EnRoute Routes

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The purpose of this presentation is to provide an overview of the Aeronautical Information Conceptual Model for the Enroute Environment.

In this briefing, we'll discuss the enroute environment and point out how the model is used to create the route. We'll work our way through the model discussing the concepts and the major data element.

What is an En-route Route?

- Air routes are designed to channel the flow of air traffic in a predictable manner to ensure safety

- Routes are highways in the Sky

- Flight Levels are defined to divide the airspace to ensure safety and more efficient use.

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What is an En-route Route?

Enroute structure

•En-route structure starts when the aircraft leaves the terminal area and ends when the aircraft re-enters the terminal area

•Routes do not start from the actual take-off or landing but will begin further into the flight.

•Routes exclude arrival and departure routes.

•Due to obstacles, terrain and the coordination of different air traffic services, a route is rarely an end-to-end straight line

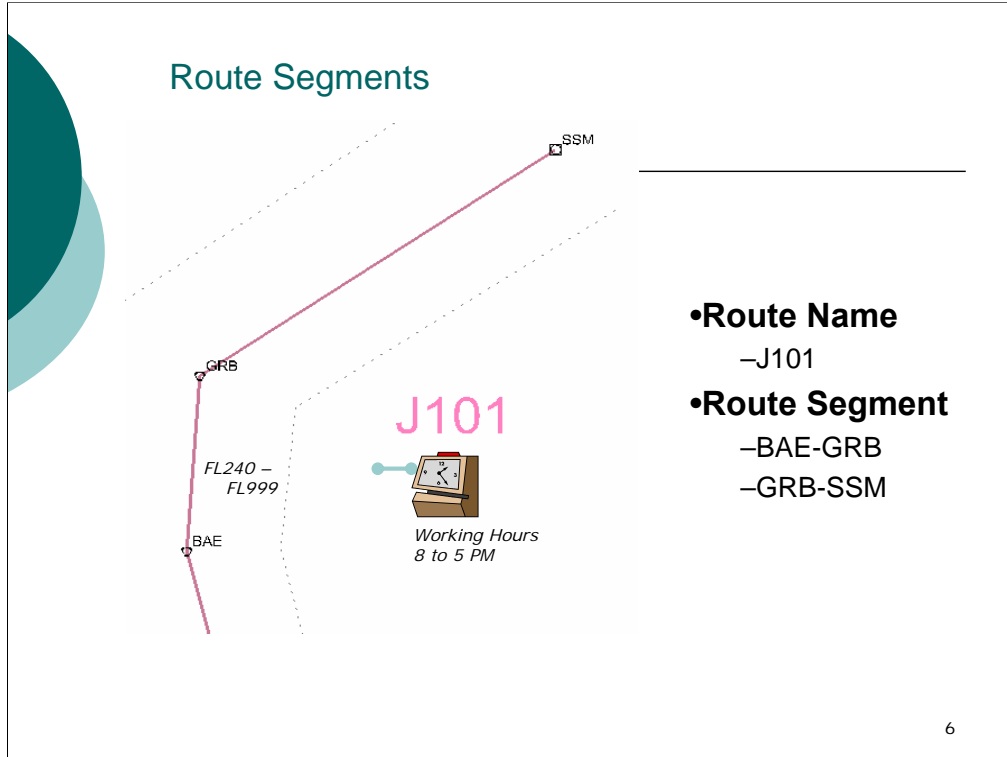•Routes are generally composed of several route segments

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Segment

•Segment is defined by a start and end point

•Altitudes and change over points are published to clear the aircraft of obstacles, terrain and to ensure navaid coverage.
•Segments are composed of consecutive connected significant points.
•Segments may be used by different routes

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Change over point. In AIXM: a change over point is implemented at the segment level. A change over point is really implemented between two navaids and is the point that signals the pilot to change to the other navaid for coverage.

