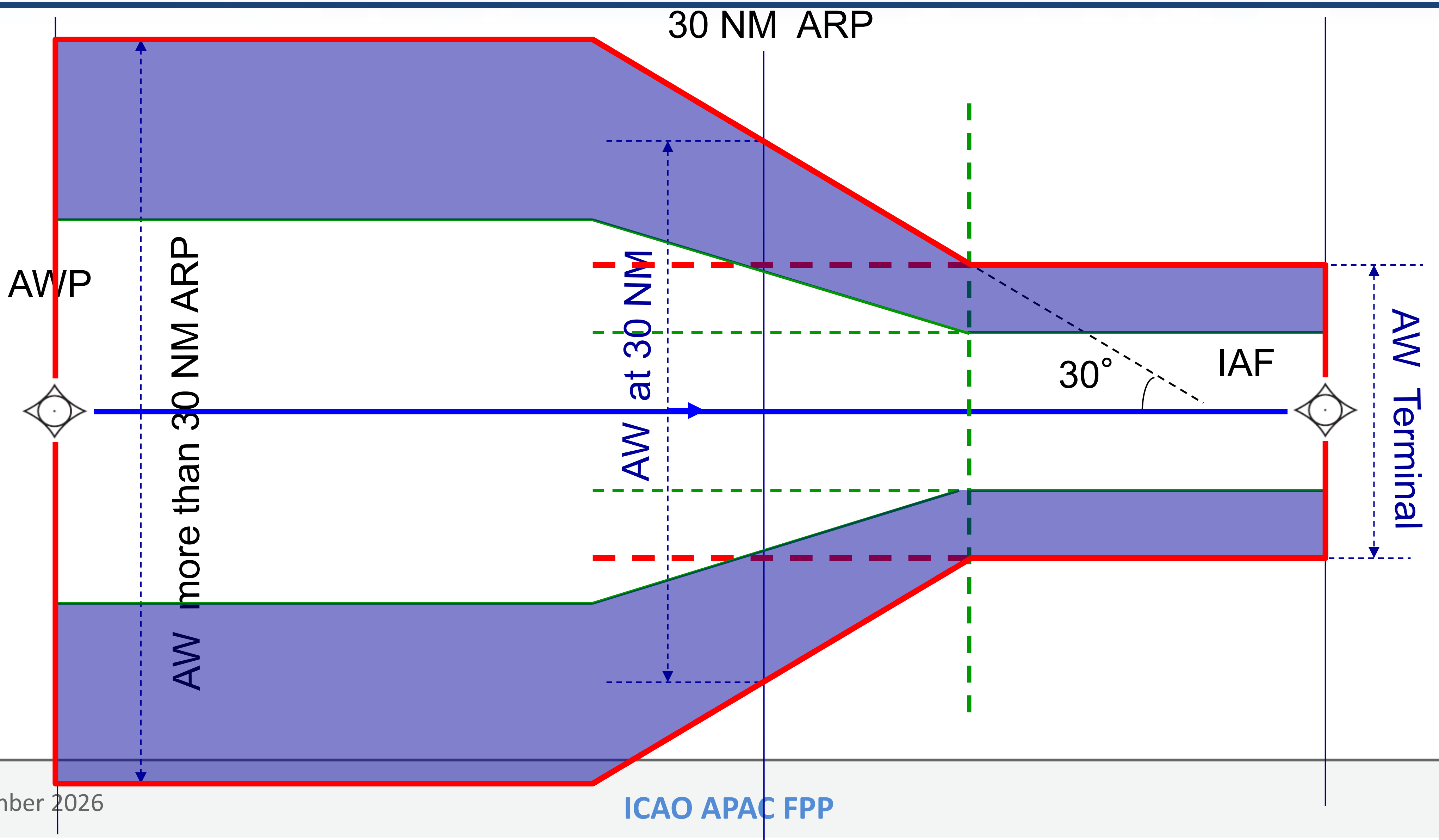
- **At 30 NM ARP BV changes from 2 to 1 Nm**

**AT THE LOCATION where BV is changing, take the BV of the PRECEDING phase.**

**BV = 2 Nm**

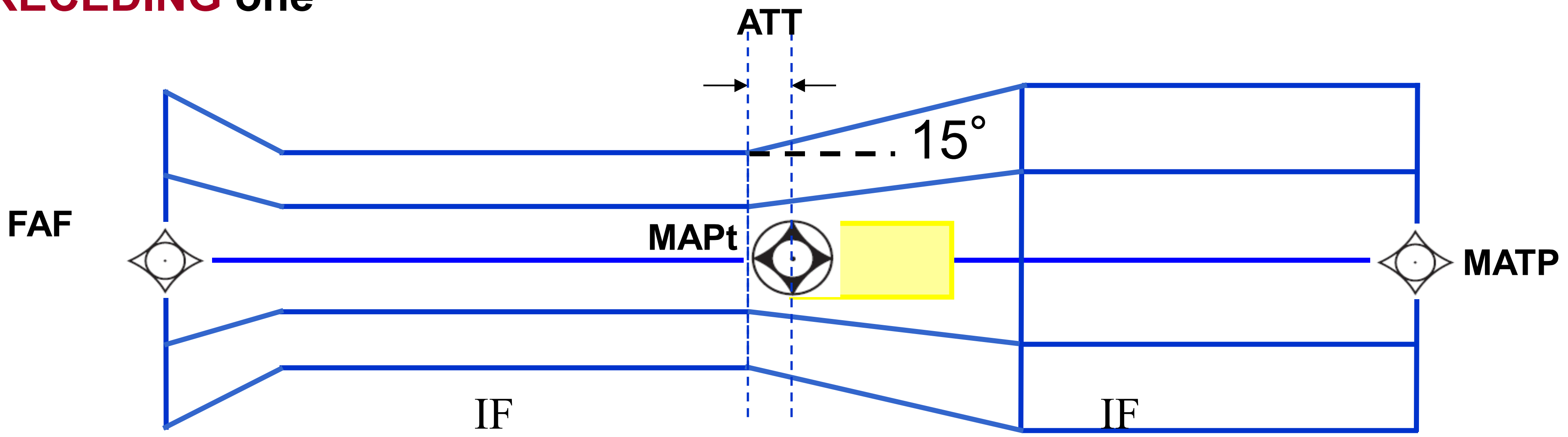
**½ AW = 1.5 x 1 + 2 = 3.5 Nm**

# Merging method



# Straight area where change of phase or RNP value occurs

**Case where area width of the SUBSEQUENT segment is GREATER than the PRECEDING one**



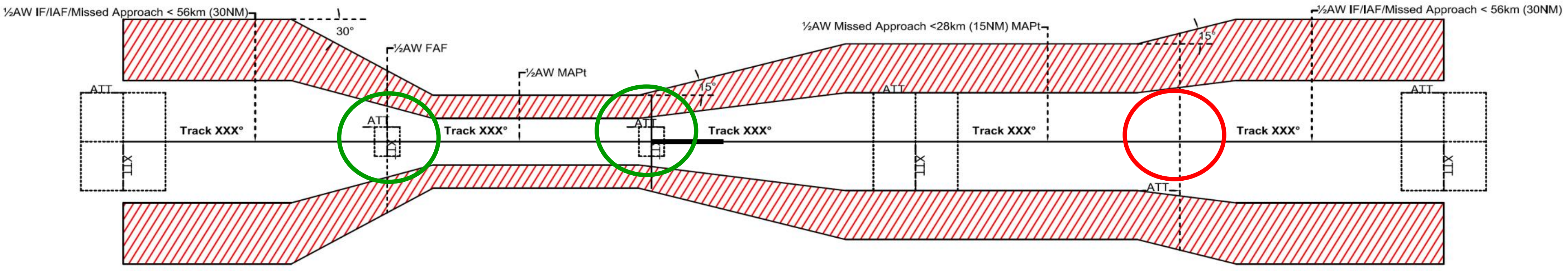

**Merge with a 15° SPLAY at the EARLIEST limit of the point of change**

# Complete RNP APCH

Figure III-3-3-2

**Change of RNP**

**Change of BV**




IAF IF | FAF | MAPt | MATF ≤ 15 NM ARP | 28km 15NM ARP | MATF ≤ 30 NM ARP

**Change of RNP and BV**

# Change of BV  Figure III 1-1-2

- **Case where area width of the subsequent segment is greater than the preceding one**