End point of one segment is the start point of the next segment then the segments are consecutive

Route Segments

SSM

GRB

J101

FL240 – FL999

BAE

Working Hours
8 to 5 PM

- **Route Name**
  - J101
- **Route Segment**
  - BAE-GRB
  - GRB-SSM

The designator starts with one or two uppercase characters and is followed by a number between 1 and 999, without leading zeros, and may end with an additional character.

Flight Levels and Altitudes
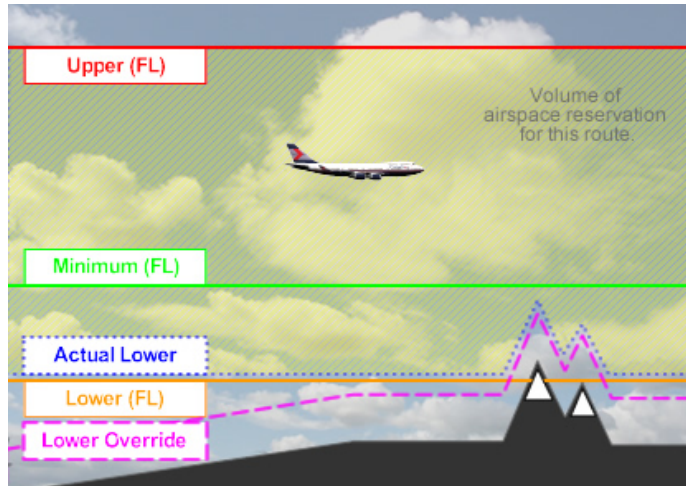
Upper (FL) - Maximum Authorized Altitude

Minimum (FL) – Used to ensure navaid coverage (min reception altitude)

The actual lower of the controlled airspace is the result of combining the lower with the override value.
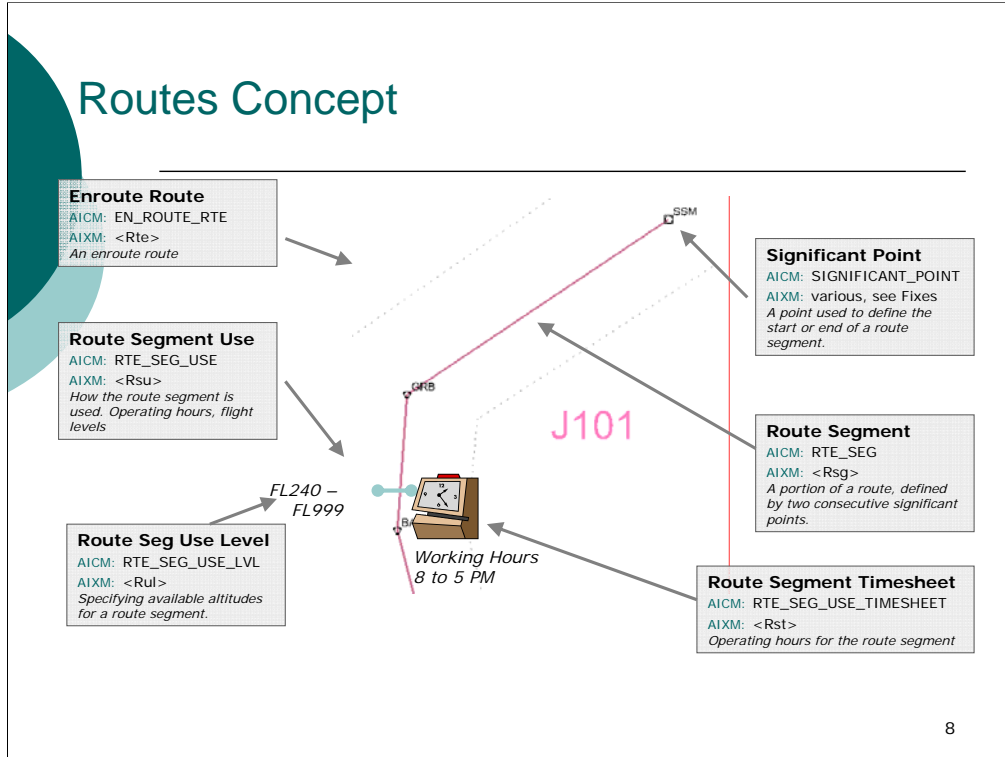
Actual Lower –The actual lower of the controlled airspace is the result of combining the lower with the override value.

Lower (FL) – Controlled Airspace

Lower override – (the higher of the ROC or Airspace) (Minimum Obstacle Clearance) Altitude Ensures the aircraft clears the ground safely

UOM – STD (FL), ALT (mean sea level), HEI (FT – measured from the ground)

Routes Concept

Enroute Route
AICM: EN_ROUTE_RTE
AIXM: <Rte>
An enroute route

Route Segment Use
AICM: RTE_SEG_USE
AIXM: <Rsu>
How the route segment is used. Operating hours, flight levels

Route Seg Use Level
AICM: RTE_SEG_USE_LVL
AIXM: <Rul>
Specifying available altitudes for a route segment.

FL240 – FL999

Working Hours 8 to 5 PM

J101

Significant Point
AICM: SIGNIFICANT_POINT
AIXM: various, see Fixes
A point used to define the start or end of a route segment.

Route Segment
AICM: RTE_SEG
AIXM: <Rsg>
A portion of a route, defined by two consecutive significant points.

Route Segment Timesheet
AICM: RTE_SEG_USE_TIMESHEET
AIXM: <Rst>
Operating hours for the route segment

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The Routes data concept area is used to define an en route route. Within the United States this includes jetways and airways used to traverse the en route airspace structure. Note that approach procedures and departure procedures are modeled separately in the procedures data concept area. This example shows a port of J101 which is a north-south route in the central United States. The ROUTE is made up of a series of SIGNIFICANT POINTS, for simplicity only the NAVAIDS that make up the route are shown in this example. Pairs of joined SIGNIFICANT POINTS are called ROUTE SEGMENTS. A ROUTE SEGMENT can include altitude limits and a width. Each segment can have a complex usage of flight level and operating hours. In this case the ROUTE SEGMENT between GRB and BAE as a timesheet indicating that the SEGMENT USAGE is weekdays between 8 and 5 PM.

Not shown in this diagram is the concept of traffic flow restrictions. These restrictions can be tied to route segments and are used to restrict traffic along the route based on complex criteria like aircrafy city pair.