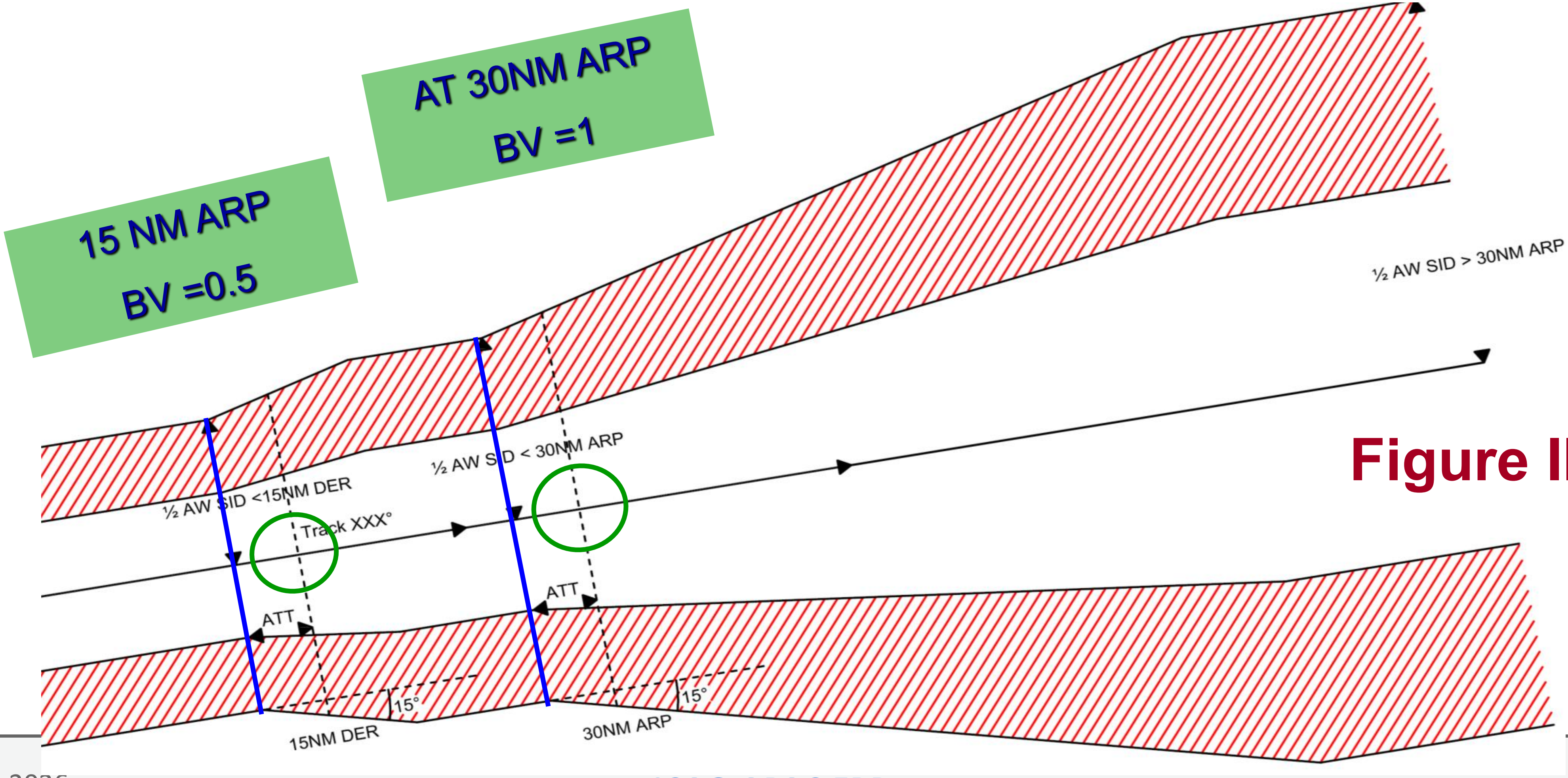



Figure III 1-1-2

# How to connect area width ?
# 2nd Merging methodology in case of change of XTT Only

- Where AREA WIDTH of the SUBSEQUENT segment is SMALLER than area width of the PRECEDING one
  - When XTT only is changing merge with a 30° line to the NOMINAL track ANCHORED at the LATEST XTT of the point of change