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EnRoute Routes
AICM Data Model
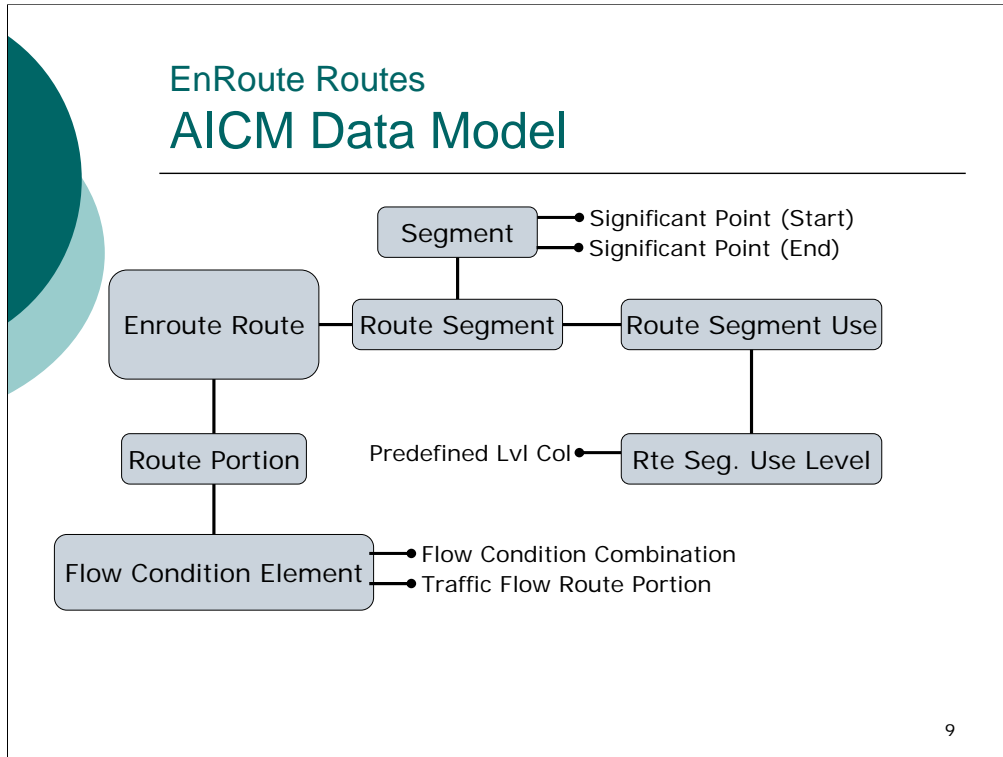
In the AICM, routes are modelled by collecting all the segments together under one "route header" called **Enroute Route**. Each route must consist of one or more route segments each of which is defined by a **Route Segment**.

Each Route Segment in turn references a single **SEGMENT** instance. Each SEGMENT instance may be used by one or more Route Segment which allows segments to be reused by different route segments and therefore different routes.

Each segment in an Enroute Route instance is built from two connected significant points (**SIGNIFICANT_POINT**). It can have only one start and one end point. A significant point may be a **Navaid** (**VOR**, **DME**, **TACAN**, **NDB MKR**) or a designated point.

As well as describing the path that a route must follow, we also need to determine different aspects of how that route is used. The **Route Segment Use** and other associated entities specify how a route segment is used.

In particular, we can detail which direction an aircraft should travel along a route, the **timetable** of availability, applicable cruising levels and whether the segment is subject to Flexible Use of **Airspace** (**FUA**).

a route segment may have several conditions attached to it using the Route Segment Use. A Route Segment Use instance specifies the availability of a route using the **CODE_RTE_AVBL attribute** (A code indicating the availability of the route segment whether covered by the Flexible Use of Airspace concept or outside this context. E.g.: NON-FUA, CDR1, SPECIAL, etc.). One or more associated cruising levels are entered into a **RTE SEG USE LEVEL** instance.
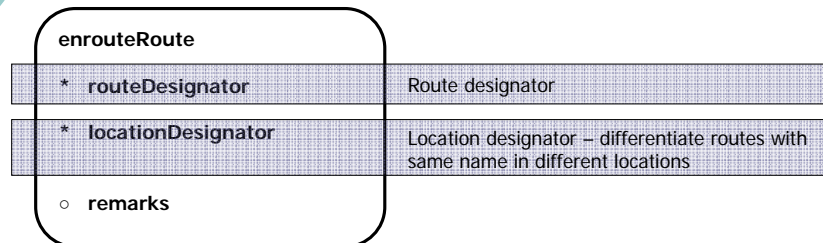
EnRoute Routes
AICM/AIXM Example
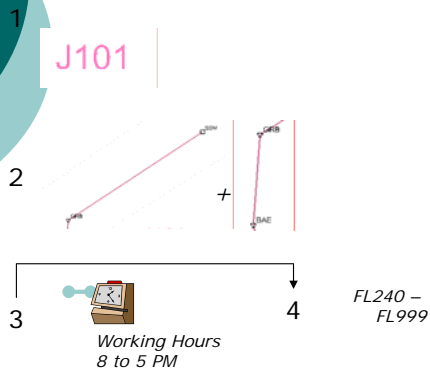
J101

1	Create the jetway
2	**Build the jetway segments and assign them to the jetway**
3	**Create segment usage restrictions based on operating hours**
4	**Augment usage restriction with flight level restrictions**

FL240 – FL999

Working Hours 8 to 5 PM

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Enroute route

○ Assign Route Designator
○ Two part designator

enrouteRoute	
* **routeDesignator**	Route designator
* **locationDesignator**	Location designator – differentiate routes with same name in different locations
○ **remarks**	

Create enroute route instance. Usually 1 or 2 character prefix, 1 to 3 digits (number) and an optional suffix.
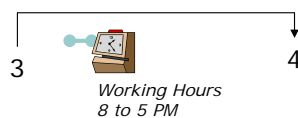
Official route designator

Area designator

Caters for routes with same official designator

Constructed as ICAO country code of first significant point followed by a "–" separator and the ICAO country code of the last significant point

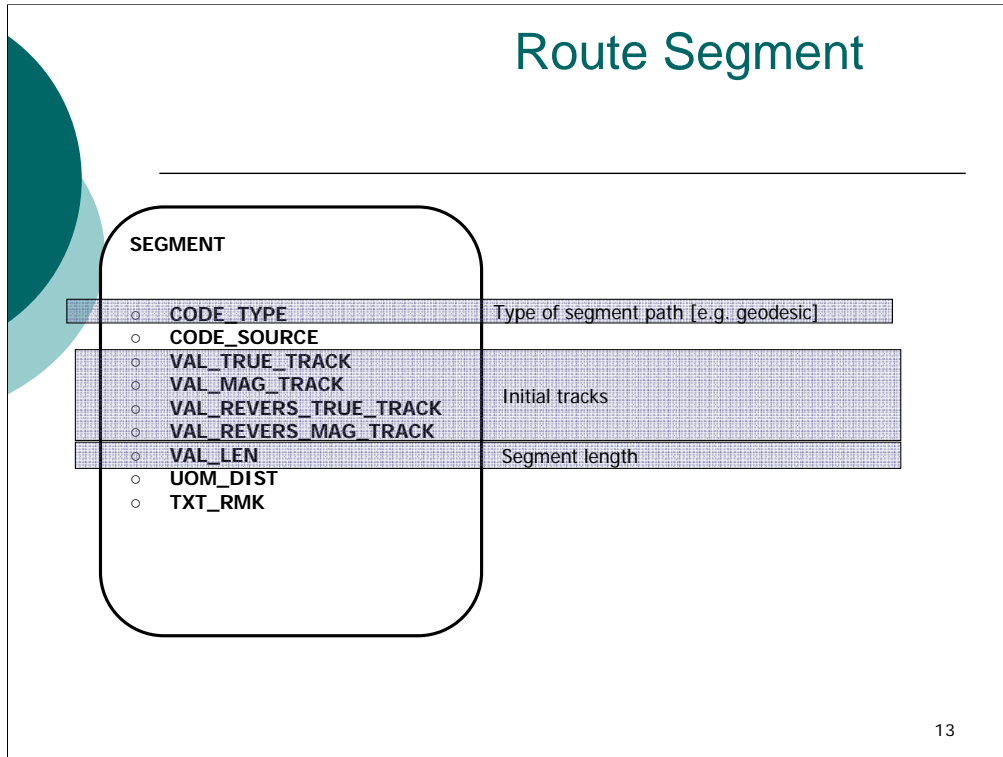Routes described South to North [first point south of the end point]

AICM/AIXM Example

J101

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*Working Hours
8 to 5 PM*

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Route Segment

```
SEGMENT

   o   CODE_TYPE                 Type of segment path [e.g. geodesic]
   o   CODE_SOURCE
   o   VAL_TRUE_TRACK
   o   VAL_MAG_TRACK
   o   VAL_REVERS_TRUE_TRACK     Initial tracks
   o   VAL_REVERS_MAG_TRACK
   o   VAL_LEN                   Segment length
   o   UOM_DIST
   o   TXT_RMK
```

CODE_TYPE [Type] mandatory [part of unique identifier]

The type of segment path.
   Eg: great circle, rhumbline, geodesic line, etc.