- Where AREA WIDTH of the SUBSEQUENT segment is GREATER than area width of the PRECEDING one
  - Merge with a 15° SPLAY from the area WIDTH of the PRECEDING segment at the EARLIEST limit of the point of change

# 2nd MERGING METHOD applicable in case of change of XTT Only

- When XTT only is changing merge with a 30° line to the NOMINAL track ANCHORED at the LATEST XTT of the point of change

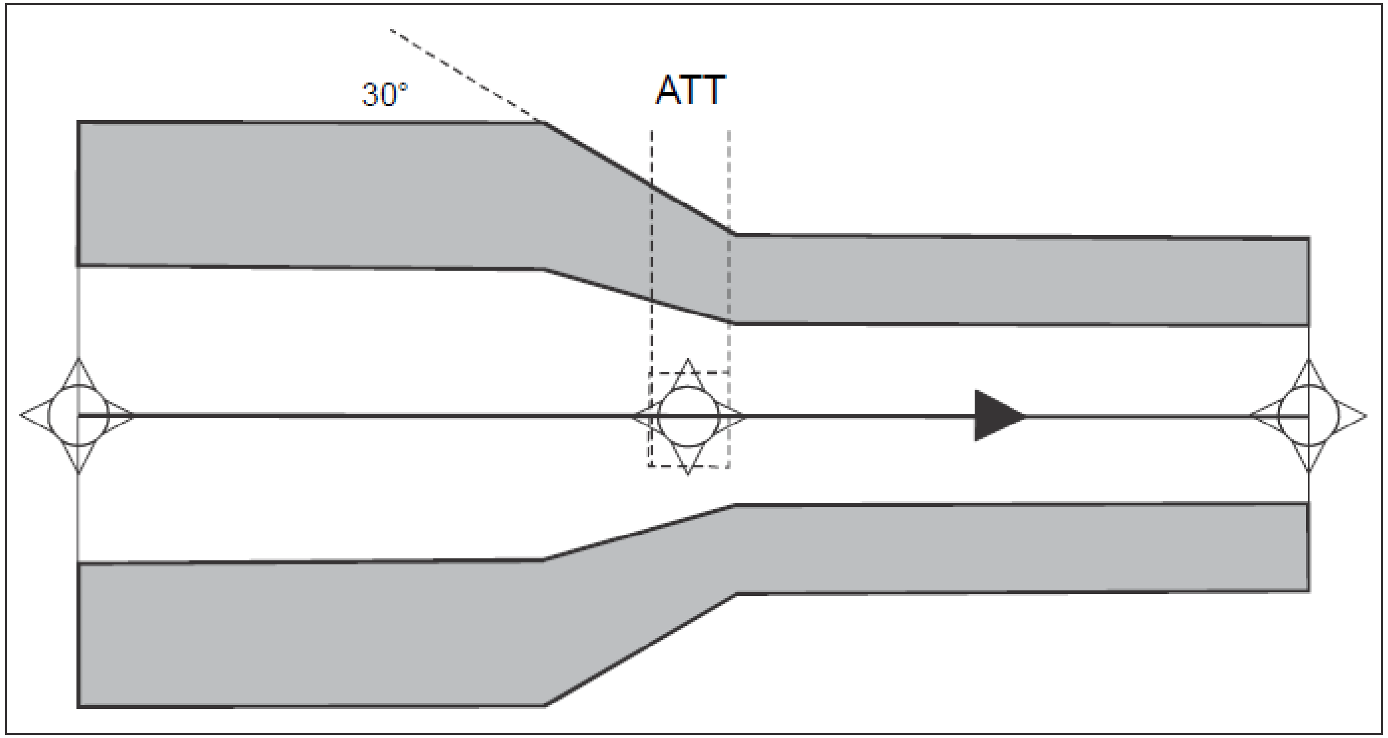



**Figure III-1-1-1. Merging segments of different widths**

# Merging methodologies  key points

- MERGING methodologies apply
  - Each time there is a CHANGE OF XTT
  - Each time there is a CHANGE OF BV
  - Whether  a waypoint is located or not