CODE_SOURCE [Source of information] mandatory

A code indicating the source of information.
   Eg: calculated, deduced, etc..

VAL_TRUE_TRACK [Initial true track] optional

The initial true track.

VAL_MAG_TRACK [Initial magnetic track] optional

The initial magnetic track.

VAL_REVERS_TRUE_TRACK [Reverse initial true track] optional

The reverse initial true track.

VAL_REVERS_MAG_TRACK [Reverse initial magnetic track] optional

The reverse initial magnetic track.

VAL_LEN [Length] optional

The length of the path (depending on the type of the path).

UOM_DIST [Unit of measurement [horizontal distance]] optional

The unit of measurement for horizontal distances.

TXT_RMK [Remark] optional

ROUTE SEGMENT

*	CODE_TYPE	
o	CODE_RNP	
o	CODE_LVL	
o	CODE_CLASS_ACFT	Route type codes
o	CODE_INTL	
o	COE_TYPE_FLT_RULE	
o	CODE_CIV	
o	VAL_DIST_VER_UPPER	
o	UOM_DIST_VER_UPPER	Upper limit
o	CODE_DIST_VER_UPPER	
o	VAL_DIST_VER_LOWER	
o	UOM_DIST_VER_LOWER	Lower limit
o	CODE_DIST_VER_LOWER	
o	VAL_DIST_VER_MNM	
o	UOM_DIST_VER_MNM	Minimum limit
o	CODE_DIST_VER_MNM	
o	VAL_DIST_VER_OVRDE	
o	UOM_DIST_VER_OVRDE	Lower override limit
o	CODE_DIST_VER_OVRDE	
o	VAL_WID	
o	UOM_WID	Width

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CODE_TYPE [Type] mandatory

The type of route from a navigation point of view (eg.
    conventional, RNAV, etc.).

CODE_RNP [Required navigation performance] optional

A code indicating the required navigation performance for the route segment.

CODE_LVL [Level] optional

A code indicating if the route segment is in the upper airspace, in the lower airspace or in both.

CODE_CLASS_ACFT [Class of aircraft] optional

A code indicating the class of aircraft that may use the route.
    Eg. jet, heli, prop).

CODE_INTL [Route classification] optional

A code indicating if a route is international or domestic.

CODE_TYPE_FLT_RULE [Flight rules observation] optional

A code indicating the flight rules to be observed by aircraft.
    Eg. VFR and/or IFR.

CODE_CIV [Civil / military status of route] optional

A code indicating the civil/military status of the route.

VAL_DIST_VER_UPPER [Upper limit] optional

The numerical value of the upper limit.

UOM_DIST_VER_UPPER [Unit of measurement [upper limit]] optional

The unit of measurement expressing the upper limit.

CODE_DIST_VER_UPPER [Reference for upper limit] optional

A code expressing the convention used to calculate the upper limit.
    Eg: Flight Level (in both feet and metres - cf. UOM_DIST_VERT), Altitude above MSL (QNH), Altitude above GND
    (QFE), Elevation, Height, etc....

VAL_DIST_VER_LOWER [Lower limit] optional

The numerical value of the lower limit.

_UOM_DIST_VER_LOWER [Unit of measurement [lower limit]] optional

The unit of measurement expressing the lower limit.