# TOLERANCE AND PROTECTION AREA

## *DME/DME SENSOR*

# REGULATORY REFERENCE

**DOC 8168 Vol II Part III (P 635)**

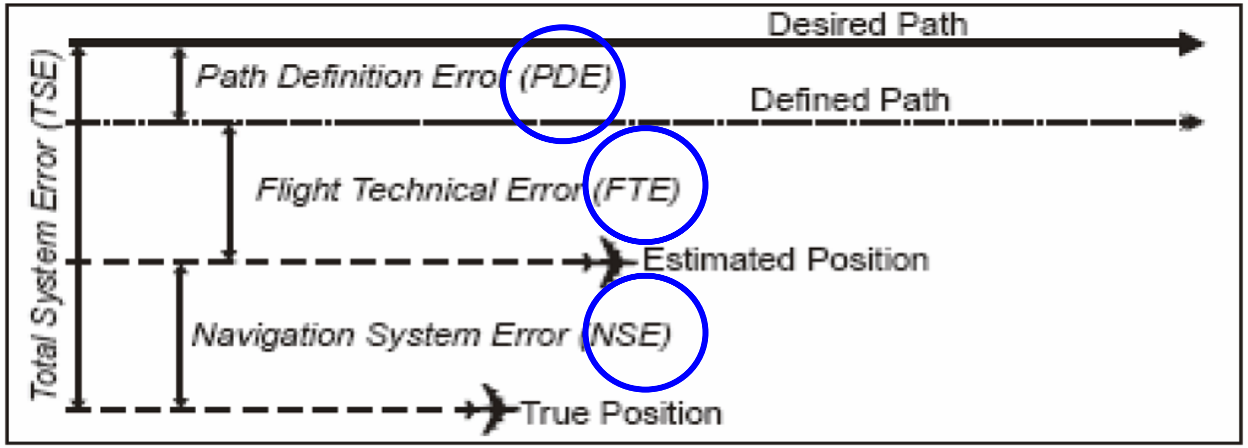
- RNAV concept
  - Section 1 Chapter 1
- Area width for DME/DME RNAV
  - Section 1 Chapter 3
  - Tables III-1-3-1 to III-1-3-8
  - Appendix to chapter 3

# Navigation specification

| Navigation specification | | Navaid infrastructure | Leg type | Flyby | RNP (NM) | TSE (NM) |
|---|---|---|---|---|---|---|
| RNAV5 | En route continental | VORDME<br>DMEDME<br>GNSS | - | - | - | ≤5 |
| RNAV2 | SID - STAR- Initial | DMEDME<br>GNSS | IF CF TF DF VA VM VI CA FA FM | Yes | - | ≤ 2 |
| RNAV1 | SID - STAR- Initial | DMEDME<br>GNSS | | Yes | - | ≤ 1 |