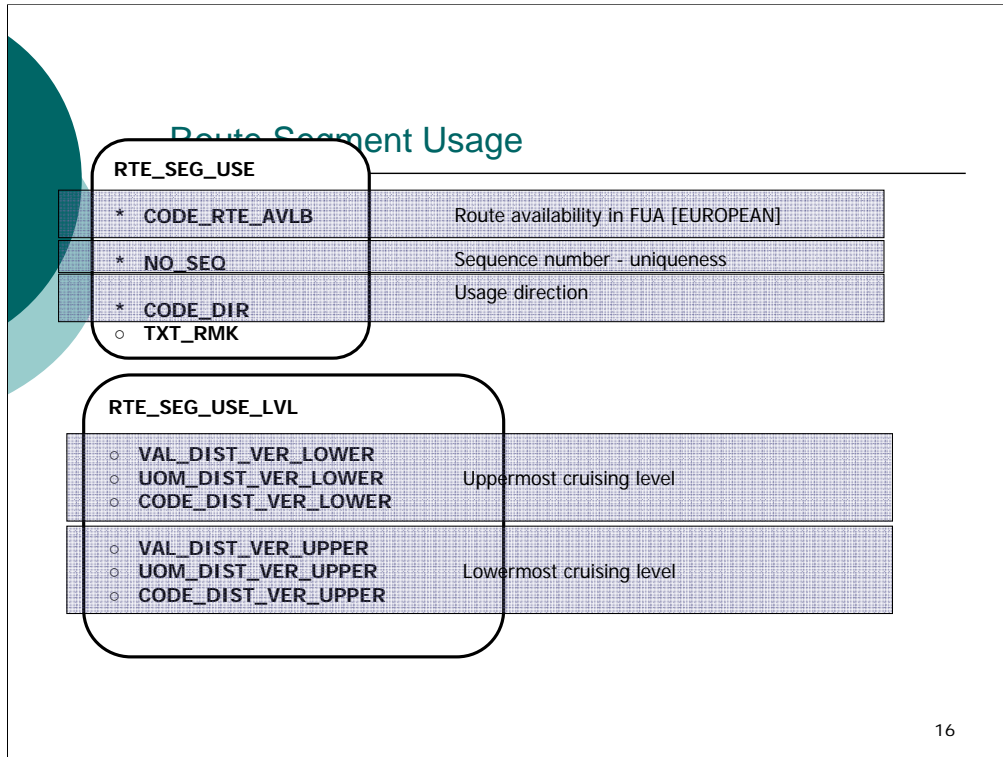**CODE_DIST_VER_LOWER** [Reference for lower limit] optional

A code expressing the convention used to calculate the lower limit.
    Eg: Flight Level (in both feet and metres - cf. UOM_DIST_VERT), Altitude above MSL (QNH), Altitude above GND
    (QFE), Elevation, Height, etc....

EnRoute Routes
AICM/AIXM Example
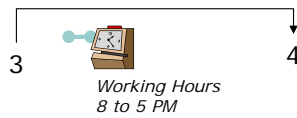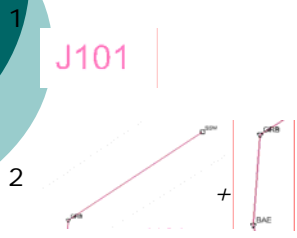
J101

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3   **4**   *FL240 – FL999*

Working Hours 8 to 5 PM

1	**Create the jetway**
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Route Segment Usage

RTE_SEG_USE

*	CODE_RTE_AVLB	Route availability in FUA [EUROPEAN]
*	NO_SEQ	Sequence number - uniqueness
*	CODE_DIR	Usage direction
○	TXT_RMK	

RTE_SEG_USE_LVL

○	VAL_DIST_VER_LOWER	
○	UOM_DIST_VER_LOWER	Uppermost cruising level
○	CODE_DIST_VER_LOWER	
○	VAL_DIST_VER_UPPER	
○	UOM_DIST_VER_UPPER	Lowermost cruising level
○	CODE_DIST_VER_UPPER	

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CODE_RTE_AVBL [Availability of the route segment] mandatory [part of unique identifier]

A code indicating the availability of the route segment whether covered by the Flexible Use of Airspace concept or outside this context.
Ex: NON-FUA, CDR1, SPECIAL, etc..