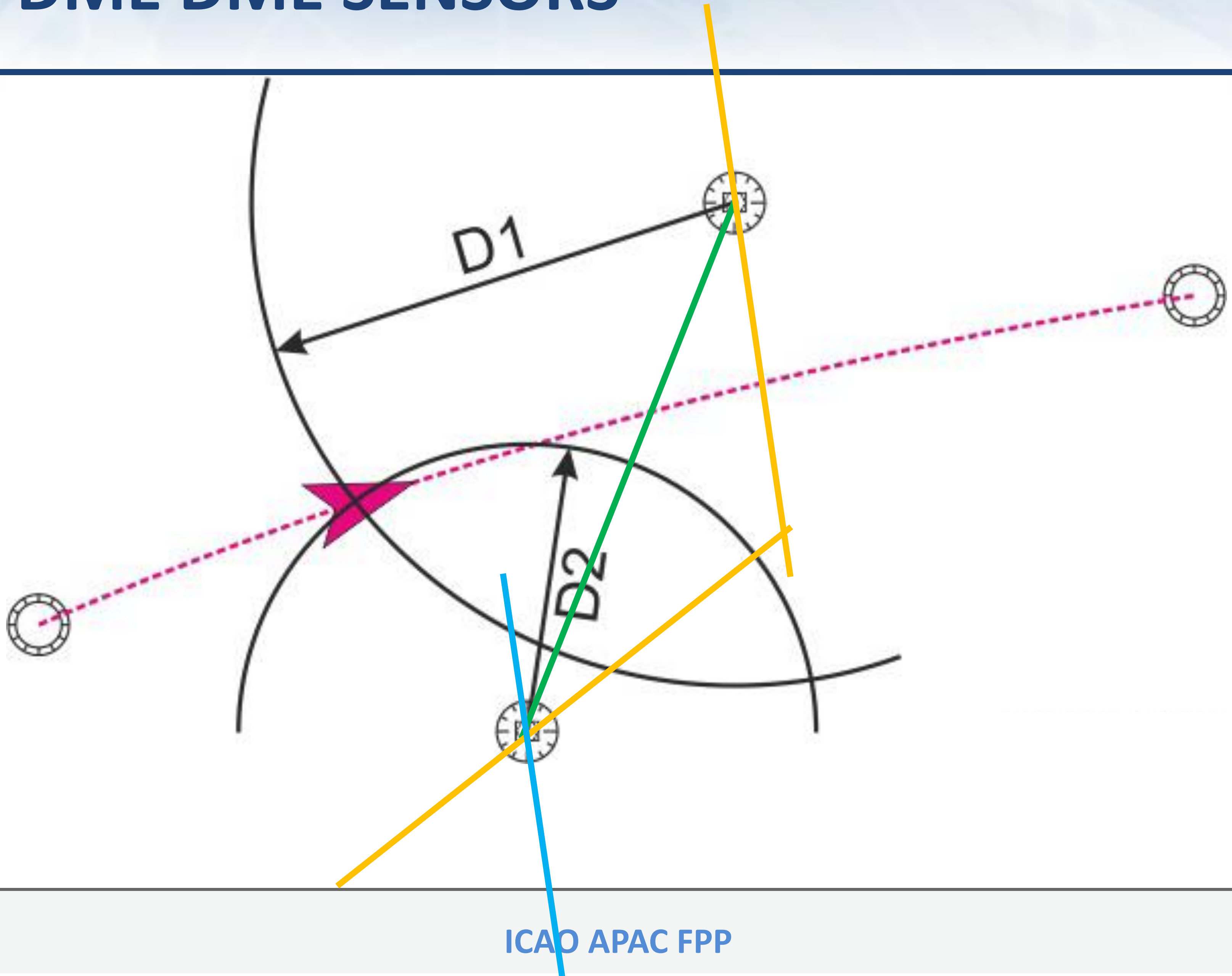
# DME-DME TSE

- The LATERAL Total system error depends on




- **The LONGITUDINAL system error depends on**
  - **NSE and PDE**

# TSE FOR DME DME SENSORS



# TSE FOR DME DME SENSORS

- Vol II part 3 section 1 chapter 3
- NSE is considered as the system use accuracy of airborne receiving system called DTT (DME system use accuracy)
- Acceptability of geometry between DME stations and aircraft is within 30° to 150°
- DTT is based on assumed angle of 90° at any point of the track when more than two DMEs are available
- DTT is based on assumed angle of 30° at any point of the track when only two DMEs are available

# ASSESSMENT OF DME/DME COVERAGE

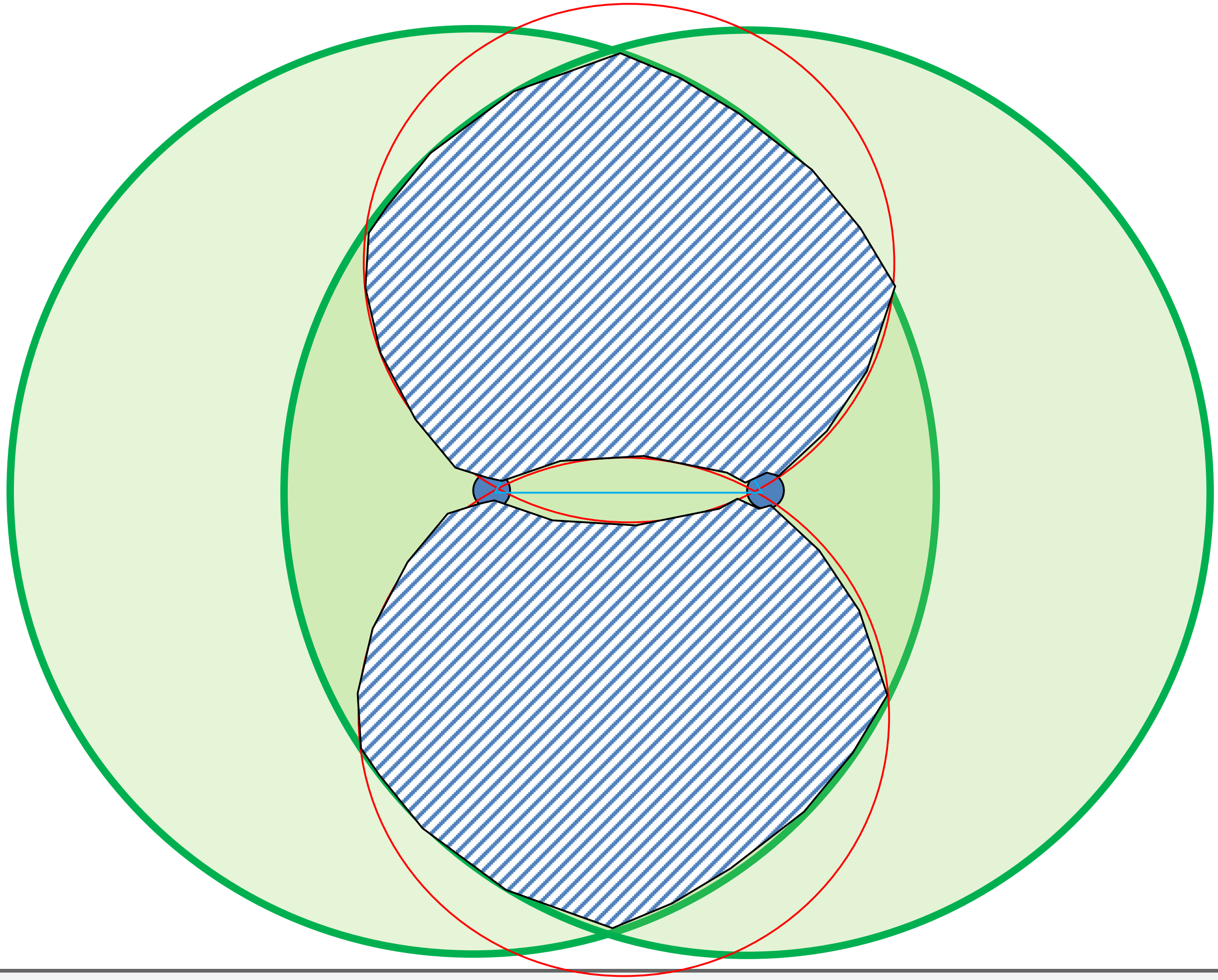
- Manual assessment
- Computer aided assessment : e.g. DEMETER

  Some Principal Inputs
  - Flight level
  - Route
  - Navaids with DOC ( designated operational coverage) and areas of no reception
  - Terrain elevation data
- Can lead to critical DME
- When no DME coverage : possibility to use Dead Reckoning segment (max 10NM)
  - 15° splay from primary area to next primary area protection

# DME DME Coverage : Manual assessment

- Circle on each DME
  - radius = DOC (designated operational coverage)
- 30° /150° intercept DME circle
  - radius = distance between DMES
- No update zone circle
  - radius = 3 Nm / DMEs

# Area of simultaneous use of two DME stations



# DME-DME : DTT

**System accuracy: DME / DME**

$$2\sigma = 2\frac{\sqrt{(\sigma_{1,air}^2 + \sigma_{1,sis}^2) + (\sigma_{2,air}^2 + \sigma_{2,sis}^2)}}{Sin\alpha}$$