Notes: *A SPECIAL value is needed for this attribute also as long as 'special' types of routes exist.*
Examples:
- routes which are closed during some time periods, but still may be used for landings on a specified aerodrome;
-'routes' on which flights may be performed below the minimum level of the route in order to arrive at a specified aerodrome.
- ...
Domain: **CODE_RTE_AVBL** **NO_SEQ** [Sequence number] mandatory [part of unique identifier]

A number in sequence applied to each 'route segment usage' having the same value for the CODE_RTE_AVBL.
For example, a route might be used:
- as CDR 1 from FL250 to FL330 from MON till FRI and
- as CDR 1 from FL 270 to FL 490 on SAT and SUN;
This situation will be described using two occurrences of the Route Segment Usage entity, both having the
CODE_RTE_AVBL = 'CDR 1', but with two different sequence numbers.
Domain: **NO_SEQ** **CODE_DIR** [Direction] mandatory [part of unique identifier]

A code indicating the direction in which the route segment is considered when a specific usage is described, ie. forward or backward.

Domain: **CODE_DIR** The values in the RTE_SEG_USE_LVL **entity** inform us of the cruising levels that are in use for the related route. Routes can have one of three level types associated with them:

Single Level
Single levels are represented by only entering values for the **VAL_DIST_VER_LOWER**, **UOM_DIST_VER_LOWER** and **CODE_DIST_VER_LOWER** attributes. There is no **relationship** with the **PREDEFINED_LVL_COLUMN** entity.

Level Band
A level band is an **airspace** within which aircraft are permitted 'free vertical movement'. It is limited by an upper and a lower cruising **altitude**. The lower limit is represented in **AICM** by entering values for the **VAL_DIST_VER_LOWER**, **UOM_DIST_VER_LOWER** and **CODE_DIST_VER_LOWER** **attribute**. The upper limit requires completion of the **VAL_DIST_VER_UPPER**, **UOM_DIST_VER_UPPER** and **CODE_DIST_VER_UPPER** attributes. Again, there is no relationship with the PREDEFINED_LVL_COLUMN entity.

Series of Levels
The upper and lower limits of the series are represented in the same way as for the level band. However, for a series of levels, a mandatory relationship exists to a PREDEFINED_LVL_COLUMN instance. This identifies the series of levels associated with the route **segment** usage.
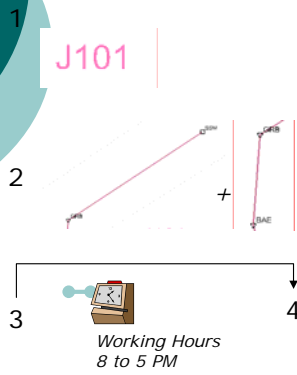
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Define usage

- Usage of a particular route segment
  - Direction
  - Timetable
  - Cruising levels
  - Flexible Use of Airspace

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EnRoute Routes
AICM/AIXM Example

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J101

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3   **4**

*Working Hours
8 to 5 PM*

1	Create the jetway
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Other Topics

- Geometry
- RNAV routes (DME/DME –critical dme navaid)
- Substitute (alternate) routes
- Dogleg
- Ground based reference

- US Extension
  - Docket number
  - Controlling obstacle addition

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EnRoute Routes
Summary

- The EnRoute Routes concept area is used to model low altitude (US – airways or victor), high altitude (US – jetways), color routes (US - NDB) and off airway routes (US – non part 95).
  - Routes are subdivided into segments, where each segment has a starting point and an ending point
  - This means that you can create a route with branches and the different branches may be turned on at different times.
  - A segment can also be shared by more than one route
- Each segment has a usage to restrict the segment by
  - A timetable
  - Permissible altitude levels
  - Complex altitude permissions can be handled using a table of altitude levels (not covered)
- Route segments can be used to specify or filter traffic flow restrictions (not covered)

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- Questions?