$\sigma_{air}$ = Max (0.085 Nm , 0.125% D)

$\sigma_{sys}$ = 0.05 Nm

- *« α» is 30° for 2 DMEs*
- *« α» is 90° for more than 2 DMEs*

# DME- DME : Which Altitude ?

- D is the theoretical radio horizon: $D=1.23\sqrt{Alt(ft)}$

- Altitude :
  - ARRIVAL : Min altitude of previous segment
    - MOCA or
    - Procedure altitude only if procedure altitude is due to a lack of DME coverage

  - SID : Altitude obtained at the point with the min PDG

# DME-DME SENSOR ATT – XTT CALCULATION

Tolerance:
DME / DME

- « ST » in doc 8168 means « PDE » in PBN manual
- « DTT » in doc 8168 means « NSE » for DME-DME

$$ATT = \sqrt{DTT^2 + ST^2}$$

$$XTT = \sqrt{DTT^2 + FTE^2 + ST^2}$$

# DME DME : DTT, ATT and XTT computation

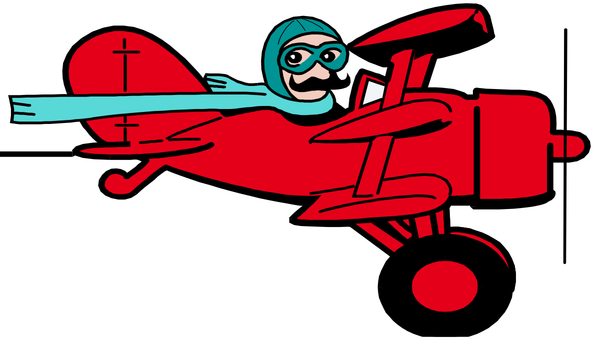
- Ref. Table III.1.3.1 to III.1.3.6
- Parameters:
  - RNAV1
  - STAR within 30NM ARP
  - Altitude 10000 ft
  - with appropriate DME coverage.

# DME DME : DTT, ATT and XTT computation

**Table III-1-3-2. XTT, ATT and area semi-width for DME RNAV (RNAV 1) in en-route, arrival, initial/intermediate approach and departure phases of flight (NM)**
**Table based on availability of two DME update stations**

| *Altitude (ft)* | *En-route/STAR/SID (>30 NM ARP)* | | | *STAR/IF/IAF (<30 NM ARP)* | | | *SID (<15 NM DER)* | | | *FAF* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *XTT* | *ATT* | *½ A/W* | *XTT* | *ATT* | *½ A/W* | *XTT* | *ATT* | *½ A/W* | *XTT* | *ATT* | *½ A/W* |
| 15 000 | | For all altitudes | | 1.24 | 1.13 | 2.85 | 1.24 | 1.13 | 2.35 | | | |
| 14 000 | 1.24 | 1.13 | 3.85 | 1.20 | 1.10 | 2.81 | 1.20 | 1.10 | 2.31 | | | |
| 13 000 | | | | 1.17 | 1.06 | 2.76 | 1.17 | 1.06 | 2.26 | | | |
| 12 000 | | | | 1.14 | 1.02 | 2.71 | 1.14 | 1.02 | 2.21 | | | |
| 11 000 | | | | 1.11 | 0.99 | 2.66 | 1.11 | 0.99 | 2.16 | | | |
| 10 000 | | | | 1.07 | 0.95 | 2.61 | 1.07 | 0.95 | 2.11 | 0.98 | 0.95 | 1.97 |
| 9 000 | | | | 1.04 | 0.91 | 2.55 | 1.04 | 0.91 | 2.05 | 0.94 | 0.91 | 1.91 |
| 8 000 | | | | 1.00 | 0.86 | 2.50 | 1.00 | 0.86 | 2.00 | 0.90 | 0.86 | 1.85 |
| 7 000 | | | | 0.96 | 0.82 | 2.44 | 0.96 | 0.82 | 1.94 | 0.86 | 0.82 | 1.79 |

*Any questions?*




# Let's Focus/Propose/Plan Together